PROCEEDINGS

OF THE

PENNSYLVANIA ACADEMY OF SCIENCE

VOLUME IV

1930

HARRISBURG, PENNSYLVANIA
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OFFICERS

1930–31

President	D. S. Hartline, Bloomsburg
Vice-President	E. M. Gress, Harrisburg
Secretary	T. L. Guyton, Harrisburg
Assistant Secretary	Vernon Haber, State College
Treasurer	H. W. Thurston, State College
Editor	R. W. Stone, Harrisburg

The Science Press Printing Company,
Lancaster, Pa.

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PENNSYLVANIA ACADEMY OF SCIENCE

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

BLOOMSBURG, PENNSYLVANIA—APRIL 18–19, 1930

The meeting was called to order by Dr. Robert T. Hance. The report of the secretary was given as follows:

The Pennsylvania Academy of Science met in its fifth annual session at State College, March 29 and 30, 1929. The program was filled with interesting papers, all of which have appeared either in abstract or entirety in Volume III of the Proceedings of the Academy which was mailed to the members during the fall of 1929. In addition to the interest of the program, the trip to the quarries at Bellefonte was of striking interest. The Academy is under obligations to the local committee for the excellent entertainment afforded at the time of its last meeting.

Fifty-one persons were elected to active membership in the Academy, and one was elected to honorary membership, Dr. W. W. Keen, an eminent physician, who has reached the advanced age of ninety-two and is still active in his profession. Upon motion it was decided to hold the sixth annual meeting in Bloomsburg, Pennsylvania, during the Easter vacation, 1930.

The following were chosen as officers for the coming year: President—Robert T. Hance, Vice-President—D. S. Hartline, Secretary—T. L. Guyton, Assistant Secretary—John W. Keller, Editor—R. W. Stone and Treasurer—H. W. Thurston. The Executive Committee for the year is composed of the elected officers and the retired presidents of the Academy.

The summer session of the Academy for 1929 convened at Cook's Forest, July 26 and 27. The meeting was quite informal. The assembly was addressed by District Forester C. E. Zerby, who gave a brief historical account of the Cook State Forest. The forest became the property of the State January 1, 1929, and is now a State park. Dr. E. M. Gress, State Department of Agriculture, told of the myths surrounding some of the plants found in the park. Dr. O. E. Jennings, University of Pittsburgh, described the evolution of the plant cover of the region. The trip through the forest on the 27th illustrated many of the points which Dr. Jennings made. During the trip various pathological condi-

tions were pointed out and many lively discussions were indulged in. This park indeed is a possession of which all Pennsylvanians can well be proud.

It is my sad duty to report the death of the following members during the year:

M. W. Grissinger, Selinsgrove, Pa., died in 1928

T. H. Hoge Patterson, 4231 Walnut St., Philadelphia, Pa., died April, 1929

Howard Crawley, 5239 Wissahickon Avenue, Philadelphia, Pa., died May, 1929

Dr. John Fred Mohler, Dickinson College, Carlisle, Pa., died January, 1930

Professor A. W. Dupler, Juniata College, Huntingdon, Pa.—Died some time during the year.

During the year fourteen resignations were received. There is also a list of members to be dropped for non-payment of dues. This list is not ready to be given to you at this time. The present membership may be split into two parts: those who are members of the American Association for the Advancement of Science, and those who are not. A little more than half of the members of the Academy are also members of the American Association. The secretary pointed out to you at this time last year that there are a great number of persons in the State who are interested in science who have no connection with either the Academy or with the American Association, and that he believed some method should be devised for the Academy to reach these persons. Of the number of names proposed for membership last year, a little over four-fifths were members of the American Association, and of the number to be presented this year, this same relationship holds. It is the secretary's feeling that the Academy could be of much service to the persons in the State interested in science who now have no affiliation with a scientific organization.

T. L. GUYTON, *Secretary.*

The treasurer's report was received and approved, the Auditing Committee having stated that the accounts were correct.

TREASURER'S REPORT FOR 1929–1930

Receipts		*Disbursements*	
Balance on hand	$ 468.98	Proceedings	$ 544.32
Dues	660.00	Stationery and printing	52.50
A. A. A. S. rebates	89.00	Secretary's account	37.91
Sales	13.00	Treasurer's account	35.00
Miscellaneous	10.00	Cash in bank	569.25
		Checks returned	2.00
	$1,240.98		$1,240.98

We find the above account to be correct.

Signed F. J. W. HORICK
JOHN C. JOHNSON

The following committees were appointed: Nominating Committee—O. E. Jennings, L. K. Darbaker and N. R. Stewart; Auditing Committee—Frank Horick and John C. Johnson; Resolutions Committee—R. W. Stone and E. M. Gress. The society was then welcomed to Bloomsburg and the State Teachers' College by Dr. Francis B. Haas, President of the college. His address was on the "Relation of Science to Teaching." He spoke of the new education.

The following program was presented:

April 18, 10:00 to 12:00 A.M.

Pathological Study of Commercial Yeast in Lungs of White Rats, M. W. Eddy and E. S. Kronenberg, Jr., Dickinson College.

The Boletaceae of Pennsylvania, M. C. Strauser, Pennsylvania State College.

Observations on the Effects of Nematocysts of Hydra on Amphipods, Wm. Hudson Belney, Lebanon Valley College.

A Natural Graft between Unrelated Species, *Quercus rubra* and *Prunus avium*, S. Hoffman Derickson, Lebanon Valley College.

Senecio antennariifolius in Pennsylvania, E. M. Gress, Pennsylvania Department of Agriculture.

Altitude Effects on the Gastropoda and Their Trematode Parasites, John C. Johnson, State Teachers' College, West Chester.

Areas of Biological Interest in Western Pennsylvania Deserving Preservation, O. E. Jennings, University of Pittsburgh.

The Effect of X-Rays on Developing Corn, Geo. E. Snyder, University of Pittsburgh.

Physiology of the Prostate Gland, B. H. Kettelkamp, University of Pittsburgh.

Modernizing Scientific Communications, Robert T. Hance, University of Pittsburgh.

Some Biological Effects of High Frequency Electrostatic Fields, G. M. McKinley, University of Pittsburgh.

April 18, 1:30 to 4:00 P. M.

Address of the President: A Mechanistic Fantasy, Robert T. Hance, University of Pittsburgh.

The Ambystomid Salamanders of Pennsylvania, Charles E. Mohr, Bucknell University.

Distribution of *Triturus viridescens* on Presque Isle, Erie, Pennsylvania, H. B. Hudson, University of Pittsburgh.

The Results of an Intensive Study of Birds in a Small Area, Maynard B. Henry, Bucknell University.

Ecological Observations upon the Flora of Wading River, Long Island, New York, LeRoy K. Henry, Carnegie Museum, Pittsburgh.

Flora of the Kartabo Region, British Guiana, Edward H. Graham, University of Pittsburgh.

A Preliminary Report on the Phytoplankton of Presque Isle Bay, Lake Erie, Russell Y. Gottschall, University of Pittsburgh.

4:30 P.M.

Auto trip to places of interest near Bloomsburg.

6:30 P.M.

Annual Dinner.

Address: Troubles in the Woods, Dr. H. H. York, Professor of Botany, University of Pennsylvania.

Motion Pictures: Plant Growth and Activities, Dr. L. K. Darbaker, Professor of Pharmacy, University of Pittsburgh.

SECTION A

April 19, 9:00 to 11:30.

GENETIC STUDIES ON THE PARASITIC WASP, *Habrobracon juglandis* (Ashm.), P. W. Whiting, University of Pennsylvania, and Anna R. Whiting, Pennsylvania College for Women.

Introducing the following papers:

A. Linkage Relations of Long Antennae, P. R. David.

B. Linkage of Factors for Eye-color, C. H. Bostian.

C. A Factor for Fused Antennae and Tarsi, Neita C. Bostian.

D. Selection for Biparental Males, D. R. Charles.

E. The Genetic Composition of Biparental Males, Magnhild M. Torvik.

F. A Microscopic Study of the Effects of X-Rays on the Ovarioles, Edward McCrady, Jr.

Twinning in Chick Embryos, Stella M. Hughes, Lebanon Valley College.

A Case of a Polydactylous Cat, Russell Morgan, Lebanon Valley College.

Two-headed Snake, V. Earl Light, Lebanon Valley College.

Chromosomes of the First Form Male Termiti *Reticulitermes flavipes*, Joseph M. Benkert, University of Pittsburgh.

Is the Passenger Pigeon Extinct? E. H. Nelson, Bloomsburg State Teachers' College.

Temperature Effects Observed on the Ova of the European Corn Borer (*Pyraustis nubialis* L.), R. E. Springer, Sharon, Pennsylvania.

Variations in Wing Reticulations and Size of *Erythrodiplax berenice* with Regard to Geographic Distribution, S. Irvine Shortess, Bloomsburg State Teachers' College.

SECTION B

Pennsylvania Caverns and Relation to Geologic Structure, R. W. Stone, Pennsylvania Geological Survey.

Correlation of Pennsylvania Anthracite, Homer G. Turner, Lehigh University.

Chemical Composition of Limestone, Benj. L. Miller, Lehigh University.

A Medical Chemist Looks at Water, Max Trumper, University of Pennsylvania.

The Forgotten Part Played by a Pennsylvanian in the Early Development of Alaska, Evan O'Neill Kane, American Society for the Control of Cancer, Kane, Pennsylvania.

The Possibilities of Forensic Chemistry and Its Limitations, Robert T. Paessler, Wilkes-Barre, Pennsylvania.

The Use of Certain Modified Xanthene Compounds in the Diagnosis of Malignant Neoplasms, Donald C. Butts, Hahnemann Hospital, Philadelphia.

Standardization and Identification of Color in Nature According to Ostward's Method, E. Alfred Wolf, University of Pittsburgh.

Some Experiments in X-Ray Technique, Benjamin F. Cary, Blossburg.

Business Session, 11:30 A.M.

At the business session at the close of the meeting, the reports of committees were heard. The following persons were elected to active membership.

Edwin J. Anderson, Agricultural Experiment Station Building, State College.
Leroy A. Baer, 1020 Walnut St., Berwick.
Edward R. Barnsley, Newtown.
Dr. Lawrence W. Bass, Mellon Inst. of Indust. Res., Univ. of Pittsburgh, Pittsburgh.
Prof. G. R. Bradshaw, Thiel College, Greenville.
Mrs. H. M. Bridgham, 5871 Ellsworth Ave., Pittsburgh.
John Bright, 127 Roup St., East Liberty, Pittsburgh.
E. Eleanor Carothers, Dept. of Zoology, University of Pennsylvania, Philadelphia.
Louise Casselman, 731 N. Fourth St., Reading.
Jaques Cattell, Science Press Printing Company, Lancaster.
Prof. Ray M. Cole, Bloomsburg.
Dr. David Francis Crawford, 5243 Ellsworth Ave., Pittsburgh.
William R. Van Dersal, Dept. of Botany, University of Pittsburgh, Pittsburgh.
Prof. John J. Fisher, 311 Light Street Road, Bloomsburg.
Dr. Earl W. Flosdorf, 612 Elkins Ave., Tabor, Philadelphia.
Newton Wellington Geiss, Oley.
Prof. L. P. Gilmore, 414 E. Second St., Bloomsburg.
Miss Malvina M. Grieves, Syracuse University Hospital, Syracuse, New York.
Prof. Sara R. Hamlin, Catawissa.
E. C. Herber, Dickinson College, Carlisle.
Harrison S. Hires, 206 South 24th St., Philadelphia.
Edward Hoberman, 369 E. Park St., Lock Haven.
Dr. George E. Holtzapple, 203 S. George St., York.
W. G. Hutchinson, 446 Nevin St., Lancaster.
Dr. J. H. James, Chemistry Department, Carnegie Inst. of Technology, Pittsburgh.
Mrs. O. E. Jennings, 241 Oakland Ave., Pittsburgh.
Dr. Evan O. Kane, 230 Clay St., Kane.

Dr. Edward I. Keffer, 5971 Drexel Road, Philadelphia.
William M. Kerr, Liberty Trust Building, 1343 Arch St., Philadelphia.
Harry B. Kirk, Bureau of Plant Industry, Harrisburg.
Prof. Martin H. Knutsen, Department of Bacteriology, State College.
Prof. John C. Koch, State Teachers' College, Bloomsburg.
Edward S. Kronenberg, Jr., 431 S. College St., Carlisle.
Dr. Robert G. Leavitt, 808 Crown St., Morrisville.
Miss Bess M. Long, 328 E. First St., Bloomsburg.
Prof. Warren B. Mack, 103 Horticultural Bldg., State College.
Dr. Thales Martins, Instituto Oswaldo Cruz, Caixa 926, Rio de Janeiro, Brazil, S. A.
Dr. Ralph Vincent McGrew, Department of Chemistry, State College.
Charles H. McKnight, 1625 Vine St., Scranton.
Prof. T. M. McMillion, 303 Angeles Apartments, Beaver Falls.
Dr. N. A. Michels, Baugh Inst. of Anat., Jefferson Med. College, Philadelphia.
Plantou Middleton, 6623 Greene St., Germantown, Philadelphia.
Walter S. Mitchell, c/o Mellon National Bank, Pittsburgh.
Russell E. Morgan, Lebanon Valley College, Annville.
Prof. E. H. Nelson, State Teachers' College, Bloomsburg.
Dr. S. Grant Oliphant, 520 Stewart Ave., Grove City.
Prof. Wellington A. Parlin, Dickinson College, Carlisle.
Prof. David Riesman, Professor of Clinical Med., Univ. of Pennsylvania, Philadelphia.
Dr. George D. Rosengarten, Malvern.
Prof. H. Harrison Russell, State Teachers' College, Bloomsburg.
Robert Schless, 121 W. Fifth St., Emporium.
Prof. James M. Shelley, 11 E. Mercer Ave., Llanerch, Upper Darby.
Prof. S. Irvine Shortess, Bloomsburg.
Theodore P. Smith, 34 Pine St., Bloomsburg.
R. E. Springer, Sharon.
Benjamin Thaw, 316 Fourth Ave., Pittsburgh.
Dr. Benjamin A. Thomas, 1900 Spruce St., Philadelphia.
Dr. Max Trumper, 921 Medical Arts Building, Philadelphia.
Dr. Lawrence E. Van Kirk, 3002 Marshall Road, North Side Station, Pittsburgh.
Dr. Mary Vanuxem, Laurelton State Village, Laurelton.
Eugene Vellner, 401 Hellerman St., Philadelphia.
Henry Venable, 822 N. Saint Clair St., Pittsburgh.
Dr. Ernest A. Vuilleumier, 150 W. Louther St., Carlisle.
Everett D. Wells, 1008 Weschler Ave., Erie.
Frank C. Whitmore, School of Chemistry and Physics, State College.
Hans Wilkens, 241 South 11th St., Reading.
Harlan N. Worthley, 222 Hartswick Ave., State College.
Dr. Harlan H. York, Department of Botany, University of Pennsylvania, Philadelphia.

The Resolutions Committee presented the following resolutions which were unanimously accepted by the Academy:

Being deeply appreciative of the cordial cooperation on the part of the citizens of Bloomsburg, the Academy of Science desires to express its thanks to all who have aided in making this meeting so successful.

The Academy acknowledges its indebtedness to the Department of

Bloomsburg for the use of a building in which to hold the meeting, and extends thanks to the Magee Carpet Company for the opportunity to visit its large factory, to J. L. Dillon for the invitation to his greenhouses and for flowers donated, to the Bloomsburg citizens who furnished entertainment at the dinner, who provided automobiles for sightseeing, and to the Boy Scouts for their aid.

Signed:
R. W. Stone,
E. M. Gress.

The Nominating Committee reported as follows:

Bloomsburg, Pa.,
April 19, 1930.

The Nominating Committee of the Pennsylvania Academy of Science begs to nominate the following persons as officers for the year 1930–31:

President: D. S. Hartline, State Teachers' College, Bloomsburg.
Vice-President: E. M. Gress, Dept. of Agriculture, Harrisburg.
Secretary: T. L. Guyton, Bureau of Plant Industry, Harrisburg.
Assistant Secretary: Vernon Haber, Pennsylvania State College, State College.
Treasurer: H. W. Thurston, Pennsylvania State College, State College.
Editor: R. W. Stone, Penna. Geological Survey, Harrisburg.
Executive Committee: R. T. Hance, F. D. Kern, B. L. Miller, E. A. Ziegler, N. A. Stewart.

Signed:
O. E. Jennings,
L. K. Darbaker,
N. H. Stewart.

A motion was made for the secretary to cast a ballot in favor of the nominations made by the Nominating Committee. The motion was carried and the officers were declared elected. The new president was then inducted to his office. After a brief acceptance speech he proceeded with the order of business: the arranging for the summer meeting and the annual meeting. Two suggestions were offered as places for the summer meeting—one, Ohiopyle, in Fayette County; the other, Presque Isle, in Lake Erie. It was decided to leave this to the judgment of the Executive Committee for final decision. An invitation by members from Harrisburg for the annual meeting of the Academy in 1931 to convene in that city was accepted.

The Academy then adjourned until the summer session of 1930.

PATHOLOGICAL STUDY OF A COMMERCIAL YEAST IN THE LUNGS OF WHITE RATS

By Dr. M. W. Eddy and E. S. Kronenberg, Jr.
Dept. of Biology, Dickinson College, Carlisle, Penna.

Yeast has been known for many years to be pathogenic in man and animals. A number of commercially cultivated yeasts are on the market and are claimed to be non-pathogenic. In the following experiments a well-known commercial yeast was successfully grown in the lungs and trachea of white rats (*Mus norvegieus albino*). The purpose of this paper is to show that some yeasts, reputed to be non-pathogenic may produce a diseased condition, which might be brought about by accidentally introducing yeast into the lungs while eating, resulting in the yeast remaining within the trachea and lungs, which yeast might later become pathogenic. This raises the question whether there might not be danger in eating living yeast.

In the latter part of September, 1928, six white rats of Wistar Institute stock were injected with a solution of a commercial brand of yeast in the following manner:

Two yeast cakes were mixed in 500 cc of distilled water and the mixture was brought to a temperature of 36° C. One at a time the rats were etherized, their throats laid open and with the aid of a sterilized hypodermic needle and syringe, two cubic centimeters of the yeast mixture were injected directly into the lower half of the trachea. As a check, three white rats of the same stock were submitted to the same operation, with the exception that 2 cc of distilled water were injected instead of the yeast mixture. Care was taken that neither the hypodermic needle and syringe nor the distilled water were contaminated with yeast. The rats were marked and those with the yeast mixture were placed in one cage and those with the distilled water in another, in order to prevent contaminating the check rats by the coughing of the yeast-injected rats. However, they were all fed the same food and kept under the same conditions.

Two months later the rats injected with yeast developed symptoms of a bronchial and lung disorder. They developed a rapid exhalation of air as if attempting to dislodge something from the trachea and a cough also appeared. Three of their number were then killed and slides made of their lungs and trachea. Yeast was found in the trachea and to a lesser degree in the upper lobes of the lungs. The trachea and lungs of two of the check rats, which were killed at the same time, showed no

evidence of yeast. The external appearance of the lungs of the yeast-injected rats was pathological when compared with the check rats. The lungs of the yeast-injected rats had visible grey nodular areas of comparatively large sizes on their surface, especially on the anterior half of the upper lobes. The appearance of the lungs of the check rats had the normal pink color.

One month later the remaining yeast-injected rats appeared to be in a much worse physical condition. The rats had a more aggravated cough, wheezing and difficulty in breathing, and a pronounced turning of their heads to the side. These rats were then killed as well as the remaining check rat. The lungs of the yeast-injected rats appeared externally as those of the previous month, with the grey nodular patches visible on their surfaces, while the lungs of the check rats were normal. Slides made of the lungs and trachea of the infected rats revealed yeast in the tracheal and lung tissues, with a breaking down of the lung tissue, and a collapse of the alveoli and the formation of giant cells. An examination of the inner ear showed an infection which might have been due to coughing, thereby forcing yeast through the Eustachian tubes into the inner ears. Slides made of the lungs of the check rat gave no evidence of yeast.

On December 4th, 1928, ten white rats of Wistar Institute stock ranging in age from 13 to 16 weeks, were subjected to the same operation as described before. Seven of the rats were injected with the yeast mixture while the remaining three had distilled water injected as checks. They were fed the same food and kept under the same conditions, but in separate cages for the reason given before. One month later one of the yeast-injected rats was killed. Externally the lungs appeared more healthy than those killed after two months in the previous experiment, but grey nodular areas were visible on their surface. Slides made of the lungs and trachea showed yeast and a slight breaking up of the interstitial tissue of the lungs and the appearance of some giant cells.

At the end of the second month the rats developed a cough and wheezing. A second rat was then killed. Externally the lungs had visible grey nodular patches, their sizes larger than those of the rat killed the previous month. Slides of the lung showed yeast present in both the trachea and lungs, with a breaking down of the lung tissue, collapse of alveoli and the appearance of giant cells.

At the end of the third month, the cough and wheezing became more severe and an effort of the rats to dislodge something from their throats was noticeable. Another rat was then killed. Grey nodular

areas were visible on the surface of the lungs, their sizes larger than those of the rat killed the previous month. Slides made of the lungs and trachea showed an increase in the quantity of yeast in the trachea and some yeast in the lungs.

At the end of the fourth month three of the remaining four yeast-infected rats were killed. The fourth died shortly afterwards. The lungs of the three killed were externally the same in appearance as those previously killed, only with an increase in the sizes of the nodular patches. Slides made of the lungs and trachea showed yeast in abundance in the trachea and some yeast in the lungs.

It was then decided that this alone might not be sufficient proof, and that if yeast was recovered from the lungs and trachea, there could be no doubt of its presence. Therefore, on January 8, 1930, five young rats of the same stock used before, were injected with yeast. This time one yeast cake mixed in 100 cc. of distilled water at a temperature of 36° C. was used. Five cubic centimeters of this mixture were injected directly into the lower part of the trachea as described before. Immediately after the injection the lungs stopped functioning, and, in each case, it was necessary to apply artificial respiration, after which the lungs became functional. This is explained by the increased size of the injected material, which, when it ran into the lungs, caused paralysis by drowning. One rat, as a check, underwent the same operation, with the exception that no yeast was injected. A sterile needle was inserted into the trachea as before but no liquid was injected. In this case no artificial respiration was necessary.

One week later, on January 15th, one of the yeast-injected rats was killed. The external appearance of the lungs showed many deep red patches covering nearly the entire surface of the upper lobes and at intervals over the lower lobes. By means of sterile instruments the lungs and trachea were removed. Portions of the lungs were sliced and placed on two Petri dishes containing Saboroud's medium. Saboroud's medium is an agar with 1–2 per cent. peptone, 2 per cent. glucose or maltose and 0.5 per cent. glycerine. Other sections of the lungs, which were washed in several changes of saline solution, ground in mortar and suspended in saline, were placed on the third dish. On the fourth dish was placed the sediment from the saline solution, in which the lungs were suspended after being ground in the mortar. Portions of the trachea were placed on the fifth dish. All five culture dishes were placed in an incubator at a temperature of 37½° C. where they remained for one week.

On January 22nd, the culture dishes of the rat which was killed the previous week were examined under the microscope. The cultures had a typical odor of yeast when the Petri dish covers were removed. A microscopic examination showed that there were yeast cells in abundance, many of them budding, in the cultures of the lung precipitate from the saline solution; of the lung tissue which was ground in a mortar, washed, suspended in saline; and of the trachea. In the culture of the lung tissue which was placed directly on the medium, there was yeast in abundance in all stages of budding, with some cells much larger than their normal size and some elongated and some with granular centers. Bacteria were present in all the cultures. These bacteria were from the lung and trachea, because a dish of Saboroud's medium placed in the incubator at the same time as a check showed no growths.

A second rat was then killed, this being the second week since the injection of yeast. The lung and trachea were applied in the same manner to the medium as in the previous week and placed in the incubator. The external appearance of the lungs showed extensive congestion of the upper lobe with deep red discoloration. A number of small nodules were present. At this time a normal rat was killed and its lungs placed on the medium in the same manner as those of the yeast-injected rats.

The following week on January 27th, a microscopic examination was made of the cultures of the lungs and trachea of the rat killed the previous week, two weeks after the injection of yeast. As before, budding yeast was recovered from both lungs and trachea. A microscopic examination of the lungs and trachea of the normal white rat killed the previous week showed no yeast growth whatever.

On February 19th, six weeks after the injection, the third yeast-injected rat was killed and its lungs placed on Saboroud's medium, as described before, and put in the incubator. The following week, a microscopic examination revealed budding yeast present in abundance from the trachea culture. The external appearance of the lungs showed grey nodular areas over the upper lobe.

In conclusion, we wish to restate the purpose of the experiment and then show in what way our results substantiate this. It was stated in the beginning of the paper that the purpose was to show that some yeasts reputed to be non-pathogenic may produce disease, and to consider the danger if, accidentally, yeast should become lodged in the trachea and lungs while eating. Since yeast is claimed to be beneficient from the standpoint of its vitamins, it would seem necessary that yeast manu-

facturers know that their product can not become pathogenic under any circumstances.

The following facts of experiment bear out our purpose:

First, a commercial brand of yeast was successfully grown in the trachea and lungs of white rats. It not only grew there, but it was later recovered from the infected organs. Secondly, there was a physical breaking down of the tissues due to the yeast, which caused symptoms of illness and later death.

Although the yeast was injected operatively into the trachea and lungs, it is not beyond possibility, that it could be introduced by accidentally choking, while eating. The question is then raised whether the possible benefits derived from eating yeast are worth the risk.

Park and Williams make the following statement, "In generalized blastomycosis the lung seems frequently to be the seat of primary infection."

Below is a reference list to records of pathogenic yeast infection of humans.

A case of meningitis due to endomyces capsulatus, by Dr. Rewbridge, Dr. Dodge and Mr. T. T. Ayers, Amer. Jour. of Pathol. Vol. 4, July, 1929.

The following cases are from "Pathogenic Microorganisms" by Park and Williams, 8th edition.

Case of infection of Saccharomyces buss on bones, lungs, spleen and kidneys of 31 yr. old woman. Case reported by O. Buss in 1894.

Case of Saccharomyces tumefaciens as an infection on lips and neck. Reported by Curtis, 1895.

Cases of eye infections by yeasts. Reported by Jackson in Jour. Med. Assn. 1915, *65* 23.

Case of meningitis due to yeasts. Reported by Neal in Jour. Med. Res. 1916, *35* 243.

One hundred cases of skin infection in gluteal regions of men from which a variety of ordinary fermenting yeast was recovered. Reported by Kartulis in Alexandria.

Case of skin lesion in infant due to yeast. Reported by Kessler in Jour. Med. Assn. 1907, *49* 550.

Case of systemic blastomycosis by Fontaine. Reported by Kessler in ibid 1904, *4* 101.

Editor: This paper was discussed by Dr. C. A. Smith, biochemist, department of applied research, Fleischmann Company, who said, "There is no known case of brewer's yeast developing in the human trachea or lungs, and no danger of such an occurrence. There are of course certain pathogenic yeasts and yeast-like organisms (monilia, for example) but we have never heard of a case in which balicis yeast or brewer's yeast was pathogenic. In testing our yeast for freshness it is

the common practice to break a pound cake, crumble it, stick our noses down into the crumbled mass and snuff vigorously. A man doing that testing regularly will examine perhaps 75 to 100 pounds of yeast daily, week in and week out. This is done at all of our 12 or 13 factories and at most of our main offices."

THE BOLETACEAE OF PENNSYLVANIA[1]

By M. C. Strauser

Pennsylvania State College, Department of Botany

The *Boletaceae* are fleshy tube-bearing fungi which make up a relatively small family of the class Basidiomycetes. Due to their tube-bearing character the *Boletaceae* are frequently placed with the *Polyporaceae,* and in this more comprehensive sense the *Polyporaceae* embrace all Basidiomycetous fungi in which the spore-bearing surface lines the interior of tubes. The treatment here chosen for this group is that of those workers who have adopted a division of the *Polyporaceae* into two families, the *Polyporaceae* and the *Boletaceae.* The *Polyporaceae* proper usually grow on living or dead woody plants, are commonly leathery, corky, or woody in texture, and the tubes as a rule do not separate readily from the pileus. The *Boletaceae* are chiefly terrestrial, fleshy in texture, and the tubes in nearly all cases separate readily from the rest of the pileus.

With but one exception the *Boletaceae* are seemingly saprophytic. They are almost entirely terrestrial in habit, and are generally found in woods or along their borders, and in pastured woodlands. The majority of them prefer a moist habitat, but a few species grow in exceedingly dry locations. Some *Boletaceae* are restricted to the neighborhood of definite species of the higher plants; some only near or under certain conifers; others in or among hardwood and mixed stands.

The *Boletaceae* are strictly annual plants and are found in our region only in the late summer and early autumn. All the species of the family are fleshy, perishable, and putrefy very soon after maturity, especially if the weather is humid. The putrefaction is usually hastened by the attacks of certain insect larvae to which these plants are particularly subject. The life of the sporophore is exceedingly short, being not more than four or five days with most species. This tendency to rapid putrefaction makes their collection and preservation a difficult problem. The

[1] This article is a portion of a thesis for a Master of Science degree in Botany, published by the permission of Dr. F. D. Kern, dean of the graduate school.

study of this group is complicated by the fact that preserved plants in a dried condition generally lose their original color, size, shape, and some of their external markings. Thus a description of the plant must be made while in a fresh state. Most species of the family are brilliantly colored in attractive shades of red, yellow and brown, and some species turn to a pink, green, blue, or black color when wounded. Both poisonous and edible species are found among the *Boletaceae*.

According to Peck 110 species are known in the United States. At the present time 63 species are known in Pennsylvania. Following is a tabulation of reported species made from the available literature.

TABULATION OF REPORTED SPECIES OF BOLETACEAE

Species	Reported in this paper	Reported	
		By Herbst	By Peck
Boletinus			
Berkeleyi	*		
castanellus	*		
decipiens	*		
merulioides	*		
pictus	*		
porosus	*		
Boletus			
affinis	*		
albellus	*		
alboater	*		*
alveolatus		*	
americanus		*	
Betula			*
bicolor	*		
brevipes	*		
bovinus			*
castaneus	*	*	
chromapes	*	*	
calopus			*
chrysenteron	*	*	
cyanescens	*	*	*
dichrous			*
edulis	*		*
eximius		*	
flavidus			*
felleus	*	*	*
ferruginatus	*		
floccopus	*		*
Frostii		*	
fumosipes	*		
gracilis	*	*	
granulatus	*	*	*

Species	Reported in this paper	Reported	
		By Herbst	By Peck
Boletus			
griseus	*	*	
hemicrysus	*		
inflexus	*	*	
innixus			*
illudens	*		
luridus	*	*	*
luteus	*		*
miniato-olivaceus		*	*
ornatipes		*	
pallidus	*	*	
parasiticus	*		
Peckii	*		
piperitus		*	*
Ravenelii	*		
retipes	*		
rugosiceps	*		
Russelii	*		
scaber	*	*	
subaureus	*		
separans		*	
spectabilis		*	
sordidus		*	
subluteus	*	*	*
subtomentosus	*		
subglabripes	*		*
subsanguineus		*	
versipelles			
Fistulina			
hepatica	*	*	
Strobilomyces			
floccopus		*	
strobilaceus	*		

The first report of Pennsylvania species, twenty in number, was made by Peck[1] from the collections of De Schweinitz (1780–1834). In 1900 Peck[2] reported an additional new species from the vicinity of Philadelphia. Herbst,[3] a physician residing in Trexlertown, Penna., reported twenty species which had not been previously recorded for the State. In 1907 Murrill[4] published a taxonomic account of the Boletaceae of North America. For most of the species treated he gives only the general geographic range, and Pennsylvania is within the range of a large number of his plants. Species which on this basis only might be expected to occur in Pennsylvania, are not included in this paper.

In the herbarium of the Pennsylvania State College and the private herbarium of Dr. L. O. Overholts there are at the present time 42 species of this family. Twenty-four of these species are not among those reported by either Peck or Herbst and are here reported from the State for the first time.

The family embraces four genera: *Boletus, Boletinus, Strobilomyces,* and *Fistulina.* The genus *Boletus* is readily distinguished from the three other genera by the character of its tubes being easily separated from the pileus. *Boletinus* is distinguished from the genus *Boletus* and the other two genera by the arrangement of its tubes in radiating rows. *Fistulina* and *Strobilomyces* have neither of the above characters, and may be recognized by the manner of attachment of their stems and habit of growth. The stem of *Fistulina* is laterally attached, and the plant is wood inhabiting. *Strobilomyces* is centrally stalked and is terrestrial.

I wish to acknowledge my indebtedness to Dr. L. O. Overholts for his assistance, guidance, and for the use of his personal herbarium and illustrations which made this article possible.

KEY TO THE BOLETACEAE OF CENTRAL PENNSYLVANIA

(KEY TO GENERA)

1. Tubes easily separable from the pileus ..... *Boletus*
   Tubes not easily separable from the pileus 2
2. Stem strictly lateral; wood inhabiting; tubes distinct from each other ..... *Fistulina*
   Stem central or eccentric; not wood inhabiting; the tubes not as above 3
3. Tubes arranged in radiating rows ..... *Boletinus*
   Tubes not arranged in radiating rows ..... *Strobilomyces*

BOLETINUS

(KEY TO SPECIES)

1. Stem lateral or eccentric; tubes with radiating lamella-like pores ..... *B. porosus*
   Stem central; tubes not arranged as above 2

[1] Peck, Bull. N. Y. State Mus. 8: 73–161. 1889.
[2] Peck, Bull. Torrey Club 27: 17. 1900.
[3] Herbst, Fungal Flora of the Lehigh Valley. 1899.
[4] Murrill, North Amer. Flora. 9: 133–161. 1907.

2. Pileus some shade of yellow ..... *B. decipiens*
   Pileus some shade of yellow 3
3. Pileus, red or reddish, squamose ..... *B. pictus*
   Pileus brown, not squamose ..... *B. castanellus*

FISTULINA

Pileus some shade of red, thick, viscid; stem strictly lateral, wood inhabiting; a single species ..... *F. hepatica*

STROBILOMYCES

Pileus and stem distinctly squarrose-squamose; tubes not easily separable from the pileus; stem centrally stalked, annulate, solid; a single species. *S. strobilaceus*

BOLETUS

(Key to Species)

1. Stem reticulate 2
   Stem not reticulate 19
2. Tubes white becoming flesh colored with age 3
   Tubes not as above 6
3. Stem slender, generally not more than 1 cm. thick ..... *B. gracilis*
   Stem thicker than above 4
4. Flesh of the pileus decidedly bitter ..... *B. felleus*
   Flesh of the pileus not bitter 5
5. Stem usually 3–4 cm. thick; context with a sweet and nutty taste ..... *B. edulis*
   Stem usually 1–2 cm. thick; taste mild ..... *B. indecisus*
6. Tubes free from the stem 7
   Tubes adnate to the stem, or becoming depressed with age 9
7. Stem generally short and bulbous, 3–4 cm. thick, decidedly reticulate ..... *B. edulis*
   Stem not as above 8
8. Pileus with a thin separable cuticle which easily cracks and rubs off in spots; stem spongy and white within ..... *B. affinis*
   Pileus with an inseparable cuticle; stem solid, bright yellow within especially at the base ..... *B. chromapes*
9. Tubes some shade of yellow or brown 10
   Tubes whitish 17
10. Pileus scaly; stem shaggy ..... *B. Russellii*
    Pileus and stem without the above characters 11
11. Pileus shiny and entirely glabrous; stem with a deciduous reticulated bark separating like the bark of birches ..... *B. Betula*
    Plant not having the above characters 12
12. Pileus red, fading to yellowish-red or buff-brown with age; stem red, yellow at the top ..... *B. Peckii*
    Pileus and stem not as above; pileus yellow or some shade of brown 13
13. Margin thin, inflexed, concealing the marginal tubes; tubes dotted with reddish glandules ..... *B. inflexus*
    Margin and tubes not as above 14
14. Stem very coarsely reticulate to the base in typical specimens ..... *B. illudens*
    Stem not coarsely reticulate 15
15. Tubes changing to blue when wounded ..... *B. bicolor*
    Tubes not turning blue when wounded 16
16. Pileus powdered with yellow; stem entirely reticulate ..... *B. retipes*
    Pileus not pulverulent; stem strongly reticulate at the apex only ..... *B. albellus*
17. Pileus smooth and grayish-black in color; stem whitish or yellowish; yellow within at the base ..... *B. griseus*
    Plant not having the above characters 18
18. Pileus viscid and entirely glabrous ..... *B. Betula*
    Pileus dry, tomentose, scaly ..... *B. Russellii*
19. Pileus pulverulent or clothed with a yellow silkiness 20

    Pileus not as above 21
20. Stem annulate; plants growing on the ground ..... *B. Ravenelii*
    Stem exannulate; plants growing on wood, especially roots and stumps of pine ..... *B. hemichrysus*
21. Tubes red at the mouths 22
    Tubes not red at the mouths 23
22. Context white or yellowish quickly changing to blue when wounded, taste mild; tubes free from the stem ..... *B. luridus*
    Context white or yellow, lavender under the cuticle, remaining unchanged in color, taste acrid and peppery; tubes adnate to the stem ..... *B. ferruginatus*
23. Pileus viscid or glutinous when moist 24
    Pileus dry 39
24. Tubes adnate to the stem, or becoming depressed with age 25
    Tubes free or nearly so from the stem 33
25. Stem annulate 26
    Stem exannulate 27
26. Stem dotted above and below the annulus ..... *B. subluteus*
    Stem dotted above the annulus only ..... *B. luteus*
27. Stem conspicuously glandular-dotted 31
    Stem not conspicuously glandular dotted 28
28. Context decidedly bitter ..... *B. felleus*
    Context not bitter 29
29. Pileus with a thin separable cuticle which easily cracks or rubs off in spots. *B. affinis*
    Pileus not as above 30
30. Stem very short, 2–4 cm. long; pileus chestnut colored ..... *B. brevipes*
    Stem larger, 5–8 cm. long; pileus dark brown to black ..... *B. alboater*
31. Stem over 8 mm. in diameter; generally growing under or near conifers. *B. granulatus*
    Stem under 8 mm. in diameter; generally not having the above habitat 32
32. Context white; margin inflexed, concealing the marginal tubes ..... *B. inflexus*
    Context yellow; margin not inflexed ..... *B. subaureus*
33. Stem dark brown to black ..... *B. alboater*
    Stem some other color 34
34. Stem bright yellow both without and within at the base ..... *B. chromapes*
    Stem not yellow at the base 35
35. Stem scabrous or punctate-squamulose ..... *B. scaber*
    Stem even 36
36. Pileus white or whitish ..... *B. albellus*
    Pileus not as above 37
37. Pileus conspicuously reticulate-rimose ..... *B. fumosipes*
    Pileus not reticulate-rimose 38
38. Pileus dark brown ..... *B. cordidus*
    Pileus some shade of red or purple, fading to a brown color ..... *B. chrysenteron*
39. Plant parasitic on *Scleroderma* ..... *B. parasiticus*
    Plant not parasitic on *Scleroderma* 40
40. Stem spongy within, becoming hollow 41
    Stem solid 42
41. Flesh quickly changing to blue when wounded ..... *B. cyanescens*
    Flesh unchanging in color ..... *B. castaneus*
42. Pileus conspicuously tomentose ..... *B. subtomentosus*
    Pileus glabrous, pruinose, or finely tomentose 43
43. Tubes some shade of white, flesh or gray 44
    Tubes some shade of yellow 48
44. Stem slender, generally not more than 1 cm. thick 45
    Stem thicker than above 46
45. Stem short, 3–4 cm. long, distinctly pale bluish-green at the apex ..... *B. fumosipes*
    Stem longer than above, 6–12 cm. long and generally slightly curved, not bluish-green at the apex ..... *B. gracilis*

46. Context decidedly bitter ..... *B. felleus*
Context not bitter 47
47. Pileus some shade of yellow or brown ..... *B. indecisus*
Pileus dark brown or blackish ..... *B. alboater*
48. Tubes not changing in color when wounded 49
Tubes turning some shade of blue with age or when wounded 50
49. Plants parasitic on *Scleroderma* ..... *B. parasiticus*
Plants not parasitic on *Scleroderma* 51
50. Pileus areolate or rugosely pitted; margin thin, extending beyond the tubes; stem glandular dotted, generally to the base ..... *B. rugosiceps*
Pileus and stem not as above; stem furfuraceous under a lens ..... *B. subglabripes*
51. Stem turning greenish-blue when wounded ..... *B. bicolor*
Stem not turning in color 52
52. Stem glabrous, rarely tomentose at the base, even, nearly white, streaked with red or brown, often reddish within, especially near the base ..... *B. pallidus*
Stem rarely glabrous, often contorted, red or pale yellow, fibrous-striate, minutely scurvy at the apex, sometimes yellow within at the base ..... *B. chrysenteron*

The following is a list of species found in the key arranged in their alphabetical order.

Boletinus castanellus Peck, *B. decipiens* Peck, *B. pictus* Peck and *B. porosus* Peck.

Boletus affinis Peck, *B. alboater* Schw., *B. albellus* Peck, *B. Betula* Schw., *B. bicolor* Peck, *B. brevipes* Peck, *B. castaneus* (Bull.) Fr., *B. chromapes* Frost, *B. chrysenteron* (Bull.) Fr., *B. cyanescens* (Bull.) Fr., *B. edulis* (Bull.) Fr., *B. felleus* (Bull.) Fr., *B. ferruginatus* (Batsch.) Fr., *B. fumosipes* Peck, *B. gracilis* Peck, *B. granulatus* (L.) Fr., *B. griseus* Frost, *B. hemichrysus* Berk. & Curt., *B. illudens* Peck, *B. indecisus* Peck, *B. inflexus* Peck, *B. luridus* (Schaeff.) Fr., *B. luteus* (L.) Pers., *B. pallidus* Frost, *B. parasiticus* (Bull.) Fr., *B. Peckii* Frost, *B. Ravenelii* Berk. & Curt., *B. retipes* Berk. & Curt., *B. Russellii* Frost, *B. rugosiceps* Peck, *B. scaber* (Bull.) Fr., *B. sordidus* Frost, *B. subaureus* Peck, *B. subglabripes* Peck, *B. subluteus* Peck, *B. subtomentosus* (L.) Fr.

Fistulina hepatica (Huds.) Fr.

Strobilomyces strobilaceus (Scop.) Berk.

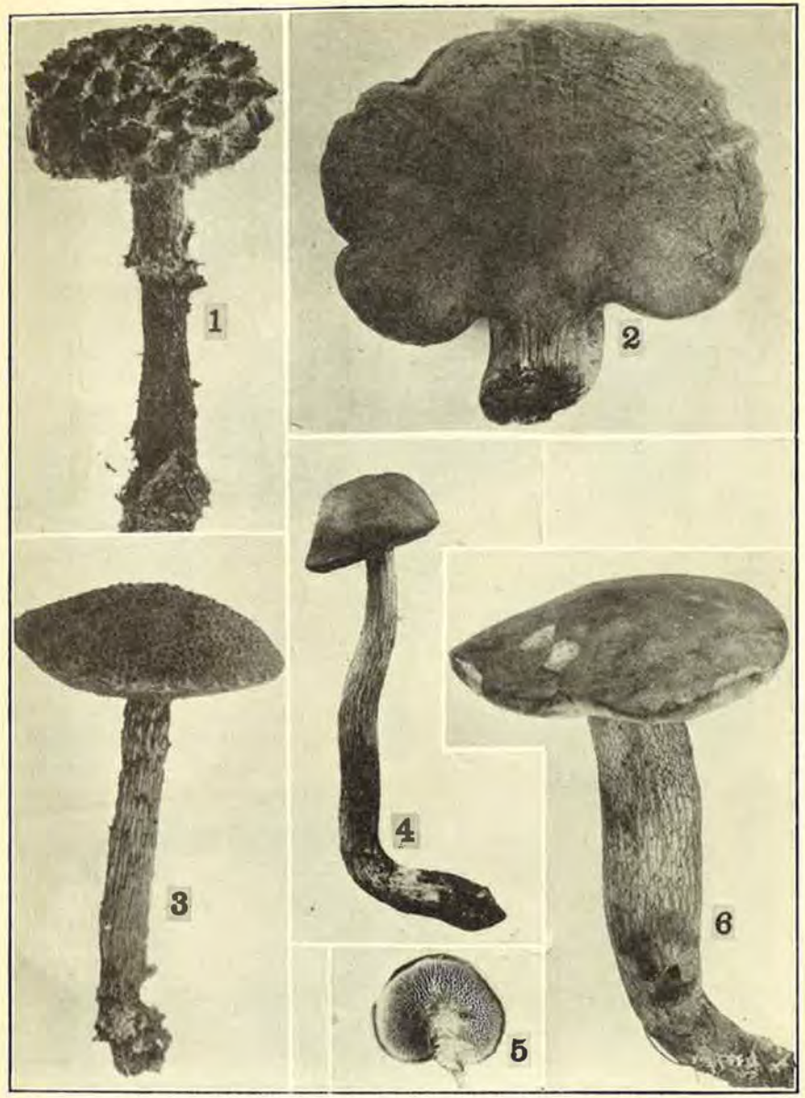


FIG. 1. Strobilomyces strobilaceus. × ½. Photo by L. O. Overholts.
FIG. 2. Fistulina hepatica. Upper surface view, × about ½. Photo by L. O. Overholts.
FIG. 3. Boletus Russellii. × about ½. Photo by L. O. Overholts.
FIG. 4. Boletus gracilis. × ½. Photo by L. O. Overholts.
FIG. 5. Boletinus porosus. × ½. Photo by M. C. Strauser.
FIG. 6. Boletus griseus. × ½. Photo by L. O. Overholts.

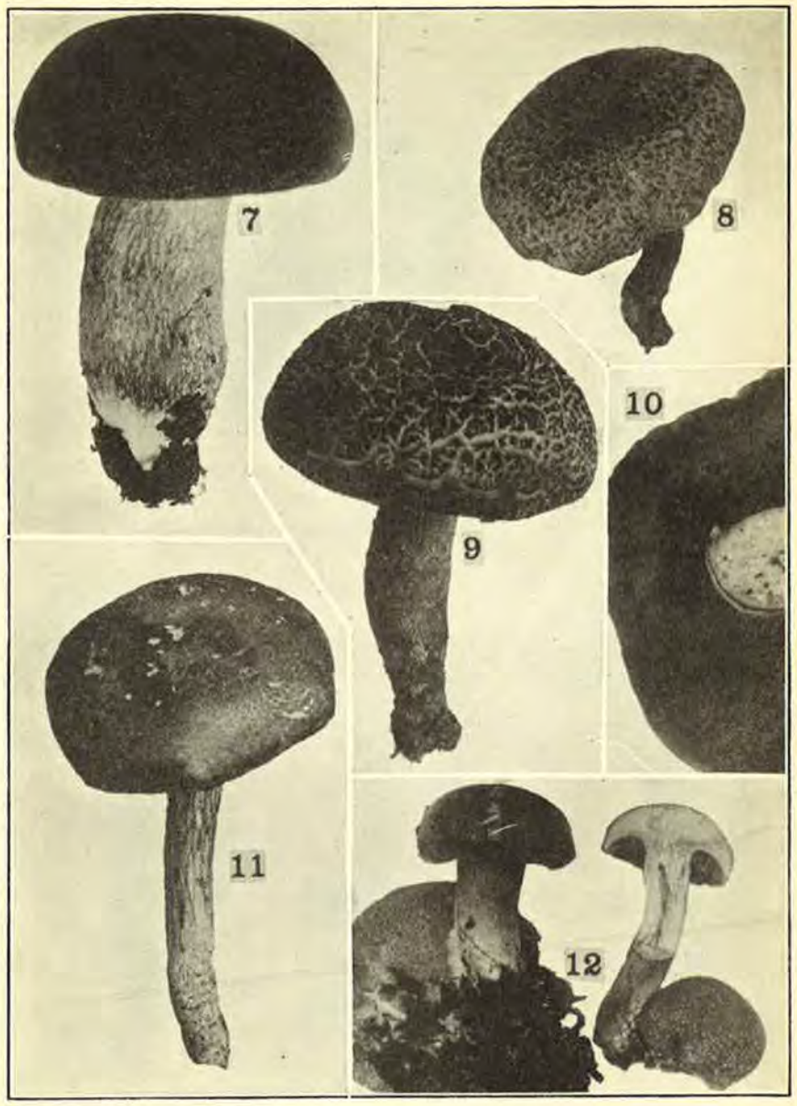
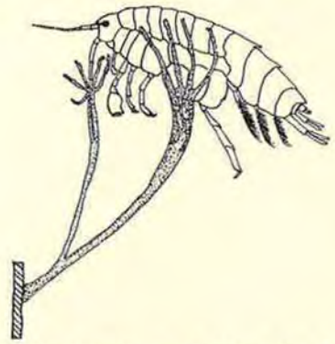


FIG. 7. Boletus felleus. × ½. Photo by L. O. Overholts.
FIG. 8. Boletinus pictus. × ½. Photo by M. C. Strauser.
FIG. 9. Boletus rugosiceps. × ½. Photo by L. O. Overholts.
FIG. 10. Boletus pallidus. Under surface view of the pileus showing the tubes. × ½. Photo by L. O. Overholts.
FIG. 11. Boletus illudens. × ½. Photo by M. C. Strauser.

OBSERVATIONS ON THE EFFECTIVENESS OF HYDRA NEMATOCYSTS ON AMPHIPODS

BY WM. HUDSON BEHNEY
Lebanon Valley College

On April 5th, 1929, while observing a number of specimens of *Hyalella knickerbockeri* (Bate) which has been collected the same day in the pond on the property of the Lebanon Cemetery Association at Lebanon, Penna., I noticed that one of the amphipods showed a great deal of activity but did not seem to make any progress. Examination of the side of the aquarium at that point with a hand lens disclosed the fact that the amphipod was being held fast by a hydra. The hydra was one of the brown variety (*Hydra vulgaris*). The incident occurred on the near side of the aquarium on a level with my eye so that my first observation of it must have been at about the same time that the amphipod was caught. At any rate the amphipod ceased his struggles to free himself and became perfectly motionless in fifteen minutes.



Sketch showing means by which Hydra was holding the Amphipod. Basal end of the Hydra was attached to the side of the aquarium.

The amphipod was being held by the fourth and fifth peraeopods on the one side as well as by the second antenna on the same side. The peraeopods were drawn within the gastrovascular cavity of the hydra while the second antenna was within the gastrovascular cavity of a bud of the same hydra. There was a marked contrast between the size of the amphipod (3 mm.) and that of the hydra. The fact that the hydra had started to engulf the amphipod at its middle presented a still further difficulty than had it started in at one of the extremities. The vigorous

activity of the amphipod when first caught did not cause the hydra to lose its attachment to the side of the aquarium.

I did not have immediate access to the proper microscopic equipment at the time so that I did not make any immediate microscopic examination of the amphipod. The specimen was preserved in 70 per cent alcohol and not examined until almost a year from the time it was obtained. Examination at this time revealed that the appendages were literally covered with nematocysts. In addition the parts which had been within the hydra showed partial disintegration, the exoskeleton having been dissolved at these points.

This ability of hydra to capture and paralyze aquatic organisms which are larger than itself when normally distended, has been observed a number of times before. Toppe in Zool. Anzeiger, vol. 33, pp. 799, notes hydra's ability to penetrate the chitinous covering of insects with its nematocysts. Gudger writing in Natural History, vol. 27, pp. 270–274, describes epidemics which occurred at various fish hatcheries amongst the fry. The fry died off at an unusually high rate and an immediate explanation could not be found. It was noted however that the mortality was higher in some troughs than in others. Examination of these troughs which had a high mortality showed them to be inhabited by large numbers of hydra, in one case as many as 131 to the square inch. Laboratory experiments with the hydras and fish fry showed that the hydra were the culprits. In this case the hydra attached themselves to the bodies of the fry and killed them by means of their nematocysts.

Gudger in the same article quotes a portion of The Monograph on the Hydras by Abraham Trembley, published in 1744. The part quoted deals with the stalked hydras and their ability to kill small fish.

West in the Naturalist (London, No. 655, pp. 301) describes his observations on *Hydra vulgaris* and its ability to paralyze the tadpoles of *Rana temporaria*. The tadpoles were too large to be engulfed by the hydra and merely sank to the bottom of the container after having been killed by the hydra. Even though some of them were able to escape after having been caught they usually succumb.

So far as I have been able to ascertain no mention has been made of hydra's ability to paralyze crustacea. My own observations on *Hyalella knickerbockeri* show that even the crustacean exoskeleton, with which these animals are provided, is not bomb proof when dealing with the nematocysts of hydra.

In order to determine whether *Hydra viridis* is able to capture the amphipods in the same manner I placed three amphipods in a small container with about 20 hydra. During the two hours that they were

under observation the amphipods came into contact with hydra many times. On most of the occasions the hydra merely contracted. Several times I noticed one which attached itself to the appendages of the amphipod but it was soon shaken off by the activity of the animal. Frequent examination of the amphipods under the microscope after these encounters did not reveal any nematocysts. The amphipods were allowed to remain in the container over night and were still alive the next morning. It does not seem as though *H. viridis* is able to duplicate the feat which I observed in *H. vulgaris*.

The inclusion of hydra in fresh-water aquaria may prove disastrous to other aquatic organisms which are placed in the same aquarium. The almost invisible *H. vulgaris* may easily obtain sole rights in the aquarium by killing off the other organisms even though they may be larger than itself. We may in this manner obtain some very beautiful demonstrations of nematocysts but at the same time lose valuable collections before we are able to utilize them or find that in an experiment which has been going well up to a certain point all our subjects have been killed off. It is with these thoughts in mind that these observations are being presented.

A NATURAL GRAFT BETWEEN UNRELATED SPECIES. *QUERCUS RUBRA AND PRUNUS AVIUM*

By S. Hoffman Derickson

Lebanon Valley College, Annville, Pennsylvania

A natural graft consists of the organic union of two organisms without the aid of man. Among plants natural grafts between individuals of the same species are occasionally observed. Union of this kind may either occur between stems or roots or, most frequently in the case of parasites, between roots and stems. Except in cases of parasitism the union is usually initiated by pressure and apposition of growth accompanied by friction caused by wind or soil movements.

The accompanying illustration shows a natural graft between a red oak and sweet cherry which may be seen a few yards north of the Pennsylvania Railroad, siding B, about half a mile west of the Mount Gretna station. The union was well established when I first observed it five years ago. The two trees grow at the base of the railroad embankment which is about 12 feet high at this point. The graft is about 20 feet from the ground. The cherry seems to be deriving benefit from the

union as the trunk and side branches are thicker and more thrifty both above and below the union. Experiments to show the actual extent of interchange of sap might be performed but under considerable difficulty due to the location and distance of leafage of either specimen from point of union. As the crude food compounds made by either specimen in its leaves are probably similar, no marked modification of structure would be expected, nor do they appear.

According to the evolutionary interpretation of Dr. Clements, the cherry, a representative of the rose family, is rather widely separated from the oak, a representative of the beech family, the two representing divergent lines of specialization.

PLATE III

A Red Oak, *Quercus rubra*, and Sweet Cherry, *Prunus avium*, with trunks

The sequence of events which probably caused the present relationship of the two trees may be summarized as follows:

1. The approximation of the two trees by chance seed distribution.
2. Friction between contiguous parts caused by wind.
3. Abrasion of the bark bringing the cambium of the two trunks in contact during the growing season.
4. Organic union of the vascular and other tissues arising from the united cambiums.
5. A probable interchange of sap during both upward and downward movements.
6. The oak overtops the cherry and from its more abundant leafage returns a larger quantity of food to the region of the graft. More food probably diffuses from the oak to the cherry than from the cherry to the oak and as a result the cherry is larger in the region of the graft than at some distance above or below it.

SENECIO ANTENNARIIFOLIUS BRITTON IN PENNSYLVANIA

BY E. M. GRESS
State Botanist, Harrisburg

Cat's-paw ragwort is a species of very limited distribution, having been previously reported from Virginia and West Virginia where it is found on stony hillsides and mountains.

On May 23, 1928, the writer found a colony of this plant growing on a shaly bank along the Lincoln Highway about half a mile east of Harrisonville, Fulton County, Pennsylvania.

As is its habit, it was growing in rather large perennial tufts where the soil is dry and shaly and where there was little vegetation of any kind except scrub pines (*Pinus virginiana*). The tufts were scattered here and there over an area perhaps a hundred feet in diameter.

So far as is known, the discovery of this colony of *Senecio antennariifolius* extends its distribution northward a considerable distance and into a State from which it has never been reported before.

ALTITUDE EFFECTS ON THE GASTROPODA AND THEIR TREMATODE PARASITES

BY JOHN C. JOHNSON
West Chester

No abstract.

AREAS OF BIOLOGICAL INTEREST IN WESTERN PENNSYLVANIA DESERVING PRESERVATION

By O. E. Jennings

Carnegie Museum and University of Pittsburgh

Presque Isle

Presque Isle, the six-mile-long peninsula at Erie, Pennsylvania, is a remarkably interesting and complete example of a rapidly shifting recurved sandspit, moving eastward at the rate of about half a mile a century, and on which the plant (and animal) associations must, also, shift eastward at the same rate, thus displaying an excellent series of consecutive successional stages. This peninsula is now a State Park and it is hoped that its use as such a park will also insure the preservation of the native flora and fauna. Many of the plants on Presque Isle, as, for instance, bearberry (*Arctostaphylos*); hoptree (*Ptelea*); sea rocket (*Cakile*); hairy puccoon (*Lithospermum Gmelini*), and various others, occur nowhere else in western Pennsylvania. The bird life, including a colony of nesting terns and a pair of nesting eagles, is of unusual interest.

Pymatuning Swamp

Pymatuning Swamp is a somewhat irregular and broken swampy area in Crawford County, in northwestern Pennsylvania, about 14 miles long and probably occupying one or more old stream channels and now bounded on the north by glacial moraines. The swamp deposits are in places reported to be over 100 feet deep and in places the swamp is more than a mile wide. At the western end this swamp is largely occupied by a black ash and red maple swamp forest, but, towards Hartstown, at the southeastern end, there are some interesting areas of tamarack-sphagnum bog. The western end of the swamp, according to State plans, will be flooded and converted into an artificial lake, but the biologically more interesting southeastern end will not be flooded and strongly merits preservation as a biological preserve. In the areas of tamarack-sphagnum bog there occur the insectivorous pitcher plant (*Sarracenia*) and sundew (*Drosera*), as well as many other, often northern, bog plants of rare interest for western Pennsylvania, such as buckbean (*Menyanthes*); calla; swamp honeysuckle (*Lonicera oblongifolia*); mountain holly (*Nemopanthes*); and a number of orchids, such as Arethusa, the Rose Pogonia, and four kinds of ladyslipper orchids (*Cypripedium*). At the southeastern end, near Hartstown, there are three small lakes, two of them with particularly clear cool waters and surrounded in part by bog

vegetation of great botanical interest and including the Virginia chainfern (*Woodwardia virginica*) and the swamp loosestrife (*Decodon*). As indicating the exceptional botanical character of the southeastern part of the Pymatuning Swamp basin it may be mentioned that it contains six species in the one genus of bog mosses (*Sphagnum*) which up to the present time have not been reported from any other part of Pennsylvania. Mr. Sutton's work on the birds of the Pymatuning Swamp (Annals Carnegie Museum, vol. 18, pp. 19–240, 1928) indicates the excellence of the region for the study of birds also. Means should be taken to keep the entire southeastern end of the swamp, beyond the limits of the flooded area, as a biological preserve.

Mercer Bog-Lake

A small kettle-hole (glacial) lake a few miles southwest of Mercer occupies a wooded depression of only a few acres in extent and, for western Pennsylvania, is of rare biological interest. The lake is clear and cold and surrounded by a quaking (floating) bog-mat of sphagnum, bog sedges, cranberry, sundew, pitcher plant, cotton-grass (*Eriophorum*), buckbean, and many other bog plants. In western Pennsylvania this is the most southern example of a typical quaking-bog vegetation and it would be a misfortune to have it blotted out.

Fringed Gentian Swamp

A few miles east of New Castle is a sloping field, wet from the seepage of the morainal knoll above. This field, of about two acres, contains every year a large number of plants of the fringed gentian, as well as other rarities such as the Grass of Parnassus (*Parnassia caroliniana*) and the swamp lousewort (*Pedicularis lanceolatus*). The present owner of the farm guards this field against vandalism and, as this is by far the most important station for the fringed gentian in western Pennsylvania, it is hoped that it may be preserved.

Ohiopyle

The village of Ohiopyle lies in the southeastern part of Fayette County, about 50 miles in an airline southeast of Pittsburgh. The Youghiogheny River here flows in a rocky valley at an altitude of about 1200 feet, whereas the mountains a few miles away rise to about 2900 feet. Immediately at the town of Ohiopyle the river makes a sharp U turn. Near the end of the upper arm of the U, the waters pitch over what the author believes to be the largest and most impressive falls in

the State. Below the falls, for nearly a mile around the U, the waters tumble along in rocky rapids. Cucumber Run, emptying into the river at the base of the U, pitches over a ledge, forming a beautiful falls about thirty feet high. Up Meadow Run, another tributary emptying into the river a short distance below the Ohiopyle Falls, there is a series of beautiful cascades collectively called Meadow Run Falls.

This whole valley is rich in southern Appalachian plants which reach here their northern limit, or approximately so, some of them being very rare even in the southern Appalachians. Under the spray of Cucumber Falls occurs a moss (*Pterygophyllum acuminatum*) reported elsewhere in the United States only in the Carolina mountains. Other southern plants found along the shores and cliffs of the river are the crazy nut (*Pyrularia pubera*), the sweet azalea (*Azalea arborescens*), Marshallia, the wild monkshood (*Aconitum uncinatum*), and Trautvetteria. Plants rare or unusual for western Pennsylvania occurring here are: golden club (*Orontium*), *Aster linariifolius,* dwarf iris (*Iris verna*), lyre-leaved salvia (*Salvia lyrata*), and the ferns *Asplenium montanum* and *A. pinnatifidum.* On the brink of Meadow Run Falls occur abundantly the unique river weed (*Podostemum ceratophyllum*) and one of the freshwater red algae (*Lemanea*). These are only a few of the many unusual or rare plants to be found in the vicinity of Ohiopyle, in the Youghiogheny, and in the tributary Meadow Run and Cucumber Run valleys. It is earnestly urged that some means be taken, perhaps through State or federal ownership, to preserve this region of beautiful scenery, interesting geology, and unusually rare and interesting biological features.

EFFECT OF X-RAYS ON DEVELOPING CORN

By G. E. Snyder
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In view of the many interesting changes which have been brought about in both animal and plant tissues as a result of exposure to X-Radiations, a series of experiments was planned to determine the effects, if any, that the rays might produce upon developing corn. The original purpose of the experiments was to determine the cytological effects, particularly those in the chromosomes; however, after exposing some of the seeds a marked acceleration was found in the growth of the radicles of irradiated seeds over that of non-exposed seeds. The difference in rate of growth which occurred was sufficiently great to warrant

following up this phase of the problem and to determine, if possible, a dosage which would produce the maximum acceleration on the seedlings.

Technic. In all the following experiments only one strength of X-Rays was used; the dosage employed was 31 K.V.; 8 ma. at a target distance of 15 mm. The only variable was the length of exposure; the periods ranging from 1 minute to 3 hours. In all the tests, unless otherwise stated, the dry seeds were exposed to the X-Rays and immediately after exposure were planted in moist paper for germination. During the entire course of the experiment the seeds were kept at room temperature and readings for the increase in length of the radicles were taken twice each day.

Results: Golden Bantam

In the first series of experiments the variety of corn used was Golden Bantam, a sugary type. When the seeds were exposed to the rays for 1 minute the seeds germinated at the same time as the controls, about 24 hours after planting. After germination had occurred, a slight acceleration was observed in the growth of the exposed seedlings over that of the controls. This acceleration 95 hours after planting amounted to 2.38% increase in the exposed radicals. After this time growth occurs at the same rate in both test and control seedlings. This initial increase is, in all probability, a transient effect produced by the rays and is not strong enough to be carried on as the seedlings develop into young plants.

When the exposure period is raised to 3 minutes an acceleration was again obtained in the test seeds, the increase being considerably greater than that found in seeds with a 1-minute period. With this exposure the test seeds show an average increase of radicle length of 20% over the controls 95 hours after planting. In contrast to the 1-minute period, the acceleration in this case is not lost but continues after the seedlings are transplanted into pots of earth, over a period of two weeks. Whether or not this increased growth will continue as the plants approach maturity has not, up to the present time, been definitely determined. That this acceleration, in the 3-minute period, is due to the effect of the X-Rays is born out by the results obtained when the seeds are exposed for 5 minutes.

With the 5-minute exposure the maximum acceleration was produced. Ninety-five hours after planting the test seeds show an average increase of 54.83% over that of the controls. This effect continues when the seedlings are transplanted in earth although, at the present time, a sufficient amount of data is not available to state whether or not it will continue in intensity as the plants mature. Present indications point

in that direction but will have to be determined in future experiments.

As has been stated the progressive increase in growth brought about by increasing the period of exposure reaches its maximum intensity at 5 minutes. When the period is raised to 10 minutes the increase of tests over controls drops to 35.7% at an age of 95 hours. Again, in this case, the beneficial effect continues in the young plants and seems to be more strongly impressed on the plants than that of the 15-minute period.

From this point on the beneficial effect produced by the rays decreases as the period of exposure increases. The gradual decrease was observed through periods of 15, 30, 45 and 60 minutes. A 3-hour exposure produces a definite retardation in the growth of the treated seeds. Not only does this length of exposure produce a retardation but, 90 hours after plating, effects a complete cessation of growth, and death to the young plants.

In conjunction with these experiments conducted on Golden Bantam corn, similar tests were run substituting two varieties of starch corn. In this case, only the 5-minute exposure was used to determine whether the same effect was produced. When Red Aleurone corn was substituted an accelerated effect similar to that obtained with the sugary type was produced. In this case 95 hours after planting, the test seeds show an increase of 25% over that of the controls. In contrast to these results is that produced when Yellow Dent corn is substituted. In these experiments, again using a 5-minute exposure, a definite retardation was produced in irradiated seeds. The growth of the exposed seeds at 95 hours being 36.73% less than that of the controls. This reversal of growth in the two types of starch corn is, from all present indications, caused by the X-Rays, but how the effect is brought about has not been determined.

Conclusions

These preliminary experiments indicate that exposing Golden Bantam seeds to X-Radiations produces an accelerated growth which increases as the time of exposure increases; the maximum effect is produced with a 5- and 10-minute period. After this the beneficial effect decreases as the period increases, a definite retardation and cessation of growth occurring with a 3-hour exposure.

It is shown that similar results may be expected when Red Aleurone corn is irradiated and that the X-Rays effect a definite retardation on Yellow Dent corn.

PHYSIOLOGY OF THE PROSTATE GLAND

By B. H. Kettelkamp
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Since the discovery and description of the prostate gland a large mass of literature has been compiled regarding its function. In reviewing the field one is confronted with a confusing tangle of supporting and contradictory evidence submitted by equally reliable investigators. It is the purpose of this paper to review briefly the literature in an attempt to clear up part of the confusion and to throw additional light on the function of the gland.

Detailed references to the importance of the gland in the field of surgery shall be purposely omitted, but it was there, naturally enough, that the function of the prostate first came into question. Hypertrophy of the prostate, resulting in constriction of the urethra, is a pathological condition which occurs frequently in old age, and surgeons are not agreed concerning the cause. Nor are they agreed in the method of treatment. Prostatectomy is a serious operation but is effective in a high percentage of cases. A second method of treatment is sometimes resorted to and favorable results are obtained. Castration is followed by an atrophy of the prostate and a subsequent correction of urethral constriction. It is also known that unilateral castration is proportionately effective. These results imply that there is a physiological relationship of a quantitative nature existing between the prostate and the testes. Further evidence of this relationship is shown by the fact that the growth of the prostate is dependent upon the growth of the testes, since it remains infantile until sexual maturity is reached. In those abnormal cases in which testicular growth is arrested the prostate remains in a rudimentary condition.

Recently the work of Moore of Chicago has lent additional evidence in support of the theory of prostato-testicular interdependence. He has utilized the cytological picture of the prostate gland as an indicator for the testis hormone. Castration effects can be detected in the prostate cytology as early as five days after testis removal. By subcutaneous injection of bull testis extract the characteristic castration changes were prevented for two months and he concluded that the normal condition could be maintained indefinitely. Furthermore, in animals which had been castrated prepubertally the arrested prostate could be developed to the normal state in twenty days and could be so maintained. Continuous injections were necessary and at their cessation the degeneration changes could be detected in the prostate after five days.

It is generally conceded that this interdependence exists but by no means is there a universally accepted explanation of the relationship. This failure to agree may be due to a difference of opinion regarding the component parts of the gland. There is general disagreement particularly regarding the prostate in rodents, and most of the work has been done on these animals.

Walker, in 1910, described a "coagulating" gland in the guinea-pig which heretofore had been considered a part of the prostate, although histologically quite different. This gland occupies the same sheath with the seminal vesicles and its secretion in dilutions of 1 part in 21,000 parts of seminal vesicle secretion was capable of forming the characteristic, so-called "vaginal plug." The secretion of the prostate alone was not able to produce coagulation in any concentration.

Engle, in 1926, working with the same animal and on the same gland finds it more convenient for his purpose to consider the "coagulating gland" which Walker described, as an integral part of the prostate. This inconsistency, however, is not limited to this one suggested function.

One of the most generally accepted theories regarding prostate function is that of neutralizing the urethra and contributing additional vehicle to the spermatic fluid. It has been suggested that the secretion exerts a stimulating influence on sperm motility and at the same time tends to shorten their length of life. A very logical explanation has been built up around the carbon dioxide binding power of the secretion. It has long been known that sperm motility is inhibited by acids. Spermatozoa in the testis and epididymis are constantly giving off carbon dioxide and in so doing make the fluid in which they are suspended sufficiently acid to inhibit their own movements. They are supplied with a definite store of energy and since they are isolated this energy cannot be replenished. Their capacity for locomotion and their length of life is therefore limited and depends upon the rate with which they expend their store of energy. But whether they live long and inactively, or short and actively, the amount of energy is constant and can be measured by the amount of carbon dioxide which is excreted. When the spermatozoa are later mixed with the prostate fluid they become activated, due to the neutralizing effects of the secretion.

Iwanoff, on the other hand, succeeded in fertilizing ova successfully with spermatozoa taken directly from the epididymis before they came in contact with any prostatic secretion. In order to secure a successful fertilization, however, it was necessary to dilute the sperm suspension with a 5 per cent. solution of sodium carbonate or some other alkaline

substance. It is possible that by mixing the suspension with such a solution one is really replacing part of the normal secretion of the prostate. This binding power, it would seem, is dependent upon prostatic activity, but it is not limited to this gland. Blood serum, when mixed with a sperm suspension exhibits the same carbon dioxide binding power, and the spermatozoa are similarly stimulated. Normally, however, it appears that this neutralizing effect of the prostate secretion is a very important factor in functionally activating the spermatozoa.

Experiments involving the removal of the prostate are open to objection since it is highly improbable that the entire gland can be removed without seriously injuring the neighboring tissues. Complete prostatectomy has supposedly been accomplished in young rats five weeks of age. The sexual development of these rats was normal, though slightly delayed. The interstitial tissue developed quite normally and the somatic sexual characters which are markedly affected by the absence of sexual hormones were normal. These experiments of Lichtenstern's lead one to believe that the development of somatic sex characters and sexual behavior are independent of the presence of the prostate.

Lichtenstern modestly admits the difficulty involved in prostatectomy. Serralach and Pares, on the other hand, encountered no such difficulty in their work and they record the most striking results. After prostate removal in dogs they found an atrophy of the testis and a complete cessation of spermatogenesis. Further, two or three days after injecting an extract of prostate spermatogenesis was resumed and functional spermatozoa were produced.

It has been suggested that the nervous and psychical disturbances which often follow prostatectomy may be due to the lack of an internal secretion of the gland and various experiments have been performed to demonstrate this function. Striking effects have been noted following the injection of extracts of the prostate. An increase in metabolism of previously castrated dogs, a rapid rise in blood pressure followed by a fall, accelerated respiratory movements, stoppage of the heart, and increased tonus of the bladder, ureter, and uterus, are only a few of the results obtained. It is possible that many of these effects can be attributed to intravascular coagulation.

One of the strongest evidences opposed to the endocrine function of the prostate is a theoretical one. It seems illogical on phylogenetic grounds that an accessory gland which arises so late in the vertebrate series should possess such an important function. The prostate is found

only among mammals and no recognized homologue is present in the other vertebrate groups. On the other hand, it may be argued that the prostate may originally have formed part of the testis, and subsequently have become differentiated as a separate organ in the course of phylogeny.

One of the strongest evidences in support of the endocrine function is found in the results of Macht's experiments. He fed tadpoles with dried prostate for several weeks and fed control animals with liver, ovary, corpus luteum, and other glands. Among the prostate-fed animals a marked acceleration of growth and metamorphosis occurred. He found also that the prostate of the bull was much more effective than that of the ox. This experiment appears to demonstrate rather conclusively that the gland contains a specific growth promoting substance, since an adequate control experiment was carried out and the many possibilities involved in injection experiments were excluded.

During the past year a series of experiments has been performed on white rats in an attempt to further demonstrate this endocrine function. Prostatectomy was unsuccessful. The lobular nature of the gland and the many ducts by which it enters the urethra make it nearly impossible and highly impracticable to remove it. A small portion of the gland always remained and testicular development was normal. Vasectomy, likewise, did not affect the development of the prostate. Several operations were performed and in all cases the gland developed to full size and histologically showed normal secretory epithelium.

Injection experiments showed more striking results. Fresh bull prostates were ground and dried. A suspension was made with normal saline and the clear, decanted fluid was injected intraperitoneally into male and female rats. Injections were begun when the animals were two or three weeks of age and continued every other day. Controls were injected with a suspension of beef muscle prepared in the same manner.

A number of animals were injected with heavier dosages at more frequent intervals. These showed symptoms of what is assumed to be intravascular coagulation. The respiratory rate and heart beat were greatly accelerated and the animals died before reaching sexual maturity. Females seemed to be more susceptible than males. Autopsy showed the lungs to be completely congested with blood. It is possible that the albuminous nature of the prostatic solution is responsible for these results. Several of the females injected with lighter dosages at greater intervals produced normal, healthy litters which lived for only

a few days. Examination showed that no milk was present in their stomachs and the mammary glands of the mother failed to reach functional activity. All the females again became pregnant and produced apparently healthy litters which died shortly after birth.

Recently the testes of sexually immature rats have been exposed to varying dosages of X-rays. Since suitable dosages are specific for the sex cells it is hoped that by destroying these a final check may be made on the nature of the relationship of the prostate and the testes; that is, whether the development of the gland is dependent upon the secretion of the interstitial tissue of the testes or upon the germinal activity of the sex cells.

All of these experiments are being repeated on a greater number of animals and until all results confirm or completely disprove the original results, no definite statement will be made regarding what is still thought to be the hypothetical endocrine function of the prostate.

MODERNIZING SCIENTIFIC COMMUNICATIONS

By Robert T. Hance

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I have a distinct feeling that I am not only carrying coals to New Castle, but that I am also rushing in where only a zoologist, in contrast to the angels, would *not* fear to tread. Also one who rises to object to a certain condition and in objecting commits the very sins he is holding up to ridicule is indeed in an indefensible position. Let us clearly understand then that all I may say can not be retroactive nor yet go into effect with the present effort. Like the king, the objector can do no wrong and therefore needs none of his own medicine. But after this and us—the deluge, suggesting, of course, in modern parlance, the general dampness of my thesis.

For a good many years it has seemed to me that there was a good bit of Puritan or better, of the monastic, in the scientist. For the sake of his deity, he must don the sackcloth and the hair shirt and groan at regular intervals in the cold ashes of the unscientific ritual of scientific communications. The feeling is abroad in the land that we must love this sort of thing for its own sake. In science we tend to follow the ethics of the Pilgrims to whom any attempt to garnish the aridity of a three-hour sermon was a profanation suggesting an attempt at anaesthesia. Civilization and theology, however, have gradually come to

realize that, though the lily may not be improved with gilt, the beauty of jewels can be enhanced with the proper setting. Why then should the scientist and the teacher lag behind in the art he uses to display his discoveries and creations. Partly perhaps because he feared to be considered superficial by his audience who might suspect his radical attempt to humanize and to dramatize his science through artful use of imagination and words to be a flippancy that was merely covering his inadequate grasp of the profundities. But largely because most of us are too lazy to write briefly and interestingly, to speak to the point and on the main issues of our subject, too selfish and too bad pedagogues to consider the pleasure and best interests of our audience, we jam onto paper a lengthy and stupid effusion and rush it to press via the air mail. We harangue our fellow anchorites in full realization that we are but working off a hangover for which their anaesthetic utterances are responsible. Turn about is considered fair play. In one case we are credited with a new title and in the other a new speech. What else matters?

But how the audience sits up and takes its eyes off the clock that is so slowly approaching the adjourning hour and even forgets its gratitude to the speakers listed on the program who failed to put in an appearance, when a man begins to talk who thinks so much of his work that he wants everyone to live again with him through the thrills he had in its prosecution. He is not afraid to properly set his pearl nor to gild his lily if necessary, nor in spite of puritanical scientific opinion to support his sermon with the harmonies of the organ. And the audience, the listeners, what of them? Unless I greatly misjudge human endurance the effect is not unlike one that I once experienced at a dance. A famous orchestra was playing but without its regular leader. The music sounded well but our muscles could tell that something was wrong since they were straining to keep in time. In short order I was more than ready to leave with nearly every muscle of my body aching—when the regular leader arrived. Not a man in the orchestra changed nor were any of the instruments, but it was only a matter of minutes before the rhythm of the new music had soothed the protesting muscles to terpsichorean bliss. That leader knew how to handle his material.

So with the considerate scientific speaker and writer. He studies his words, he smooths out the technicalities, he even descends to popular language equivalents for much of his big guaged ammunition, and then—first, last and all of the time he is brief. Biologists in particular sin in these matters. Their science being in an inexact state allows and encourages them to verbosity and their publication channels being many

permits them the opportunity of floating their philosophizings into print without much critical editing.

The time is coming, or perhaps is here, when the numbers of papers will exceed the means of publishing if the usual length standards are adhered to. Few biological papers, however, but could advantageously be cut in half and perhaps even to a lesser fraction. We must first consider what story we are trying to tell and write for our readers rather than for our personal vanities. Few people to-day have the time or the desire to read a long paper and usually confine themselves to the summary. If the summary gives an adequate idea of the contents, how much of these might to the advantage of space and lucidity have been omitted? The chemists are already handling their material with great brevity and the biologist, through his experience of expressing for *Biological Abstracts* the gist of lengthy articles, is finding that the use of a little intelligence and energy enables him to say much in few words and to say them pithily.

Much as brevity and clarity are needed, we should not lose sight of the desirability of decoration, of making our communications interesting. We have gone beyond the pioneering days of science when we could be content with bare necessities and must now have some of the luxuries of speech. Few biological readers of papers are careful to cull the essential from the non-essential parts of their studies and hide, perhaps, a very real light under a bushel of details unintelligible to the general audience. This can but mean an intellectual laziness to sort wheat from chaff, or an uncritical attitude that suggests that it may even have operated throughout their studies. Either is discreditable.

Many of the old lions of biology could roar in a much more virile key. Huxley could hand the ape lie back to the bishop in a manner that the audience appreciated even if the bishops did not, and in a style that is reprinted in English texts to-day as a model of forensic skill. The elder Darwin tricked his very sound philosophies out in verse. To-day we have a new school of writers who take the most profound and fundamental drama we have, life, and work in into stories that become best sellers.

At the risk of outraging your sensibilities I am going to draw a few examples from the field of sport writing to indicate how these profane but skilled writers create mental pictures that in few words may suggest volumes.

"On the springy evening of May 5, 1925, two hostile young men sat glaring at each other enthusiastically from opposite corners of a ring in

Madison Square Garden. They were there to engage in the manly art of selfish-defense, under the rules interwoven and promulgated by the Marquess of Queensberry during one of his gouty hours. One of the young men, whose ears were already twin monuments dedicated to the memory of the marquess, was the bouncing Johnny Dundee, whose ring style was that of a honey bear fighting a swarm of indignant bumblebees. His opponent was Sid Terris, another youngster who had improved on the marquess' by-laws by adding running, skipping and jumping to the original charter. . . . Of all the cheers which have massaged the rafters of the old Garden, none could equal the reception accorded Joe when the crowd saw that he was wearing a Tuxedo which looked a 1914 limousine. The Tux rippled to Joe's massive shoulders as the waves cling to the shores of Lake Erie, but the crowd simmered down when it realized that only a sorrowful exigency could compel the genial Garden announcer to don a formal evening tourniquet in preference to a comfortable soft collar. Tears were drizzling down Joe's cheeks as he held up his hand for a silence that was already his.

"Ladies and gentlemen," bellowed Joe, "to-night we see the passing of a great institution—"

"Who's fighting?" yelled an invisible kibitzer far up in the hanging gardens.

"—to-night we see the passing of the glorious old temple of Fistiana," Joe continued, casting a withering squint of scorn up at the four-bit seats near the roof. "To-night—"

"To-night's my night with baby!" howled the shadowy heckler while the Garden roared with laughter.

"As we gather here to-night to see the last fight in this historic arena—"

"Pull in your neck, they're looking for lumber!" was the next contribution from the volunteer prompter.

This was too much for Joe. He had never been defeated in an oratorical duet with wits, half-wits or quarter sizes. Aiming his voice at the hidden kibitzer, he retorted:

"The more I see of guys like you, the more I think of birth control."

Again, a wild cat got loose during one of the circus performances in the old Madison Square Garden.

"It attacked the Garden band, but was put to flight by a frightened musician breathing his loudest prayer through the brass horn. After this unequal duet, the cat allowed itself to be cornered by two old circus men armed with ropes, nets and accident insurance. Two raccoons got away the next day and were found in the pheasant coop, smilingly beautifully through feathers."

What better condensation of history can we find than in the following comment on Bryan, who, being described in 1896 as being able to talk the ears off of a Philadelphia lawyer, was said in 1900 to still be going strong for "when he was in his prime, the voice of Fate was but a minority report to him, and national Democracy followed in his wake, picking up corn that was to fatten it for a Republican barbecue. For three decades, the echo was more important than the Alps, but in 1924, in the same Garden, Bryan changed his wavelength and was lost in the static of the longest, loudest and least of all national conventions."[1]

I know only too well that I have violated every tenet suggested above for style and brevity, but remember that prohibition did not become incarcerated in the 18th Amendment without much discussion, so we cannot expect to limit the discussion of a prohibition of dull and lengthy scientific disclosures.

I am perhaps not a sufficiently good boxer to be allowed to speak well of Shakespeare at Yale, much less to quote him here but you'll remember that Hamlet urged his players to speak "the speech trippingly on the tongue." Can we as scientists not trip a bit more gayly as to tongue and remember that words may be potential dynamite and consequently exciting or more duds that, being loaded just as are the effective shells, nevertheless land with a thud and fail to explode.

SOME BIOLOGICAL EFFECTS OF HIGH FREQUENCY ELECTROSTATIC FIELDS

By G. M. McKinley

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The design and construction of high frequency apparatus suitable for use in biology presents no great difficulties providing the shortest wave-length desired is not much under 2 meters. It is not possible at present to obtain the very short wave-lengths with apparatus which would lend itself to biological use, and for the time being the biologist is limited to a range of from 1 to 100 or more meters. In this range, however, he may work with apparatus in which he can place the utmost confidence. The equipment is relatively simple and can be gathered together at remarkably low cost. In fact, it is possible to investigate the

[1] Baer, A., Madison Square Garden: Saturday Evening Post, Sept. 8, 1928.

long infra-red end of the electro-magnetic spectrum with more precision and at far less cost than is experienced in any work in the near ultra-violet, X-ray or gamma regions.

Considered as a tool, the high frequency apparatus is proving of very great value in biology and this is especially true in the field of physiology where it has been found to be a very potent modifier of living tissue. Use of this tool has opened many new lines of investigation, and it is not improbable that it may in the future rank with the X-ray machine as a means to biological ends.

Lethal and Sublethal Effects

Exposure to the electrostatic field is highly lethal to all forms of life, it being possible to kill animals of any size providing a sufficiently high current output is used. Death seems to be caused by the generation of an internal heat of a degree incompatible with life. There is an individual variation in the time required to kill animals of the same species and this variation can be plotted as a lethal curve, the nature of which is very like the so-called "life curve."

Strong sublethal dosages often prove very injurious to animal tissue and may lead to loss of limbs and ears. Dosages of sufficient strength seem to raise the temperature of various parts of the body enough to cause blistering and stiffening of the muscles. Salamanders exposed for short periods later lose parts of their tails, one or more legs and the skin of the body. It is believed that a thorough investigation of sublethal effects in animals will reveal many interesting fields in experimental physiology.

Effects on Growth of Seedlings

Exposures of from 5 minutes to 1 hour were highly lethal to the seeds of Golden Bantam corn. In these experiments the degree of internal heat, brought about by exposure, was relatively high and was probably the sole cause of the effect.

Seeds which were exposed for 1 minute were slightly retarded in growth. The internal heat generated in this case was very low, but may have been sufficient to cause the effect.

When exposed for from 30 to 40 seconds, the growth of the seedlings was accelerated in the early germination period. In this instance the internal heat of the seeds during exposure appeared to be negligible and heat is not believed to have been instrumental in the cause of the acceleration. It is possible that the displacement disturbance brought about by exposure to the electrostatic field, may, in very mild dosages, upset the

normal equilibrium of the cell. This disturbance, penetrating as it probably does to the atomic ions, may carry with it a release of energy which brings about a new and favorable rearrangement of the equilibria governing the activity of the cell.

Heating Effects

Week-old rats killed by the electrostatic field and by the external heat of an oven did not give the same macroscopical picture after death unless a very high degree of external heat was used. A very characteristic rush of blood to the appendages of rats killed by high frequencies was not duplicated in those rats killed in an oven until the temperature of the latter reached 160° C. In both cases body regulation was able to keep the abdominal and rectal temperatures below 46° C., and for this reason the rectal thermometer is distrusted as a means of determining the actual heat to which the animal may be subjected when exposed to the electrostatic field.

Duplication of high frequency effects with heat of high degree does not necessarily show that the two types of exposure are identical, but it is probable that the only difference in severe dosages is in the position of the heat, it being in the former case entirely internal and in the second external. Internal heat generated in the body during exposure to the electrostatic field is in all probability a manifestation of a severe displacement disturbance.

Action on Nervous Tissue

Holometabolous insects when exposed to the electrostratic field showed a very marked difference in time required to kill the adult and the larva. *Tenebrio molitor,* a beetle, in the adult stage was killed in 1 minute, 19 seconds, while it took 7 minutes, 38 seconds to kill the larva. Since there is a very marked difference between the nervous organization of the adult and the larva in holometabolous insects, the difference in lethal time is taken as an indication that high frequencies have a differential action on nervous tissue.

Hemimetabolous insects when exposed did not show any marked difference in lethal time between adult and nymph, the adult being killed in 2 minutes, 1 second, and the nymph in 2 minutes, 15 seconds. (*Melanoplus femur-rubrum,* a grasshopper.) Here there is no marked difference in the nervous organization of the two and this is taken as a further indication of a possible high frequency differential action on nervous tissue.

An attempt to expose isolated nervous tissue from the frog, sciatic nerve with muscle attached, failed to give conclusive results although there appeared to be a change in the conductivity of the tissue.

Exposure of the whole of the vertebral column of the frog resulted in all cases in an immediate and strong response, the effect being observed on the hind legs. After exposure the nerves of the sciatic plexus failed to conduct faradic stimulus from an induction coil. These experiments were repeated with external heat as the agent and the characteristic reaction of leg muscles as observed for high frequency dosage, failed to take place.

The possible nervous reaction of the electrostatic field seems to be again indicated in the case of the frog, especially since the same reaction could not be duplicated with external heat.

It is evident here that high frequency and heat are by no means synonymous, and that although the electrostatic field carries with it potentialities for internal heat as a by-product, there is at the same time another and little understood reaction—a reaction depending, perhaps, upon the destruction of delicate cell balances by ionic displacements, or, as is more likely, upon the differences in absorption between the various tissues of the body.

A MECHANISTIC PHANTASY

By Robert T. Hance

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Seated one day at the microscope with a beautifully fixed complex of chromosomes beneath the lens my vision became slowly blurred with the strain of a long session. The chromosomes seemed to come to life and to assume new individuality as they rearranged themselves around the mitotic spindle. The spindle became a table and the chromosomes became men. The cell outlines framed this picture as the walls of a stately room. On these walls I could faintly see a calendar on the year line of which seemed to be the number 2000. My detached senses were alert for here were things never before seen in cytology.

The man at the head of the table arose and began to talk. "Gentlemen, the International Council of Investigation called this group of specialists together a year ago to consider the unification of our present day knowledge concerning the mechanics of living matter. It was pointed out at that time that no one individual could possibly be sufficiently versed in the many sciences that touch vital function to be able to add up the various contributions and achieve the correct total. The mobilization of the scientific brains of the country during the Great War produced results that made man afraid of his power and it is hoped that the present union may gather together the loose ends of many excellent researches and in the end give us greater control of our own lives. Infectious disease has long gone the way of the dodo but there still remain many organic abnormalities and the field of genetic as well as personality control remains but little worked. Senility and death are still with us although people are living longer and more actively. We should by this time have information at our disposal that might remove death from the realm of normal biological happenings and make it as pathological as pneumonia. When all this has been accomplished we may be able to actually create vital forces although this is of relatively little importance beyond the culminating proof of our theories. Let us now hear of the status of morphological investigations from the Chairmen of the Committee that has been reviewing that field."

"The Committee on Morphology begs to report that the line between morphology as such and physiology has practically disappeared. Today the studies of the morphologist are so closely linked with function that the old classification breaks down. There seems to be every hope that we can eventually control growth and every body function through the application of our knowledge of the endocrines. Furthermore, there has been great progress in the synthesis of these secretory substances which will enable us to carry on this work with much more certainty because of the purity of the products. It has already been possible to control the size of animal, both in height and weight; to regulate most of their physiological activities with the consequent lengthening of their lives. The rate of metabolism is now under excellent control and may be increased or decreased at will either locally or for the entire body. This discovery may enable us to solve the cancer problem since these growths are living at a faster rate than the surrounding tissues.

"The lack of regeneration in highly specialized forms has been overcome through the utilization of growth regulating substances which seem to cause a dedifferentiation of the local tissue which then in turn produces the last part. This is but the working out of the old idea that all the potentialities for a complete organism must be present in each cell nucleus since the entire chromosome complex remains intact as in the germ cells. The inhibitions imposed on these by the cytoplasm can now be removed with the remarkable results described.

"The Committee on Problem of Growth will now report.

"While this Committee covers much the same problems as the one on morphology it has limited its field of cooperative research to Genetics, Cytology and Embryology. While chromosome counting and the genetic analysis of superficial characters is still going on and is still producing much of general interest, the emphasis of the fields has been shifted to the more basic phenomena that lie behind these former interests. This has of course brought embryology to the front since only here could we expect to get an understanding of how the final adult traits unfolded or developed. With our present knowledge we can now guide development in almost any desired direction and even change at will any trait to match any specification. Sex may be determined through taking advantage of the metabolic differences between the two classes of gametes —and through subjecting these gametes to chemical action that automatically eliminates one of the classes.

"Since individuality is a function of genetics and of development we wish to point out that we can now control to a remarkable degree the physical and even the mental attributes of man through diet or through the application of appropriate endocrine products. We expect that the day may come when we shall be able to replace the deficiencies of an inadequate or poor biological inheritance.

"Great progress has been made in the identification of vital with supposedly non-vital entities with the result that we are now confident of the entire equivalence of the physical elements of protoplasm with those of ordinary chemical systems. This has and will continue to contribute to our ability to bring about the changes we desire in living things since they have now no definitely been lined up with the non-living. Since this seems now to be a fact, the opportunities for research along these lines are unlimited."

The Committee of Physiology.

"Physiology has become almost wholly a matter of chemistry and physics since the other fields have of necessity so largely usurped the familiar old stamping ground of this specialty. Physiologists through the utilization of the many new physical forces have learned much of the mechanics of living phenomena. Under certain conditions they are now able to bring back to life animals that had recently died. They have demonstrated that senility is a function of cellular permeability, or in other words, the body gradually becomes unable to cast off its waste products and these slowly poison the system by lowering the hydrogen-ion concentration below normality. Through the use of ultra-violet and

X-rays it has been possible to increase the permeability under certain conditions and to raise the pH. This may eventually be accomplished by diet or chemically as a wide variety of substances are known that effect these properties of the cell. A considerable degree of rejuvenation has followed these treatments and the committee hopes that the investigations of the next few years may go a long way to lengthening the limits of life as we now know them.

"The production of perfect nutrient solutions has enabled our embryologists to rear mammalian embryos artificially and outside of the body of the mother. This triumph coupled with the geneticists' ability to alter or produce characters to order, so to speak, may greatly affect the future methods of reproduction, if indeed reproduction does not become unnecessary through the indefinite prolongation of the lives of the present generation."

As the representative of the physiologists sat down, the general chairman rose. "Thank you, gentlemen, for the very interesting summaries you have presented. From your reports it is becoming evident that we are indeed becoming 'captains of our souls' as well as masters of our lives. Perhaps we may sum up the remarks of each committee in the following words written by Riddle years ago and which were then more of a prophecy than a statement of actual accomplishment of that day.

"Developmental mechanics—recruited from parts of endocrinology and genetics, and supplied with ever new and incisive munitions from biochemistry, biophysics, immunology, and their kindred—already conquers and bends some of their major processes of living and of becoming (development). Its province is the field of living matter where, naturally, every new grouping of atoms brings with it new properties, and where every new molecular property proves a changed environment leading to or involved in the next step in advance. It is concerned with the mechanics of the building of body and mind; and having served a glamorous apprenticeship in the animal world, it is rapidly preparing to cope with some aspects of human development. Its revelations concerning the living stuff—rather technical and abstruse—are destined to color the thought of leadership; its prospective applications to human structure and capacity—very clear and obtrusive—seem destined to catch the imagination and recast the thought and purpose of coming generations of man.

"With the ability of the chemist now to synthesize proteins the worst stumbling block to our complete knowledge of life has disappeared. In-

deed I have a surprise that I have been withholding from you. But a few days ago in my laboratory a student in subjecting a synthetic protein to a new electrical field succeeded in getting it to . . . ."

The voice died away and I saw again the cytological preparation I had under the microscope. The chromosomes were gone and evidently my hand had moved the stage. I found the proper location once more and there were the same set of chromosomes. Chromosomes they were and nothing else. I wondered what had happened during my lapse from the state of conscious observation. I could not recall—can you? Perhaps it was but a mechanistic phantasy.

THE AMBYSTOMID SALAMANDER OF PENNSYLVANIA

By Charles E. Mohr
Bucknell University

Four Ambystomids have been found in Pennsylvania—*Ambystomid tigrinum, opacum, jeffersonianum,* and *maculatum*. The first two are exceedingly rare; the latter two, common.

Observations have been made in the neighborhood of Lewisburg for several years, but a rather abrupt, early warm period this year permitted the migration and breeding of the latter two to be observed more closely than usual. The study was made chiefly at Old Gap, at the beginning of the Fourteen-mile Narrows, at an altitude of about 1200 feet; at Voneida State Forest Park (Hairy John's), in the Seven-mile Narrows, five miles east of Woodward, at an altitude of 1600 feet; and at Woodward, which is half way between Lewisburg and State College, at an altitude of about 1400 feet. The trips were made almost entirely at night and observations were made by flashlight.

Attempts to record temperatures showed that there was no correlation between points as close together as two miles, and that the only records that would be worth while must be taken daily at the ponds. We had access to the hourly weather reports made at the air-mail weather stations at Winklebleck and Sunbury.

Ambystoma tigrinum (Green):

Professor E. R. Dunn, of Haverford College, supplied the following records of this rare salamander: one adult and two larvae collected at Carlisle by Baird, and now in the National Museum; an adult from Londonville, Chester County, now in the American Museum of Natural History, and a larva in the same museum from Pittsburgh. He also has a record of an adult from Mountainville, Lehigh County.

Ambystoma tigrinum is widely distributed in North America and shows wide color variation. Dunn, who has been working on the Ambystomids, believes that *tigrinum* will split into ten races. The eastern forms seem very closely related, however.

Ruthven says, "This species usually spends most of the year under logs, in decaying stumps and in holes or burrows made by other animals; however, it has been known to remain in the water during the summer. It is voracious and carnivorous; it has been observed to eat worms, insects, and small frogs."

About ten adults have been taken on Long Island, but the only records of egg-laying which we have are from the central states. At Chicago the eggs were collected from February 25 to March 15 this year, although the season was about three weeks earlier than usual.

The courtship of the axolotyl—the permanent larval form—has been closely observed in Europe. Breeding, of course, is in the water—the male depositing spermatophores, which, when taken into the cloaca by the female, fertilize the eggs. The egg masses, according to Smith, appear as an intermediate stage between those of *Ambystoma maculatum* and *jeffersonianum*. The number of eggs in a cluster varies from 25 to 50, but averages 30. Smith records two egg clusters of 53 and 75 eggs. The masses are attached to the leaves or stems of water plants, resembling those of *Ambystoma jeffersonianum* in this respect.

Ruthven says, "Larvae emerge in about 14 days. Transformation usually takes place in about 3 months, but may be delayed by unfavorable conditions; total length of adult—182 mm."

Ambystoma opacum (Gravenhorst):

Surface records seven specimens, taken in Chester, Franklin, and Perry counties. Three specimens collected at Carlisle are in the National Museum. There are no further records from Pennsylvania, although this salamander is reported from 23 States, Central, Eastern, and Southern.

As reported a year ago, the larvae of *Ambystoma opacum* may be found in Union County, at Old Gap. A larva was taken this spring at Hairy John's. Observations made during the last year, together with records from other localities make the life history fairly complete.

The marbled salamander is entirely fossorial and breeds in the fall. Fertilization is internal and takes place on land. The eggs are laid in hollows on the ground, or under logs, bark, or rubbish, where they are flooded during the fall or early winter. The mother remains with the eggs, lying on top of them. The eggs are about 5 mm. in diameter and are always laid separately. They have a tough outer envelope to which

débris adheres. Batches of eggs recorded have numbered 73, 102, and 108.

The new-born larvae have balancers and forelimbs, and are about 15 mm. in length. The larvae are darkly pigmented, except on each side of the mid-ventral line where there is a conspicuous row of small rounded or oval light areas which appear silvery as the larva grows. They transform in June.

The dry site of the pond, where larvae have been found, was carefully searched September 15 without discovering any eggs or adults. On November 10 the pond was full of water and the larvae had apparently all hatched as no egg capsules could be found. Eggs found at White Plains, New York, on September 25, 1916, hatched three days later. They will not hatch unless covered with water, some having been kept 54 days before putting them in water, after which they hatched within twenty-four hours.

Larvae kept in the laboratory had transformed by June 10; those out of doors were just beginning to metamorphose on June 11.

Ambystoma jeffersonianum (Green):

Specimens have been recorded from only twelve counties although they have doubtless been found in twice that many. *Ambystoma jeffersonianum* is reported from four Canadian provinces and twelve States in this country. This species is rarely seen except during the breeding season when it may be found migrating to the ponds at night or hiding in logs or under stones during the day. The migration was studied closely this year; many salamanders were observed and many taken.

The first eggs were taken this year at Old Gap, on March 16, and were then about two days old. March 16 was the first warm day of the month, accordingly the eggs had been laid when the temperature was still quite low. More than 50 per cent. of these eggs did not develop, but the clusters deposited during the following ten days were almost 100 per cent. fertile. Practically all the observations, however, were made at Hairy John's (Voneida State Park) and at Woodward, where the season was several days later.

On March 16 there were a few clusters of recently laid eggs at Hairy John's. Adults were fairly numerous. In one spot of the pond seven adults were observed lying on the bottom within an area of three by five feet. They were not active. At Woodward ten adults were seen. A single cluster of eggs was found.

On March 17 there were showers and the first *Ambystoma maculatum* were seen at Hairy John's. Both species were active there. At Woodward a single spotted salamander was seen emerging from the base of a stump. Here, however, 200 Jefferson's salamanders were seen and 26 collected.

On this night there was great activity, probably many more than 200 specimens being in the pond. The ripples caused by the raindrops interfered somewhat with the observations.

Everywhere, within three or four feet of the shore, Jefferson's salamanders were rising to the top, taking a bubble of air, after the fashion of the spotted salamander. Close to shore the salamanders seemed to be congregating.

A closer scrutiny showed that a number of salamanders were embracing each other. Seven pairs were observed and five of these taken without separating them. In every case a male was grasping the female, the former being on top and grasping the female tightly just behind the forelimbs. In several cases the male was noticed to rub the top and side of the female's head with his snout. Also several of the males were undulating their tails.

Other salamanders, collected without reference to sex, paired off when put in a large aquarium in the laboratory late the same night. Four such pairs were noted and segregated. Seven females deposited eggs in the laboratory, although development in none passed the blastopore stage.

As mentioned below, three females were observed at Woodward in the process of egg-laying. There were no males nearby. No eggs were seen and none were laid up till midnight.

On March 18 there were heavy rains. About 100 adults were seen and three clusters of eggs found.

On March 20 many eggs were found, both at Hairy John's and at Woodward. Three females were observed in the process of egg-laying.

On March 24 there were freshly laid eggs. At Woodward about 15 adults were observed; five in shallow water at the very edge of the pool, apparently ready to leave the pond. At Hairy John's half a dozen adults—all males, were in the same area in which they had been gathered eight nights before. Again there was no activity nor were there any eggs nearby.

On March 25 there were heavy rains which turned to snow. Not a single specimen was seen although *Ambystoma maculatum* were rather numerous.

On April 12 the first larvae had hatched at Old Gap.

We summarize the following points:

Sixty-two specimens of *Ambystoma jeffersonianum* were taken, 40 males and 22 females. The sexual dimorphism was marked in most cases, the best distinguishing marks being the greater body length of the females, their more rounded heads and tails, and their less prominent cloacal swellings. Our largest specimen measured 184 mm.

A well-formed spermatophore was found in the cloaca of an adult male. This was before any spermatophores of *Ambystoma maculatum* had been deposited.

There was no correlation between the amount of bluish-silver spots and either size or sex. In most cases the spotting was very pronounced.

The beginning of the spawning season may vary as much as four days in areas 20 miles apart, and egg-laying may continue for a period of ten days in a single locality.

The larvae hatch about four weeks after the deposition of the eggs. This may be lessened by continued warm weather. The larvae transform late in June.

A large percentage of the eggs do not develop when deposited in very cold water, very likely due to a pathological condition of polyspermary as Piersol suggests. However, most of the egg-masses were deposited during milder weather, and, contrary to popular belief, not more than five per cent of these eggs failed to produce larvae. Slight freezing does not injure the developing eggs.

Ambystoma maculatum (Shaw):

This is the best known and most widely distributed member of the family. Specimens have been recorded from about half the counties of the State.

The studies of *Ambystoma jeffersonianum* gave opportunity for close observations of this species.

On March 17 the first specimens of *Ambystoma maculatum* were seen at Hairy John's. They were numerous there, both males and females being seen and taken. There were showers.

On March 18 there was heavy rain. The first spermatophores were found, at Hairy John's. There was great activity. One gathering of forty adults was observed.

On March 24 the first eggs were seen, some apparently a day old. Three gatherings of 30 to 50 males were noticed. They were depositing spermatophores. Three large females were taken in the act of spawning.

Our observations may be summarized:

We established the fact that one female lays either clear or opaque egg masses, but not both as was suggested previously. Twelve individuals deposited eggs in the laboratory. Nine of these masses were opaque, three clear. The difference is probably due to the chemical conditions of the oviduct since the gelatine is clear or opaque as it is deposited. Both masses develop at the same rate and both produce living larvae.

The largest specimen, a female, measured 217 mm.

Our observations bore out Blanchard's report that moisture is of primary importance, temperature secondary, in the beginning of the migration of the spotted salamander.

The duration of the spawning season may be affected by the distance of migration, which Bishop believes may take two or three nights, and which would be influenced by the weather, and by the degree of exposure of the woods and hillsides to the sun, as Piersol believes.

Females were found the first day, indicating that the migration stimulus is the same for the two sexes. Blanchard believes that the females migrate more slowly. However, proximity to the ponds would discount such slowness.

THE DISTRIBUTION AND HABITAT PREFERENCE OF THE URODELE AMPHIBIAN *TRITURUS VIRIDESCENS*, AT PRESQUE ISLE, ERIE, PENNSYLVANIA

By H. B. Hudson

The peninsula of Presque Isle at Erie, Pennsylvania, is a very interesting locality having an undisturbed flora and fauna in rather definite associations. The problem undertaken by the author has been the determination of the particular habitat preference and the distribution of the urodele amphibian *Triturus viridescens*. The author wishes to thank Dr. H. H. Collins for his guidance and criticism of the work; also to thank Dr. O. E. Jennings for assistance in permitting use of maps of Presque Isle.

It may be of interest to begin the study by giving an idea of the formation of Presque Isle. It is believed by investigators that the peninsula has been formed by four factors. (1) A littoral spit-forming current deviating from the surf-line; (2) Conflicting currents tending to turn the spit inward, thus forming a recurved spit or hook; (3) The ridge-forming surf of great storms from north and east; (4) The soil-accumulating and soil-binding effect of the vegetation, aided by the drift-

ing power of the wind. The prevailing westerly wind tends to cause a constant movement of the beach-débris towards the east, both in the littoral current, and on the beach higher up. The most powerful agent in the distribution of the beach-débris after it has reached the tip of the spit is to be found in the surf of great northeast storms which pile the sand up in the form of beach bars or ridges beyond the reach of the ordinary surf. As the ridges form parallel to the waves producing them, several very prominent ridges traverse the central part of the peninsula longitudinally. Lagoons are formed between the ridges. The lagoons are surrounded by a *Potamogeton* area and a considerable growth of *Chara*. The peninsula in brief is composed of the following parts: (1) The western third consisting of the area from the mainland out to the Big Chimney Pond, an area which is very narrow, varying from one-eighth to one-half mile wide, two and one-half miles long; (2) the middle third extending from the Big Chimney Pond to the light house is from one-half to one mile in width and a mile and a half in length, constituting the wildest part of the peninsula as well as the most productive area of both animal and plant associations; (3) the outer third of the peninsula extends from the light house to the tip of the peninsula, which ends in a hook directed to the south. This area is about a mile and a quarter long and about one-half to one-eighth of a mile wide. Associations on this part of the peninsula are relatively scarce. Lone Ridge extends to the east of the light house for two miles, then swerves to the south rather brokenly. The area located south of Long Ridge between Big Chimney Pond and the light house is split up into several lagoons, the largest of which is Long Pond. Animal and vegetable decay have formed a black muck at the bottom of Cranberry Pond. This leads one to think that it is a very old pond.

The problem was begun by dividing the peninsula as described. A thorough investigation of each area disclosed the fact that *Triturus viridescens* occurs in a rather restricted portion of the peninsula, namely, the central portion near the lagoons. Following is a comprehensive set of data for the central area.

A. Long Pond.
  (1) Plant associations.
    a. Cattail and marsh grass area.
    b. Polygonum.
    c. Chara.
    d. Elodea and Myriophyllum.
    e. Pickerel weed (Pontederia).

  (2) Animal associations.
    a. Protozoa.
      Amoeba, rotifers.
    b. Coelenterates.
      Hydra.
    c. Porifera.
      Spongilla found attached to stem.
    d. Arthropoda.
      Insecta.
        Ranatra Americana (Water Scorpion).
        Dytiscid beetles and larvae.
        Backswimmers (Notonecta).
        Belostoma. Lesser water bug.
        Benacus. Giant water bug.
    e. Chordata.
      1. Small fish such as minnows.
      2. Amphibia.
        Frogs, *Rana pipiens, R. clamitans.*
        Salamanders, *Triturus viridescens.*
  (3) pH determination.
    Readings taken at various places in pond:
      a. North shore.
        7.03, 7.03, 6.9, 7.01.
      b. East shore.
        6.5, 7.3, 6.8, 6.7.

Note: Triturus found mostly in neutral media.

  (4) Location of *Triturus viridescens.*
    Triturus was found only on the northern shore near the eastern extremity. There was observed an unusual area of Chara, Potamogeton, and Polygonum and numerous small crustaceans.

B. Cranberry Pond.
  (1) Plant associations.
    a. Chara, Myriophyllum, Polygonum, Elodea.
  (2) Animal associations.
    a. Gammarus, Belostoma, Dytiscids, Odonata, Corixidae, Gerridae, Water weevil (Rhynchophora).
  (3) pH determinations.
    7.2, 7.1, 6.9, 6.8. East shore.
    7.0, 7.0, 7.2, 6.9. North shore.
  (4) Location of *Triturus viridescens.*
    Triturus was found only on the northern shore, associated with the Chara and some of the fresh-water algae. The pH in which it was found was approximately 7.

C. Dead Pond.
  (1) Plant associations.
    Same as in Long Pond with an excess or a predominating amount of Chara.

(2) Animal associations.
Same forms as Long Pond. Many Cladocerans.

(3) pH.
6.9, 7.0, 6.9. North shore.
6.7, 6.8, 6.9. South shore.

(4) Triturus found:
On the northern shore. pH 7, under leaves in shallow water. Fairly abundant.

D. Ridge Pond.

(1) Plant associations.
a. Buttonbush and cattail border very prominent.
b. Forms mentioned in Long Pond also here.

Note: (2) Data on animal forms and pH readings closely parallel Long Pond. Triturus not so abundant here. Possibly due to high water.

E. Land area between Long Pond and Cranberry Pond.

This area has two rather high ridges with several low intervening hollows. *Triturus viridescens* was found only in the low lying areas under small sticks and bark. The floor consists of a rather damp sandy and leafy mass. The forms were the characteristic orange color. The smaller forms seem to be located close to the lagoons while the larger forms were farther inland.

Summary:

(1) Triturus prefers relatively old ponds.

(2) Triturus is found close to lagoon shore in shallow water associated with Chara.

(3) They prefer a neutral medium.

(4) They seem to prefer the north shore possibly because their food supply would be blown there by the prevailing westerlys.

(5) The land forms vary in size, the smaller ones being closer to the lagoons.

(6) The land forms vary in coloration as well as in size. It was observed that the smaller specimens were lighter in color. The ones found further inland were larger and tended to become darker in color.

INTENSIVE BIRD STUDY OF A SMALL AREA

By Maynard B. Henry
Bucknell University, Lewisburg, Pa.

The following report is the result of an attempt to show the species of birds which may be found by intensive study in a limited area. The area studied was the Montandon Marsh, a marshy woodlot at the junction of the Lewisburg branch of the Pennsylvania Railroad and the old canal, one mile east of the Bucknell campus. It contains within its narrow limits of a quarter by an eighth of a mile all types of environment from bushy woodland to the distinctly marshy. The river at one time ran through the fields to the right of the marsh, parallel to the present course. This probably accounts for the swampy condition of the land. About 35 years ago when the old canal was in use the swamp was filled with water. Then the ponds were large enough to permit the use of boats. When the canal went out of use the swamp was drained and an attempt was made to farm it. The trees were cut and the land cleared. The ground, however, was too soggy and it soon fell back into an unused state. In this abandoned land in the last five years over 120 species of birds have been found, the records being made from January to June.

Despite the dwindling amount of water and aquatic life, many of our rarer water birds are still found. The nest of the Black-Crowned Night Heron may be found along the banks, or the Great Blue and Little Green Heron, and the American Bittern flushed up from among the cattails. The Horned and Pied Billed Grebes, American Coot, Pintail and Wood Ducks, and others are transient visitors in the migratory period. The old homing instinct persists and the birds come back to the same spot year after year, though the cultivated fields and the railroad may encroach on their nesting grounds and change it.

In the drier sections of the marsh the conditions for birds have decidedly improved in the last few years, especially for the smaller birds. The brush which now covers much of it offers an ideal hiding place for the shier species. In the migration period the trees and bushes are filled with the birds. The protection offered by the thickets is well shown by the abundance of the smaller species, as shown by the records of ten types of sparrows, seventeen of warblers, four of vireos. The larger trees also offer shelter to the hawks, five species being recorded.

Some of the more interesting visitors are the Pileated Woodpecker, found as an occasional visitor, and also the Woodcock, Northern Shrike, Northern and Louisiana Water Thrushes, Palm, Parula, Worm-Eating, Wilson's, and Hooded Warblers.

The above is merely a summary of the results of a study, but we are anxious to exchange average migration dates with other observers in the State, and if any of the readers have such records we would like very much to get in touch with you.

ECOLOGICAL OBSERVATIONS UPON THE FLORA OF WADING RIVER, LONG ISLAND, NEW YORK

By LeRoy K. Henry

Acknowledgment

The specimens collected for this study are now located in the Carnegie Museum Herbarium, where the identifications and preparation for this work were made under the supervision of Dr. O. E. Jennings, to whom the writer wishes to take this opportunity to express his sincere appreciation and thanks.

Introduction

Wading River is in the north-central part of Suffolk County, Long Island, New York. During the summers of 1928 and 1929, collections of plants and notes upon their distribution were made. There are three outstanding plant communities in this region: the **pine-barrens,** the **deciduous forest,** and the **fresh-water lakes.** This is of interest because the climate of the whole region is identical and all three types of vegetation lie within a radius of 2½–3 miles. The purpose of this study is twofold: to show that edaphic factors control the environment and to give an idea of the types of plants that are characteristic of each habitat.

Topographic and Geologic Features

This section of the country is of fairly regular topography with several points rising to an elevation of 190 to 200 feet above sea-level. Long Island, a part of the glaciated Atlantic Coastal Plain, is 118 miles long by 12 to 23 miles wide, with an outline suggesting the shape of a large fish. The core of the island is composed of Cretaceous deposits which come to the surface at a few places, such as the bluffs along the north shore. Following this period, erosion took place, and a number of emergences and submergences occurred. The Pleistocene epoch was a time of glacial and interglacial periods. There were three main glacial stages with their respective deposits: the Manetto, the Manhasset, and the Wisconsin stages. The Wisconsin ice sheet was not vigorous in its erosion, often merely riding over the Manhasset formation. The Ronkonkoma moraine, extending across the center of the island and out the south fluke, was formed by the first advance of the Wisconsin ice sheet; the Harbor Hill moraine, extending along the north shore and out the north fluke, was a result of the second advance of this glacier. Each moraine has its outwash plain lying to the southward, the northern margins of which often contain kettle valleys of pre-Pleistocene formation.[1]

Physiographic and Edaphic Features

The particular region around which this work centers is a kettle-hole lake, Deep Pond, which lies about 2¼ miles in a bee-line from the north shore of the island and about one mile southeast of Wading River railroad station. In the southern sections are many kettle valleys of which Long Pond represents an irregular kettle valley system, partly closed; while Deep Pond represents a branching kettle valley system, completely closed.[1] The northern section is crossed by the Harbor Hill moraine of the Wisconsin glacial stage, whose outwash plain covers the section to the south. The whole region is underlain by the Manhasset formation and is covered with more or less of the glacial Wisconsin drift.[2]

The soil of Suffolk County is very sandy, although not inherently unproductive. The natural vegetation is shrubby, due to the frequency of forest fires. The greater part of the island is made up of unconsolidated clay, loam, sand, gravel, and boulders. The oldest of these are the clays which belong to the Cretaceous period. Just above these clays are beds of gravel, sand, and loam which may or may not belong to the Pleistocene age. On top of these beds are various sands, gravels, and loams which have been deposited by the glacier. On the outwash plains, composed chiefly of Norfolk sand and Norfolk coarse sandy loam, the soil and subsoil together are less than 36 inches deep. A layer of gravel separates the subsoil from the coarse gravels below. On the moraine, composed chiefly of Alton stony loam with interspersed areas of Miami sandy loam and Galveston sandy loam, the soil is without a gravel bed beneath and varies in depth from 3 to 40 feet. The different soil types are the chief controlling factors of the vegetation of the island, since the pine-barrens are confined to the shallow soil of the outwash plains and the deciduous forest is limited to the deeper soils of the terminal moraine.[3]

Climate of Long Island

Climatic conditions of Long Island itself are the nearest approach to a maritime climate in New York State. The values for the Setauket

[1] Fuller, Myron L. Geology of Long Island.
[2] Fuller, Myron L. Geologic Map of Long Island.
[3] U. S. Dep't. of Agriculture. Field Operations of the Bureau of Soils.

Meteorological Station indicate a midwinter temperature of nine degrees above the average of the State and a midsummer temperature of three degrees above that average. The ocean and the sound moderate the daily ranges of temperature on the island. Long Island's average precipitation for the year is 50 to 55 inches, the eastern part having its annual maximum during the winter.[4] According to data obtained from the U. S. Weather Reports,[5] Wading River region has an average growing season of 161 days, and the annual precipitation seems to occur in approximately seven-year cycles of excessive rainfall as shown by a plotted curve of the precipitation over a period of 27 consecutive years.

Vegetation

The vegetation of Wading River region may be divided into five communities.

The Pine-Barrens

The pine-barren, a typical association of the Coastal Plain flora, is located in the transition zone between the Southern Mesophytic Evergreen Forest Formation and the Northeastern Deciduous Forest Formation. Four layers of vegetation make up this pine-barren forest: (a) the trees, chiefly oaks, *Quercus velutina, coccinea, stellata,* and *alba,* with pitch pine, *Pinus rigida,* which is the dominant species; (b) the small trees and shrubs, dominated by the scrub oaks, *Quercus ilicifolia* and *prinoides,* with scattered specimens of sassafras, *Sassafras variifolium;* shag-bark hickory, *Carya ovata;* and wild black cherry, *Prunus serotina;* (c) the low shrubs and herbs, the great majority of which are blueberries and huckleberries, *Vaccinium vacillans* and *Gaylussacia baccata* respectively, together with the bracken fern, *Pteris aquilina;* (d) and the low and trailing herbs, such as the bearberry, *Arctostaphylos Uva-ursi,* wild pink bean, *Strophostyles umbellata,* and trailing arbutus, *Epigaea repens.* Where this habitat borders upon the lakes, the presence of broad-leaved trees is very noticeable, especially the maple, *Acer rubrum;* the aspens, *Populus tremuloides* and *grandidentata;* and the white birch, *Betula populifolia.*

The first year after a forest fire, the area is occupied by dwarf sumac, *Rhus copallina;* bracken, *Pteris aquilina;* and fireweed, *Epilobium angustifolium.* In two or three years, the same area will be dominated by the black scrub-oak, *Quercus ilicifolia;* and scrub-chestnut oak, *Quercus prinoides,* with scattered species of young oaks belonging to the species

[4] Henry, A. J. Climatology of the United States.

[5] U. S. Weather Bureau. Annual Report of Chief of the Weather Bureau, 1901–1927.

already mentioned. This stage in succession passes into the oak coppice, dominated by *Quercus velutina, coccinea, stellata,* and *alba;* and finally into the mixed pine-oak associes.

The Ponds and Bog

The ponds of Wading River region present various stages of plant succession. Deep Pond is probably the youngest of the three large ponds, as indicated by three indistinct zones of vegetation around its shores. No one species seems to be dominant, although several aspects are prominent, such as the rose tickweed, *Coreopsis rosea;* followed by the flat-topped goldenrod, *Euthamia tenuifolia;* and *Eupatorium hyssopifolium.* The shrubby zone along the bank is dominated by the buttonbush, *Cephalanthus occidentalis.* Next in age comes Long Pond, which has several distinct zones of vegetation surrounding it. Water lilies, *Castalia odorata;* and cattails, *Typha angustifolia,* grow at a distance of 40 to 50 feet from the shore. In the aquatic zone are bladderworts, *Utricularia cornuta* and *vulgaris;* and the pondweed, *Potamogeton Oakesianus.* The sundews, *Drosera rotundifolia, filiformis* and *longifolia;* and the yellow-eyed grass, *Xyris caroliniana,* are confined to the moist sandy zone at the edge of the water. Just behind this is a third zone dominated by sedges, rushes, and grasses—*Cyperus dentatus, Eleocharis melanocarpa, Rynchospora glomerata, Juncus articulatus* and *Panicum commosianum* and *virgatum* respectively. Several coves have been cut off from this pond and are now filled with water and bog species. Grass Pond, the oldest one, is almost filled with vegetation, and around the edges the soil is soggy upon which is growing Sphagnum moss, swamp azalea, *Azalea viscosum;* teaberry, *Gaultheria procumbens;* and stagger bush, *Lyonia mariana.* The remaining plant zones are similar to those of Long Pond. The vegetation zones around these lakes might be more defined, if it were not for the fact that they are kettle-hole lakes whose surfaces lie in the plane of the ground-water table and consequently rise and fall with the annual precipitation of the region.

The Deciduous Forest

This deciduous forest is confined to the loamy soil of the Harbor Hill moraine, where one notices the absence of pitch pine and the abundance of maples, elms, and beech trees. The vegetation of this forest may be roughly divided into three layers: (a) the trees, among which are the beech, *Fagus grandifolia;* the sugar maple, *Acer saccharum;* the silver maple, *Acer saccharinum;* black walnut, *Juglans nigra;* hickories; chestnut oak, *Quercus Prinus;* and other oaks already mentioned in the pine-

barrens; (b) the shrubs, of which the flowering dogwood, *Cornus florida;* and the elderberry, *Sambucus canadensis,* are the dominant species; (c) and the herbs, characterized by a great number of species common to all deciduous forests—agrimony, cinquefoil, avens, pokeberry, Joe Pye weed, etc. This forest has not yet reached the climax stage, but might be called the Beech-Oak-Maple Associates on account of the predominance of these three species.

The Beach

The north beach in Wading River region is rough and storm beaten, so that few plants are growing here. However, on the pebbly and sandy soil at the base of the cliff are scattered specimens of dusty miller, *Artemisia stellariana;* saltwort, *Salsola Kali;* the beach plum, *Prunus maritima;* and *Atriplex arenaria.* On the opposite side of the cliff or ridge that faces the north shore, grows the swamp rose mallow, *Hibiscus Moschuetos;* and *Juncus Greardi,* together with other species characteristic of salt marshes. On top of the cliff grow gnarled and twisted red cedars, *Juniperus virginiana;* and young oaks over which climbs the greenbrier, *Salix glauca.*

Roadsides and Abandoned Fields

The vegetation of the roadsides is a mixture of the introduced species and those that have migrated from the pine-barrens and the deciduous forest. In all probability, it represents a border line or ecotone between these two formations. Along the village road are many introduced trees, such as *Acer platanoides, Acer Pseudoplatanus;* buckeye, *Aesculus Hippocastanum;* sweet gum, *Liquidambar Styracifolia;* weeping willow, *Salix babylonica; Catalpa speciosa;* and white mulberry, *Morus alba.* In the fields that were once cultivated, the following weedy herbs have taken possession and become well established: English plantain, *Plantago lanceolata;* lamb's quarters, *Chenopodium album;* pigweed, *Amaranthus retroflexus;* and daisy fleabane, *Erigeron ramosus.* A great variety of perennial and annual weedy herbs grow along the grassy bank bordering the roads, among which are: dayflower, *Commelina communis;* spotted cowbane, *Cicuta maculata;* chicory, *Cichorium Intybus;* bouncing bet, *Saponaria officinalis;* butter and eggs, *Linaria vulgaris;* yarrow, *Achillea Millefolium;* sunflower, *Helianthus divaricatus;* wineberry, *Rubus phoenicolasius;* and many other species.

Summary

There is a tendency for the vegetation of the deciduous forest to invade the pine-barren region. Some are merely migrants which disappear after the first season, while others complete ecesis by germinating, growing, and reproducing themselves. Ecesis is the adjustment of the plant to a new home, and this is accomplished only when the plant is able to reproduce itself in that area. The roadsides and abandoned fields may serve as a stepping-stone in this process of migration. The vegetation of the ponds clearly indicates the advance of plant successions and the great work of plants in converting ponds into swamps and the latter into dry land. These pine-barrens seem to be an association of the deciduous forest held in check by edaphic factors, as shown by the ecesis of oaks and locusts after the former's destruction by fires.

FLORA OF THE KARTABO REGION, BRITISH GUIANA

By Edw. H. Graham

Carnegie Museum, Pittsburgh

Introduction

This paper is essentially an abstract and preliminary summary of the "Flora of the Kartabo Region, British Guiana," which is now undergoing completion at the Herbarium of the Carnegie Museum, Pittsburgh, Pennsylvania, under the direction of Dr. O. E. Jennings, to whom the writer wishes to express his most sincere appreciation for invaluable assistance and inspiration.

Kartabo is a settlement, now abandoned, at the confluence of the Mazaruni and Cuyuni Rivers in British Guiana, on the northeast coast of South America. The position of Kartabo is 58° 42′ West Longitude and 6° 23′ North Latitude, being just 400 miles north of the equator and 45 miles in a direct line south southwest from the Atlantic coast.

Botanical Collections from the Region

The region covered in the "Flora" is that within an approximate radius of 60 miles of Kartabo. The specimens upon which the "Flora" is based are those now in the Carnegie Museum. They are from collections made by and under the direction of Dr. H. A. Gleason of the New York Botanical Garden during the years 1922 to 1927 and by Edw. H. Graham during the summer of 1924. Ten localities are represented as follows: Bartica, 5 miles east of Kartabo; Wismar, on the Demerara River, 35 miles southeast of Kartabo; Malali, on the Demerara River, 55 miles south southeast of Kartabo; between the Demerara and Berbice Rivers, 60 miles southeast of Kartabo; and the Pomeroon River,

Pomeroon District, some 50 miles north of Kartabo. These five are localities of Gleason collections and the following five are those of Graham collections: Kartabo; Kalacoon, Hills Plantation, 3 miles down the Mazaruni River from Kartabo; Kyk-over-al, an island at the junction of the Mazaruni and Cuyuni Rivers; along Camaria road, Cuyuni River, 8 miles west of Kartabo; and Matope, Cuyuni River, 20 miles northwest of Kartabo.

Environmental Conditions

Records taken at His Majesty's Penal Settlement and at the Hills Plantation, respectively on the north and south shores of the Mazaruni River, 3 miles below Kartabo, give a knowledge of the meteorological conditions of the region. There are two wet and two dry seasons during the year, the dry seasons occupying 7 months of the twelve, but with no month of the year averaging less than 4.5 inches of rainfall. The average annual rainfall is 100.53 inches. The humidity is high with a yearly average of 84.2 per cent, and there is an average of 5.3 hours daily sunshine with dull, cloudy weather rarely experienced except when rain is falling. The average shade temperature is 79.2° F., although the average sun temperature exceeds 140° F. Trade winds blow prevailingly from the east, the heaviest rainfall coming with continental rains from the south or southwest.

The Kartabo region is in a zone of sand and clay, which zone lies between the low, flat, alluvial coastal strip on the north and the undulating plateau and mountain country to the south. The land varies in elevation from 15 to 200 feet and the soil, which is black mold, for the most part, lies only 6 inches to 2 feet thick over quartz sand or kaolin, which in turn rests on an underlying granite.

Vegetation of the Region

The area covered in the "Flora" is a tropical rain forest, characterized by many species and few individuals of each species. Great trees stand straight and scattered, their trunks branchless for many feet, and their tops forming a mass of foliage which partially excludes the sun from the scanty growth below. Hanging from the branches of the tall trees fall the roots of many epiphytes, among which some of the Bromeliads and Arums are of immense size. Lianas and vines are very common. Mosses and lichens are abundant on most of the leaves and twigs and while the smaller parasitic fungi are frequent, the larger fungi are not common. Herbs are not very often observed, although in the jungle clearings they are fairly numerous.

The vegetation of this tropical rain forest may be roughly divided into three zones: First, that of the forest or jungle itself; secondly, that of the jungle clearings; and thirdly, that part of the jungle which is exposed along the water ways, including the plants in the water along the shore.

In the jungle the commoner large trees, which sometimes reach a height of 200 feet, are the Mora, *Dimorphandra excelsa* (Benth.) Baill.; the Greenheart, *Nectandra rodiaei* Hook.; the Purpleheart, *Copaifera pubiflora* Benth.; the Crabwood, *Carapa guianensis* Aubl.; the Trysil, *Pentaclethra macroloba* (Willd.) Kuntz; the Etaballi, *Vochysia tetraphylla* DC.; Guana, *Cassia multijuga* Rich.; Wild Plum, *Spondias lutea* L.; Locust, *Hymenaea courbaril* L.; Duka, *Tapirira guianensis* Aubl.; and many others. While palms are not common, the following genera are known to occur: *Astrocaryum, Mauritia, Maximilliana* and *Euterpe.*

In the jungle clearings the commonest herbs are: *Sipanea pratensis* Aublet; *Valerianodes jamaicensis* Med.; and *Sida* of several species, with grasses and sedges of the genera *Andropogon, Panicum, Coix, Kyllinga, Cyperus* and *Scleria.* Trailing over bushes and low shrubs are *Mikania, Tabernaemontana,* and *Petraea.* Among the shrubs of the clearings are *Psidium, Icica, Vismia, Clusia, Pentaclethra* and many *Melastomaceae,* including *Bellucia grossularioides* (L.) Triana, locally called Messopra.

Along the rivers are found many vines which form a mass of growth from the tree tops to the water's surface, like an immense curtain which shuts from view anything of the jungle beyond the river's banks. These vines are the Allamanda, *Allamanda cathartica* L., with large yellow flowers; *Souroubea guianensis* Aubl; *Marcgravia cuyuniensis* Bailey; *Posoqueria latifolia* R. and S.; the Shooting star, *Posoqueria longiflora* Aubl,. with a corolla tube 15 inches long; and species of the genera *Cydista, Arrabidaea, Convolvulus,* and *Combretum.*

In the water along the shore there grows the Mangrove, *Rhizophora mangle* L.; the Ginger Lily, *Hedychium coronarium* Koenig; *Eleocharis geniculata* (L.) R. Brown; the Gentian, *Coutoubea spicata* Aubl.; the tall Arum, Mucka-Mucka, *Montrichardia arborescens* (L.) Schott; with species of *Xyris, Hippeastrum, Utricularia* and others.

Summary of Taxonomic Treatment

No attempt was made at an ecological study of the region other than that afforded by casual observation, the "Flora" being largely a taxonomic treatment of the vascular plants of the region, including lists of important synonyms, descriptive notes, specimen references, general distribution and noteworthy remarks. Complete keys to families, genera

and species are included, based as far as possible on workable field characters.

In the "Flora" the Pteridophyta are represented by 7 families, 17 genera, and 30 species. The families represented are: Hymenophyllaceae, Cyatheaceae, Polypodiaceae, Schizaeaceae, Salviniaceae, Lycopodiaceae, and Selaginellaceae.

The Monocotyledoneae are represented by 21 families, 52 genera and 65 species. The grasses and sedges are well shown, with 8 and 10 genera respectively, and interesting Monocot families are the Taccaceae, Rapateaceae, Haemodoraceae, Zingiberaceae, and Marantaceae.

Among the Dicotyledoneae there are 76 families, 224 genera and 300 species. The families represented by the most species are: Leguminosae with 38 species, Melastomaceae with 37, Rubiaceae with 28 and the Malpighiaceae and Compositae each with 14 species. Other families which are well represented are Piperaceae, Euphorbiaceae, Malvaceae, Myrtaceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Verbenaceae, Bignoniaceae, and Acanthaceae. The following interesting families are also represented: Proteaceae, Olacaceae, Monimiaceae, Connaraceae, Vochysiaceae, Bombaceae and Gesneriaceae.

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PRELIMINARY REPORT ON THE PHYTOPLANKTON AND POLLUTION IN PRESQUE ISLE BAY, LAKE ERIE

By Russell Y. Gottschall
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Acknowledgment

I wish to express my sincere gratitude to Dr. O. E. Jennings, Head of the Department of Botany, University of Pittsburgh, whose efforts have made this survey a success; also to Mr. Philip Hartman, superintendent of the Erie Fish Hatchery, whose assistance was invaluable, and to Mr. Dunwoodie, superintendent of the Erie Water Department, who gave us the use of the Department cruiser for collecting purposes.

Introduction

Fish are either directly or indirectly dependent upon the microplankton, the macroplankton and the bacteria for food material. The larger fish may live upon smaller fish and they in turn live either directly or indirectly upon the plankton and the bacteria. The larger fish may also also live directly upon the plankton.

It was therefore planned that the food supply be investigated since this is a matter of great importance in regard to fish life and population and that this phase be thoroughly investigated throughout the entire year.

Pollution also may have some effect upon fish. Noxious material discharged into the water may kill them outright. Bacteria may turn over the organic material and in this way lower the oxygen content and raise the carbon dioxide content and so make conditions unfavorable.

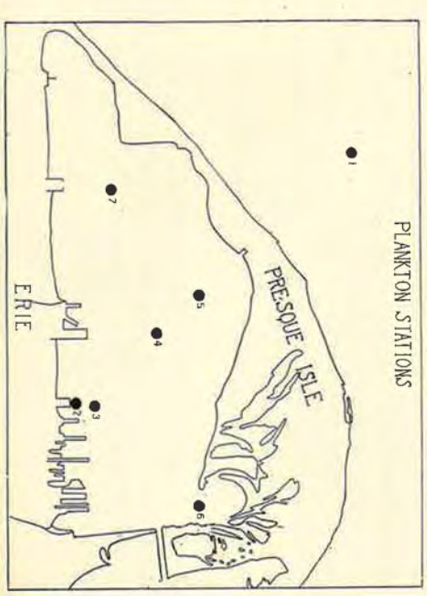
Until we know these conditions it is impossible to say just what causes the present low fish population in Lake Erie.

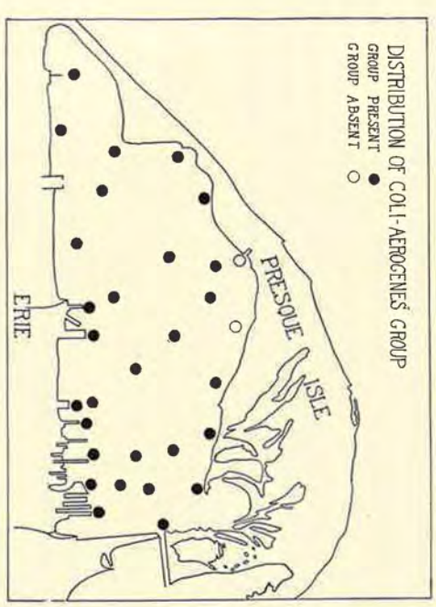
Men from the Federal, Ohio, New York, and Ontario Commissions cruised the deeper waters of Lake Erie during the summers of 1928–29. It was thought that conditions in Presque Isle Bay and nearby points would be of particular interest to the Pennsylvania Fish Commission so this work was taken up.

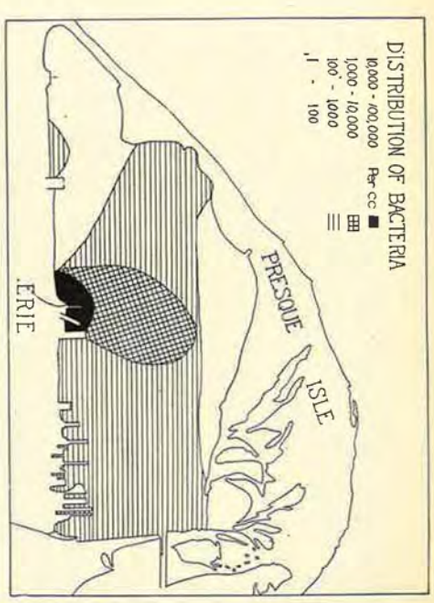
Mr. Herbert Graham started the investigation in February, 1929. He resigned in June to take up similar work on the Carnegie Institute magnetic ship, "Carnegie." The work was then taken up by myself under the direction of Dr. O. E. Jennings.

Methods

In order to obtain accurate results it was found necessary to have







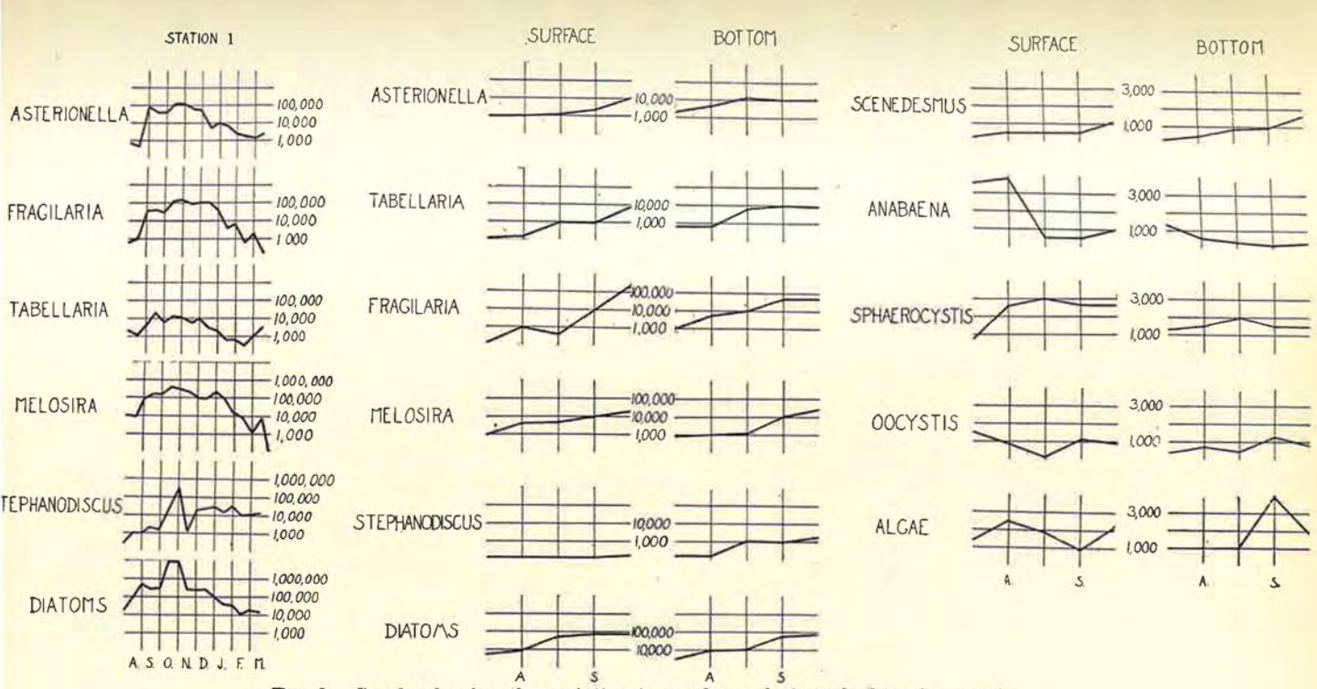


FIG. 3. Graphs showing the variation in numbers of phytoplankton by months.

showing the position of the water intake pipe for the city water supply were chosen. They are shown on the map by station numbers 3, 4 and 5. One station at each end of the bay was also chosen and one at the Fish Hatchery pier so as to get a general survey of the entire bay. The depth of station 2 is 2 meters; 3, 4.5 m.; 4, 7 m.; 5, 5 m.; 6, 5 m.; 7, 4.5 m. The intake pipe for the Erie water supply is about 3½ miles from the Fish Hatchery and about two miles from the shore of Presque Isle. It is 6 meters below the surface and 2 meters from the bottom of the lake.

These stations were plankton collecting stations. Here samples for determination of oxygen, pH values and carbon dioxide content were also taken. Temperatures of the water were taken on the regular trips. The determination of oxygen, pH values and carbon dioxide however was not made until the end of the summer and so not many results were obtained.

Collecting of Samples

Samples from the bay were regularly taken twice a week at the three stations, 3, 4, and 5. Samples from stations 6 and 7 were taken about once a week and from station 2 every other day. From the intake pipe also, samples were taken every other day.

Collecting was done by means of a weighted bottle lowered to the bottom of the bay. This method of collection was used exclusively during the summer of 1929. Samples were also taken in like manner six inches below the surface.

Samples from the intake pipe were taken throughout the entire year but only twice a week during the winter months. The samples were taken, preserved with formaldehyde, well packed so as to avoid as much breakage of the delicate organisms as possible and sent to the laboratory at Pittsburgh where they were examined. This gives an index as to the content of plankton throughout the entire year which is, although not an extensive survey, an invaluable one.

Laboratory Methods

The samples brought into the laboratory were filtered through sand by the Sedgwick-Rafter method.

Counting was done by means of a ½ cc. counting cell and a Whipple micrometer. Two ½ cc. portions per sample were examined and 20 counts made at random. The organisms were counted as to genera.

The number of organisms in one liter was calculated by means of the following formula:

$$\frac{\text{Capacity of counting cell in cubic millimeters}}{\text{Number of fields counted}} \times \frac{\text{cc in sample}}{\text{cc in water filtered}} \times 1000 = \text{Units per Liter}$$

The organisms were averaged for two week periods and graphs made of the more abundant genera.

The error by this method has been shown never to be greater than 10 per cent.

This method of concentration for study of the phytoplankton was used throughout the year.

The methods of chemical analysis used are those in Standard Methods of Water Analysis, except that a quinhydrone electrode was used to obtain the pH value instead of the methods as there presented.

Distribution of Genera

The genera at one station were practically always found in the other stations in approximately the same numbers, taken on two week averages. This is to be expected since the territory covered was only 4.5 square miles and the conditions were practically the same excepting depth.

A greater number of diatoms was found in the bottom samples than in the surface samples. The quantity of algae varied with the season both in surface and bottom samples.

Flagellatae

Dinobryon was found distributed over the entire bay and part of the Lake. On the bottom it decreased from July 15th to August 31st and then increased toward the end of the summer. On the surface it increased until the 15th of August, decreased until September 15 and then again increased toward the end of the summer.

Confervales

Cladophora glomerata was occasionally found in the samples. This species grows abundantly along the shores of the bay especially near the outlets of sewers.

Protococcales

Schendesmus increased steadily from the middle of July until the end of September. It was found at all stations over the entire bay. The bottom samples contained more of this genera than did the surface samples, the maximum concentration being 1,600 per liter.

Coleastrum, Polyedrium, Dictyosphaerium, Porphrydium, Botrycoccus, Rhaphidium, Selenastrum, Quadricula, and *Actinastrum* were found occasionally but they never reached a high concentration.

Characium, both attached and free floating forms, were found in great abundance during the summer.

Oocystis was present in some quantity. On the surface water it decreased steadily from July 15 to August 31st and then increased until the end of September. In the bottom waters it remained at about the same concentration from the middle of July to August 31st. It increased to 1,250 per liter and again decreased.

Pediastrum was at no time abundant. The highest concentration was 600 per liter. The bottom and surface samples showed very slight variation.

Sphaerocystis on the surface increased from 1,450 per liter to 3,200 per liter. On the bottom the concentration remained practically the same throughout the summer with but a slight increase at the end of August.

Cyanophyceae

Merismopedia, Chroococcus and *Oscillatoria* were found throughout the entire bay. They were never very abundant.

Microcystis reached its peak of abundance on the surface at the end of August, the concentration being 1,400 per liter. The bottom samples gave the peak of abundance in the middle of September.

Anaebena on the surface waters reached its greatest abundance the middle of August. It fell rapidly and declined to 500 per liter at the end of August. It increased slowly until the end of September. The bottom waters decreased in quantity from the middle of July until the end of September.

Anaebena and *Microcystis* were sometimes so abundant as to be visible with the naked eye. The water at the boat landing at Water Works Park was sometimes green with these algae.

Bacellariales (Diatoms)

Navicula on the surface waters decreased until the end of August and then again increased. On the bottom it increased until the end of August, decreased until the middle of September and then again rapidly increased.

Stauroneis, Amphiproba, Pleurosigma, Cymbella, Encyonema, Cocconeis, Gomphonema, Nitzschia, Synedra, Diatoma and *Meridian* were occasionally found although never in great quantities. These rarer forms were practically always found at stations 5, 6, or 7, which may mean that they grow in the pools of Presque Isle and are carried out into the bay at certain times.

Surirella was abundant throughout the entire bay. On the surface it increased from the middle of July until the end of September when a decrease was noted.

Fragillaria increased throughout the summer both on the surface and on the bottom. It is one of the most abundant diatoms found in the waters.

Asterionella was on the increase on the surface throughout the summer. The bottom samples showed an increase until the 31st of August and then decreased.

Tabellaria on the surface showed an increase during the summer. On the bottom it increased until September 15th and then decreased slightly.

Melosira was very abundant and increased during the summer.

Stephanodiscus was found in small numbers throughout the summer. Very little difference was found between the surface and bottom samples.

Abundant Genera from Intake Pipe

Algae were not found in very great numbers in the samples from the intake pipe. Occasionally *Pedistrum, Oocystis, Microcystis,* and *Dinobryon* were found but never in great quantities. This may have been partly due to the breaking up of these organisms by being drawn 3½ miles through the pipes.

The diatoms however were very abundant. *Surirella, Fragillaria, Asterionella, Tabellaria, Melosira* and *Stephanodiscus* were found in abundance. The forms occasionally found were *Navicula, Stauroneis, Cymbella, Cocconeis, Synedra* and *Nitzschia.*

Surirella increased in August and then decreased in September. It reached its peak of abundance in September when 17,000 per liter were found. It then decreased to 100 per liter in December and reached two sub-peaks in January and March.

Fragillaria increased until in the beginning of November when the concentration was 900,000 per liter. The concentration remained above 600,000 until the middle of January, then decreased until March when 300 per liter were found.

Asterionella decreased until the middle of August and then reached a concentration of 93,000 per liter. It decreased until the end of September and then increased to 250,000. It decreased until the middle of March to 62,000.

Tabellaria also decreased until the end of August and then reached the peak of abundance at the end of September, the highest number found being 37,000. It then decreased rapidly.

Melosira is probably found in the greatest numbers of any of the diatoms. It reached a concentration of 700,000 in October and did not fall below 100,000 until the end of January. It then decreased steadily until March when 100 were found.

Stephanodiscus increased from the middle of July until the beginning of November the concentration reaching 500,000 and then rapidly falling to 2,200. It again increased to 55,000 and fluctuated between this number and 9,650 until April.

Bacteriological Investigations

Methods

Samples were taken from 31 stations distributed over the bay in order to find the contaminated areas. The bacterial counts on gelatine and agar as given by Standard Methods of Water Analysis and the tests for the coli-aerogenes group were made. Surface samples only were taken, there being no apparatus on hand to take deep samples. The samples were taken on quiet days when the water was not stirred up.

Results

The entire bay was found to be contaminated, with the exception of a small part at Water Works Park on Presque Isle. Here the water from the lake seeps through the sand, purifying it. The largest numbers of bacteria (150,000 per cc.) were found at the outlet of sewers and polluted creeks. The smallest numbers (60 to 80 per cc.) were found along the shores. These numbers however are not absolute but give only the number of obligate saprophytes and facultative saprophytes. The analysis however is a comparative index to the bacteriological content of the water.

Among the plate colonies were found some putrefying organisms and in some places pathogenic organisms were picked up. *Staphylococcus aureus* was found in some cases.

Conclusions

1. The phytoplankton of Presque Isle Bay and the waters of Lake Erie just outside of Presque Isle Bay are very abundant both as to genera and numbers. The lowest number of phytoplankton found was 30,000 per liter in July.

2. The plankton content is sufficient to support a very large fish population.

3. The waters of Presque Isle Bay and just outside of Presque Isle are contaminated with sewage from the city of Erie. The lowest number of bacteria per cubic centimeter found were 60, the highest number 150,000.

4. No evidence has so far been found of anaerobic respiration or so low an oxygen content which would not support life. The lowest oxygen content was found in September, the per cent of saturation being 41 at station 2; the highest oxygen content was *complete saturation* in January.

5. Much more work must be done in order to understand fully the conditions of the water in regard to fish life.

Further Plans

During the coming summer a much more intensive survey is to be made. In addition to bottle samples, tow net samples will be taken by means of a Hensen vertical closing net. Apparatus has been obtained to take deep samples of water for bacterial and chemical analysis, oxygen determination, pH values and carbon dioxide content. It is expected that this study will be carried on from the beginning of June until the end of September if possible.

Work will be done in the lagoons of Presque Isle as well as in the bay. These lagoons are favorite breeding places for fish and a complete survey of this water will be of great importance.

List of phytoplankton determined:

Flagellate

Dinobryon divergens Imhof.
stipitatum Stein..
Halobryon mucicola (Lemm.) Pascher.

Cyanophyceae

Merismopedia tenuissima Lemm.
Microcystis aeruginosa Kutz.
Chroococcus limneticus Lemm.
Oscillatoria sp.
Anabaena sp.
flos-aquae Kg.

Protococcales

Schendesmus arcuatus Lemm.
dimorphus Kg.
quadricauda (Turpin) Ktz.
bijugata Kutz.
Coleastrum reticulatum Nag.
microporum Nag.
Ophiocytium capitatum Wolle.
Characium Nagaelii A. Br.
ambiguum Herm.
limneticum Lemm.
Polyedrium muticum A. Br.
Dictyosphaerium Ehrenbergii Nag.
Porphyridium cruentum Nag.

Botryococcus braunii Kg.
Oocystis Borgei Snow.
elliptica W. West.
Chlorella (?) vulgaris Beyerinck.
Rhaphidium polymorphum Fres.
Selenastrum gracile Reinsch.
Quadrigula lacustris Chodat.
Pediastrum simplex Meyen.
duplex Meyen.
Actinastrum gracillium Smith.
Sphaerocystis Schroeteri Chodat.

CONJUGALES

Closterium Dianae Ehrb.
pronum Breb.
Cosmarium tetrapthalmum Kutz.
granatum Breb.
tinctum Ralfs.
Spirogyra tenuissima (Hass.) Kutz.

CONFERVALES

Stigeoclonium sp.
Cladophora glomerata Kg.

BACELLARALES

Navicula longa Ralfs.
cryptocephala Kg.
Stauroneis phoenicenteron Ehr.
Amphiproba ornata Bail.
Pleurosigma attenuatum Sm.
Cymbella tumida (Breb.) V. H.
cystula Hembr.
Encyonema prostratum Ralfs.
Cocconeis sp.
Gomphonema capitatum Ehrb.
Nitzschia sp.
Surirella anceps Lewis.
splendida Kg.
saxonica (?) Lewis
Synedra sp.
Tabellaria fenestrata (Lyng.) Kg.
Fragillaria virescens Ralfs.
crotonensis (Edwards) Kitton.
Asterionella formosa Nassal.
Melosira crotonensis (Bail.) Smith
granulata (Ehrb.) Ralfs.
varians Ag.
Diatoma elongatum Lyngb.
vulgare Bory.
Meridion circulare Grev.
Stephanodiscus niagara Ehr.

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GENETIC STUDIES ON THE PARASITIC WASP, *HARBROBRACON JUGLANDIS* (ASHM.)

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The braconoid wasp, *H. juglandis* (Ashm.), parasitic on the caterpillars of the Mediterranean flour-moth, *Ephestia kuehniella* Zeller, has been for several years the subject of investigation in genetics. With its ten day generation, its convenient size (about 3 mm.) and the fact that it is easily reared in small shell vials, it is ideal material for this purpose.

As in the honey-bee, virgin females produce from unfertilized eggs male offspring in gametic ratios. Mated females give rise to males and females, the latter developing from fertilized eggs. Normal inheritance is therefore criss-cross like sex-linkage and has been called sex-linkoid. Females show dominant traits of both parents, while males resemble their mothers alone. Males in fact normally have no fathers and can have no sons, but through their mothers and daughters have grandfathers and grandsons respectively.

From certain types of crosses, however, a few biparental males are regularly produced in addition to those normally expected. Such may be recognized since they show paternal as well as maternal traits. They have been called in contrast to their brothers anomalous or irregular vs. regular, patroclinous vs. matroclinous or impaternate, biparental vs. uniparental, and diploid vs. haploid. Like their few daughters they are

almost sterile, tend toward morphological abnormality, but display no intersexuality either in structure or in instincts. The cause or causes of their production and their genetic and chromosomal composition are of interest from the point of view of sex-determination.

Habrobracon is being subjected to X-radiation and effects investigated. Sterilization and the production of genetic changes are the two phases of this work.

Mutations, whether X-ray or spontaneous, are being utilized in the solution of genetic problems.

These investigations are being conducted at the University of Pittsburgh and at Pennsylvania College for Women. They are aided by grants from the American Association for the Advancement of Science and from the National Research Council (Committee on Effects of Radiation on Living Organisms).

THE LINKAGE RELATIONS OF LONG ANTENNAE

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The gene "long antennae" is a simple recessive which lengthens the antennae by elongating the individual segments. The number of antennal joints is not increased, but the segments are ellipsoid rather than rectangular, and present an irregular, beady appearance. In addition the distal cell of the wing is shortened, and the wing is bent down terminally, giving a spoon-like effect.

Counts on several thousand individuals in the F_2 from crosses of cantaloup-eyed wasps with wasps having long antennae, and from the reverse cross, cantaloup-long by type, show that the factors for cantaloup eyes and long antennae are linked, with a cross-over value of $11.5 \pm .4$ per cent.

In tests of these factors with fused antennae and with Mutant Yellow—a dominant gene which lightens the proximal joints of the antennae —no linkage is apparent. The free segregation of fused and long may be regarded as established, though in the test with Yellow the numbers involved were not large enough to be altogether conclusive.

A three-point experiment involving cantaloup, long, and a gene for defective wing venation gave cross-over values of 28.4 ± 1.5 per cent. between cantaloup and defective, and 30.0 ± 1.9 per cent. between long and defective, furnishing presumptive evidence for the location of defective and long on opposite sides of the cantaloup locus.

A more extended test was made with cantaloup, long, and reduced, the latter being a gene which shortens the wing, broadens it distally, and somewhat modifies the venation. It was intended to use this experiment as a test for linkage with reduced, and at the same time to determine whether age had any appreciable effect on the crossing-over between cantaloup and long. To this end, the females heterozygous for the three factors were set within twelve to eighteen hours after emergence and were transferred to new culture vials every 48 hours. The first bottles in which the females were set were labelled *a*, the second ones *b*, and so on, so that the lettering of the bottles was an index to the age of the mothers at the time the progenies in them were produced. Nearly three thousand wasps were counted in this experiment.

Upon analysis of the results, the cross-over value was found to fluctuate, being high in the *a* and *b* bottles (12.5 per cent.), dropping in *c* (9.2 per cent.), with a rise in bottles *d* and *e* (to 10.1 per cent.), another decline in *f* (8.8 per cent.), and a final maximum value (13 per cent.) in the *g* and subsequent vials. These differences are not statistically significant, however, and the only one which approaches statistical significance is the drop between the *b* and *c* series, which is not quite three and a half times its own probable error. Grouping the *a* and *b* series together, the *c* through *f* bottles, and the *g* through *l*'s, which at first looked like a promising approach, gave no difference more than 2.75 times its own P.E.

In this same experiment, however, an altogether unexpected and surprising result came to light. The factor reduced gave no evidence of linkage with either cantaloup or long but, on the other hand, gave a recombination value with each of them considerably greater than would be expected from random segregation. The cross-over value between long and reduced was $52.5 \pm .6$ per cent. This exceeds the one to one ratio by nearly 4.2 times the P.E. Moreover, this phenomenon was restricted to the *a*-through-*e* bottles, in which the recombinations constituted $53.7 \pm .67$ per cent. of the 2400 progeny, which differs from 50 per cent. by five and a half times the P.E. In the later bottles, *f* through *l* (573 individuals) there were only 47.6 ± 1.4 per cent. recombinations, which is well within the range of a one to one ratio, but is sufficiently smaller than the value appearing in the early bottles for there to be high probability that the difference (6.1 ± 1.6) is significant. The mothers of these wasps were from a cross of cantaloup-long by reduced; the "coupling" cross of cantaloup-long-reduced by type has still to be made, but in the meantime the explanation for this curious situation is not ap-

parent. The possibility of its interpretation on grounds of differential viability seems remote after examination of the data from this angle and comparison with other viability data on Habrobracon. Too little is known of the actual mechanism of normal crossing-over to theorize on a possible mechanism that would produce excess cross-overs, but one speculative suggestion might be ventured: if crossing-over is due to the mutual exchange of parts between chromosomes that have twisted about each other or have overlapped terminally, might not a chromosome that is normally bent, rather than straight, tend to cross over more often than not?

LINKAGE OF FACTORS FOR EYE-COLOR

By C. H. Bostian
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Four mutant characters in Habrobracon, orange, miniature, cantaloup, and long, seem to fall in the same linkage group. Orange is an eye-color recessive to type. Miniature reduces general body size and antennal length, and changes the outline of the anterior wing. The characters cantaloup and long have been described by P. R. David.

At the meeting of the Academy last year P. W. Whiting gave data showing close linkage between the loci of orange and miniature, the cross-over value being approximately 10 per cent. He also brought out that miniature is semi-lethal, only 45.5 per cent. of expected males reaching maturity.

David has shown that close linkage also exists between cantaloup and long.

To see how these two pairs of factors would segregate against each other, orange miniature males were mated to cantaloup long females, and the sons of the F_1 females counted. Examination of the data shows that the cross-over value for o and m is practically the same as that reported by Whiting. The cross-over value between c and l, however, is smaller than that reported by David, it being about 7 per cent. in my data. The classes containing m are small because only approximately 45.5 per cent. of miniature reach maturity. The classes containing both m and l are smaller than those with m alone.

On the assumption that o and m segregate independently of l and c, the classes type, omlc, om, and lc were expected to be equal except for lethality of miniature. The class lc is actually much larger than type, and the class om is more than 45.5 per cent. of type. This disagreement

can be explained by assuming linkage between the foci for m and l. According to actual data this linkage may exist:

m / l	type	m	l	ml
	771	405	936	176

Only the non-miniature can be used in calculating the cross-over percentage because of the differential viability of the two miniature classes.

$$\frac{\text{type}}{\text{type}+1} = \frac{771}{1707} = 45.1 \pm 1.2 \text{ per cent. (S.E.)}$$

The standard error here is less than one-fourth the difference between the cross-over value and 50 per cent., or independent segregation, and the value is thus statistically valid.

Assuming then that the two groups of linked factors are themselves in the same linkage group, the smallness of the miniature long classes remains to be explained. Apparently the lethality of miniature is increased considerably by the presence of long. But for lethality the

F_2 Males from Orange Miniature Males crossed with Long Cantaloup Females

Composition of F_1 Females: o m / l c

I II III

Regions of Crossing-Over	Classes	Expected	Actual
Straights	om	736.3	335
	lc	766	766
X-Overs			
I	m	87.9	40
	olc	90	90
II	type	652	652
	omlc	653.4	149
III	l	62	62
	omc	63.9	29
I, II	o	74	71
	mlc	61.4	74
I, III	ol	18	18
	mc	2.2	1
II, III	oml	44.3	10
	c	39	39
I, II, III	oc	6	6
	ml	13.1	3
		3366.5	2288

classes type and omlc should be equal, because they are alternate classes. The omlc, however, are only 22.7 per cent. as numerous as type.

For the purpose of further analysis the classes containing m and ml were increased to expectation without lethality.

The loci of o and c show a cross-over value of 48.3 per cent., which is very near independent segregation.

The loci of m and c, and likewise of o and l, show a cross-over value of 47.1 ± 1.03 per cent. The difference from that expected with independent segregation is almost three times the standard error, which was computed by using 2288 as N instead of 3367, the total of the increased numbers.

On the basis of the various cross-over values and the nearness of alternate classes to each other, the genes o, m, l, and c may all be linked, having the linear arrangement shown in the table.

A FACTOR FOR FUSED ANTENNAE AND TARSI

By Neita C. Bosian
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In February, 1929, a peculiar looking male with much shortened antennae was found in a culture of wasps. The student who found this, thinking it might be a mutation and not a freak, mated it to a type female. The daughters were normal but in the second generation the character reappeared in the expected 1:1 ratio, proving it to be a recessive mutation.

These F_2 individuals were examined more closely to see to what extent they differed from the normal. It was found that in all cases the joints of the antennae were so fused together as not to be distinguishable. The antennae vary considerably in length, among different individuals, but are always shorter than those of normal males. The tarsi also are much shortened, with the joints fused, making it difficult for the individual to maintain its balance. The same mutation also produces another variation from type, an indentation at the end of the costal vein of the wing. The differences from normal are easily distinguishable among several thousand wasps which have been counted. The gene was termed "fused" from its influence on antennae and tarsi, though it really has multiple effects.

The fused males have great difficulty in walking and in mating with normal females. Also in some breeding experiments there appears a slight decrease in viability, many dying in the pupal stage. With the

character having such effects on a haploid individual we wondered what the homozygous females would be like. Tests showed the females much less viable, and completely sterile. Perhaps the sterility is due to the fact that the females cannot sting caterpillars and thus obtain nutriment. When given stung caterpillars they likewise do not feed and hence are unable to develop eggs.

Breeding work thus far has given some peculiar results, and more must be done to determine the significance. Tests show apparent linkage with another factor, reduced, in the fourth chromosome.

SELECTION FOR BIPARENTAL MALES

By D. R. Charles
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As a definite measure of the number of biparental males among the offspring of a cross or group of crosses in Habrobracon, the "percentage of male biparentalism" has been adopted. It is expressed as the number of biparental males in a group divided by the total biparentals, male and female.

Anna R. Whiting crossed black-eyed males of a number of different stocks to orange-eyed females all of the same stock, and found the offspring from each type of cross to show a characteristic percentage of male biparentalism. She also mated black-eyed males all of the same stock to orange-eyed females of a number of different stocks, finding again that each type of cross produced a characteristic percentage. Not all the fraternities, though, included biparental males.

These percentages may range from less than 2 to more than 10. That is, these same percentages of all the fertilized eggs that survive to the adult stage become biparental males rather than females.

The production of biparental males, then, is influenced by both father and mother, and the tendency to this production appears to be inherited.

Now it would seem a sufficiently reasonable question to ask whether one could, by one means or another, change the percentage of biparental males characteristic for a cross between two stocks.

The first method attempted was to expose orange-eyed females to a variety of X-ray dosages before mating them to black-eyed males. The results, reported at the Pennsylvania Academy meetings last year, indicated that the treatment could not have had more than a slight effect, if any, in changing the normal percentages of male biparentalism among the offspring of these females.

A second means used for testing the possibility of increasing male biparentalism percentages has been selection, combined with inbreeding. More promising results seem to have attended this effort.

Now, a recessive female (with orange-eyes, for example) must be mated to a dominant male (with black eyes) in order that biparental males may be detectable among the offspring. They will have black eyes, like their sisters, while the normal brothers will have orange eyes.

A series of such crosses was made, but only a small proportion of them produced biparental males.

The sisters of these males, mated to their normal orange-eyed brothers, produced orange and black males and females. Biparental males could not, of course, be detected in this generation.

Orange-eyed females, produced by the black heterozygous sisters of biparental males, were mated to their black-eyed brothers. Among the offspring, females of those fraternities containing biparental males were again selected for continuing the strain. Thus percentages of male biparentalism could be calculated only in every other generation.

Observations have now extended through eleven generations of this strain, the six odd-numbered generations furnishing male biparentalism percentages.

If one splits these odd-numbered generations into two groups—those fraternities that contain biparental males and those that do not—the male biparentalism percentage within the group that did produce such males shows no consistent increase from generation to generation.

If however all the females and biparental males be totalled in each generation and percentages of male biparentalism be calculated a fairly steady increase is seen. Obviously this is because of increase in the proportion of matings producing biparental males. For the six generations these percentages are: 8, 15, 56, 61, 72, and 80.

The tendency to produce biparental males is then hereditary, yielding to selection.

That the percentage of male biparentalism decreases with increasing age of mother is shown by vials a, b, c, d, through which she is successively passed. Totalling vials in all fraternities producing biparental males, we have the following:

Vial—	a	b	c	d
Percentage ± S.E. of male biparentalism	11.96 ± .34	7.71 ± .57	7.77 ± .73	5.41 ± .75

The two significant drops, from vial a to vial b, and from vial a to

THE GENETIC COMPOSITION OF BIPARENTAL MALES

By Magnhild M. Torvik
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It has been, for some time, an established fact, that biparental males do occur in Habrobracon. Unlike their impaternate, haploid brothers these males resemble their biparental diploid sisters in showing either the dominant traits of their fathers or those received in the egg from their mothers—that is, they show the dominant traits of both parents.

It was at first supposed that they might be haploid mosaics. Anna R. Whiting (1928) showed that when the dominant members of two allelomorphic pairs affecting one and the same part of the body (the wings) were contributed by opposite parents, both dominant traits appeared in the wings. This disproves mosaicism and indicates, though it does not prove, diploidism.

A similar situation obtains with respect to eye color. The two loci involved in the production of eye color are the ivory locus of the first chromosome and the cantaloup locus whose linkage relations have not as yet been completely determined. Crosses of ivory females by cantaloup males gave, in addition to ivory males and black eyed females, 25 black eyed males. These biparental males, like their sisters, receive the dominant allelomorph to cantaloup from their mother, the dominant allelomorph to ivory from their father. These complementary dominant factors produce black eye color.

A further step will be to demonstrate the presence of homologous chromosomes in biparental males by means of linked factors. Cantaloup and long have recently been shown to be rather closely linked. Cantaloup females are being crossed to long males. A few biparental males have been obtained. These are black eyed and normal winged and would seem, therefore, to contain homologous chromosomes, the dominant allelomorph to long being brought in with cantaloup by the female, the dominant allelomorph to cantaloup being brought in with long in the homologous chromosome of the male.

Still better evidence of diploidism of biparental males is found in those cases in which dominance is variable. Females carrying the two allelomorphs, light (ocelli) -ivory (eyes), at the orange locus show dominance of ivory in ocelli but of light in eyes. Their biparental brothers resemble them in this respect and thus demonstrate a duplex condition of this factor. Such a combination would be impossible in a haploid male.

Inheritance of the two pairs of factors yellow (antennae) and short (wings) determining variable characters has been studied and biparental males have been found to be intermediate between the two types of haploid males (normal and mutant). This indicates a diploid condition for these factors in biparental males.

It has been suggested that there may be a sex chromosome for which these biparental males are simplex. Each new mutation must be tested with this in mind. Eleven loci have been tested to date. Data thus far obtained suggest that biparental males are diploid for all chromosomes studied.

Another proof of the diploidy of biparental males might be obtained from their daughters. Although biparental males are almost always sterile they will occasionally produce daughters. The latter, in almost all cases, show only the dominant traits of their male parent regardless of how these traits entered his composition. These males, then, do not behave like diploid individuals in that they do not segregate recessives. In order to explain this discrepancy it has been suggested that the sperm may be *diploid.*

If the sperm of biparental males are diploid their daughters may be expected to be triploid. They must possess some irregularity in chromosomal constitution since they are often morphologically abnormal and rarely produce offspring.

The triploid nature of these daughters is being tested at present by means of two linked (Aa and Bb) and one independently segregating (Cc) pairs of factors. Each dominant is being brought in by a different individual. The biparental male will result from the union of egg (Abc) with sperm (aBc). He (AaBbcc) will be mated to a female (aabbCC). If the daughters from this cross show all three dominants, this will indicate probable triploidism.

A MICROSCOPIC STUDY OF THE EFFECTS OF X-RAYS ON THE OVARIOLES

By Edward McCrady, Jr.
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First a study was made of the normal anatomy of the abdomen of Habrobracon females. It was found that two physiological conditions of the individuals present very different histological aspects, and these had to be analyzed before a legitimate comparison could be made with the irregularities found in X-rayed sterile specimens.

The females, if supplied with caterpillars, will feed on them exclusively. However, if caterpillars are not accessible, they will feed on honey water. They can be kept on this diet indefinitely, and will be perfectly normal in every respect but one—they become completely sterile. It was necessary to know the histological aspect of this sort of sterility before one could be certain what cellular irregularities found in X-ray sterility were peculiar to the X-ray effect. An examination of serial sections revealed that three organ systems were affected. The digestive tract had changed primarily in the enormous extension of the crop, which had come to fill most of the anterior end of the abdomen, even reflecting itself back over the proventriculus and the anterior end of the ventriculus so as to cover them on all sides. The crop is not a digestive organ in the true sense, but serves for storage; and its enlargement is probably only the result of distension under pressure of the large quantities of honey imbibed. The fat body, on the other hand, had undergone physiological reduction. The whole organ was exceptionally small, but the individual cells appeared normal in size. Their fatty contents in most cases showed evidence of emulsification, and it was apparent that digestion of them had set in to fill the needs of the animal during fat starvation. In the genital tract the most extensive changes had occurred. The ovarioles were reduced to a mere vestige. The oöcytes and ova were resorbed, and only the anterior apical fifth containing the oögonia was intact. The rest of the genital tract posterior to the ovarioles (*i.e.*, the oviducts, vagina, receptaculum, and bursa copulatrix) was not harmed. It is interesting in this connection that a restoration of the caterpillar diet results in a restoration of fertility after a few days. This indicates that the oögonia have supplied the lacking ova.

The experimental animals were subjected to several different X-ray dosages. Three degrees of sterility were observed. The first sign of a sterilizing effect came when certain individuals exposed to a relatively small dosage became sterile after laying eggs for several days. The sterile period lasted about a week or a little more, at the end of which normal fertility was regained. A higher dosage gave a similar initial result, but allowed no subsequent restitution of fertility. Finally a dosage was found which produced immediate and permanent sterility. I shall refer to these three types as delayed temporary, delayed permanent, and immediate permanent sterility respectively. The histological aspects of the three differ in certain essential respects.

In normal caterpillar-fed females the ovarioles are divided naturally into three distinct elements in antero-posterior alignment. The most anterior is the slender apical region which contains nothing but oögonia.

Posterior to this is the region of the follicles, where the oöcytes are surrounded by the chorion cells, and derive nourishment from the nurse cells. The last region posteriorly is the very much enlarged storage portion containing only mature ova and occasionally secondary oöcytes.

These three regions also represent three degrees of activity among the germ cells. The most active group is the middle one where the first maturation division, the accumulation of yolk, and usually the second maturation division occur. The next most active group is the anterior one where normal mitotic divisions of the oögonia take place. The third group usually has no mitotic divisions, but contains for the most part the mature eggs.

Now if X-rays do have a higher lethal effect on dividing than on stable cells, we should expect these regions to be disabled in the order: two, one, three. In other words, with the least effective dose only the second or oöcyte region should suffer. With a slightly higher one, both this region and number one (*i.e.*, oöcytes and oögonia) should be affected. And finally, with a sufficiently high dosage one should be able to kill the cells in all three parts, the adult eggs being the last to succumb. This sequence of susceptibility would produce exactly the three types of sterility which we have observed, and in the same order. When only the oöcytes were affected, the mature eggs would be laid in the first day or so, a period of sterility would follow, and eventually the oögonia would replace the lost oöcytes so that fertility would be restored (delayed temporary sterility). In the second case, the oögonia would be lost also, so that no restoration of the lost oöcytes could take place (delayed permanent sterility). In the third case, since the mature eggs would also be dead, no eggs would ever be laid after raying (immediate permanent sterility). The actual phenomena of X-ray sterility accord, then, in every detail with what might be expected on the hypothesis that kinetic cells are more susceptible to lethal injury from X-rays than are stable cells.

A further confirmation of this hypothesis comes from the actual visible effects in my microscopic slides. Here is an opportunity to examine in cross section a complex assortment of different kinds of cells, and to observe just which sorts are selected by the X-rays, if there actually is any differential susceptibility.

That the effect is selective is at once obvious, for certain whole systems of organs are intact, so much so that the normal viability of the individual is unaffected. No dosage has yet been given which affects any cells of the digestive tract, muscles, nervous system, heart, or sting apparatus. The only two parts affected at all are the genital tract and the fat body.

Now the fat body is perhaps the most variable organ in the abdomen. During fat starvation it is reduced to a mere vestige; and when fat is plentifully supplied it expands to fill the interstices of the abdomen, almost obliterating the remnants of the body cavity, and forming a compact matrix for the viscera. Furthermore when it is in its most reduced condition the cells that are left are fairly normal in size. This means that when fat is accessible a rapid multiplication of fat cells provides storage for it. As all of these X-rayed females were well fed with caterpillars, this tissue was at the time of irradiation a very active one.

The other system affected, the genital tract, exhibits within itself even a further selection. It happens that only the anterior half, only the part made up of actively dividing cells, is harmed. Here there is a complete degeneration of the cells, not a resorption as the fragments are still apparent scattered through the abdomen. But the oviducts, the receptaculum, the vagina, and the bursa copulatrix are in perfect condition. These unaffected parts of the genital tract, together with all the other unaffected tissues of the abdomen, have been completely stable since the time of pupation. This seems to me to be very convincing evidence of differential lethality as far as active and resting cells are concerned.

TWINNING IN CHICK EMBRYOS

By Stella M. Hughes
Annville

(Paper not submitted)

A CASE OF A POLYDACTYLOUS CAT

By Russell E. Morgan
Lebanon Valley College, Annville, Pa.

About a year ago, Professor Derickson brought to my attention a polydactylous cat which had just died. The feet, each of which bore a supernumerary digit, were radiographed and the skeleton was mounted. The matter was not investigated further. Recently Professor Light discovered another polydactylous specimen. The front paws of this animal were manipulated in a queer fashion. When the cat was standing, the

paws had the appearance of large mittens laid flat on the ground. When the cat clawed at an object, the digits were spread much like a half-clenched fist. It was the unusual size and action of the paw that first attracted attention to the anomalism. Desiring to compare conditions with the first mentioned case, photo and radiographs of the feet were made. Polydactility was the only abnormality encountered. Each foot was studied separately, special attention being paid to the front feet. It is of interest to note that both specimens studied were from litters of cats whose parents were polydactylous, proving quite conclusively that the peculiarity is hereditary. One litter contained three kittens: one normal female, one normal male, and one polydactylous male.

A supernumerary digit is the most conspicuous abnormality in the external appearance of each foot. The proximal pad of each front foot appears to be normal. The large central pad on both front feet has a lateral extension which is approximately one-third the size of the large pad and which extends proximad. Five of the digits have normal pads. A sixth bears a double pad. On the right foot this digit also has a double claw, but only a rudimentary double claw appears on the same digit of the left paw. In both feet, this digit occupies the place of what normally would have been the index. The pads on the rear feet are normal in shape, the additional digit bearing a single pad.

X-rays of the feet revealed the presence of supernumerary phalanges, metacarpals, and carpals. As a basis of comparison, a normal cat was radiographed and the differences noted. In brief review it can be stated that the normal front foot, following the carpus of seven bones arranged in two rows, contains five metacarpals with a digit attached to each. The pollex has two phalanges; the other four have three each. The abnormal right foot contains nine carpus bones. A normal scapholunar, cuneiform, and pisiform, and a normal trapezium, trapezoid, magnum, and unciform appear to be present. In addition, there seems to be a small central carpus bone, comparable to the centrale found in the lower vertebrates. Two additional bones also appear in the distal row. Davison, in his "Mammalian Anatomy," offers a plausible explanation for this. He says, "In all mammals possessing five digits the anlage of three bones in the proximal row, five bones in the distal row, and a central element occurs in the embryo, but through fusion of elements a less number is present in most adults." It may be possible that the fusion of the carpus bones has not been complete in this case, resulting in the condition now existing.

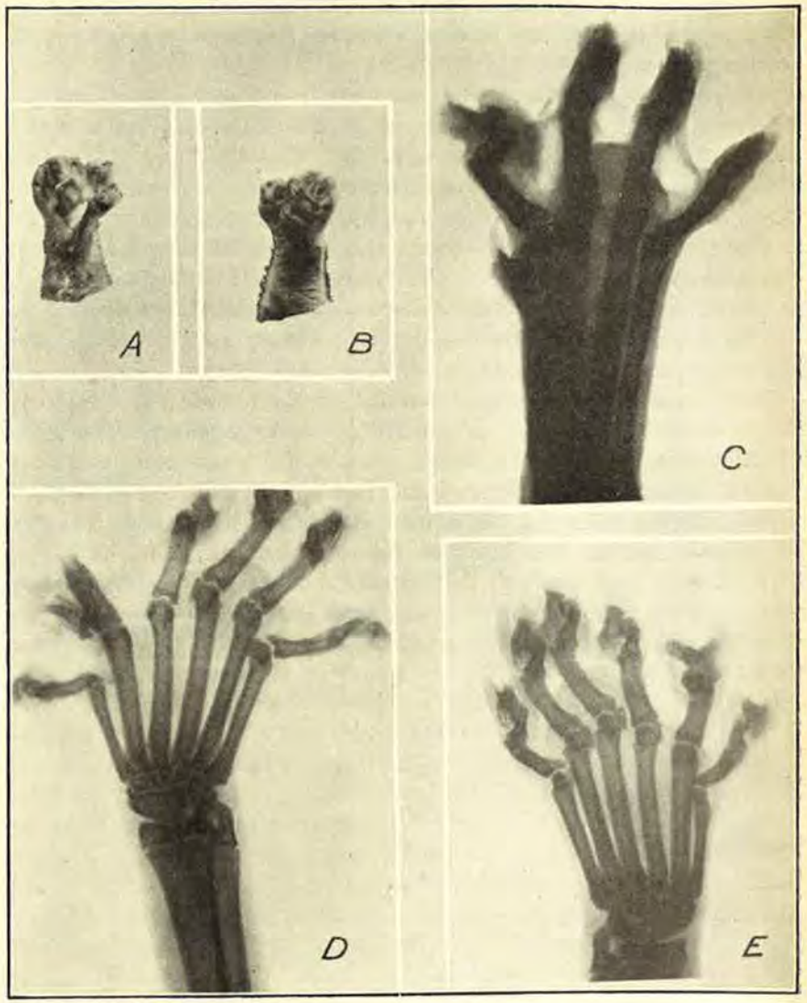
An additional metacarpal can be noted. Five of the metacarpals are approximately the same size; a sixth is only slightly smaller. There are

three phalanges on each digit. This is a further abnormality in that the normal pollex has only two phalanges and its metacarpal is usually much smaller than the others.

As previously mentioned, the second digit from the medial side seems to show the most abnormal situation. It will be remembered that this is the one bearing the double pad and claw. The phalanges of this digit are disarranged. The proximal phalanx is normal, but the second is bent backward to point proximad, while the distal phalanx is again turned to point distad. This is the case in both fore feet, and, as far as can be learned, is not the result of an injury. The fact that both of these abnormalities are symmetrical seems to establish this statement.

The left front foot, with the exceptions already named, has the same abnormalities.

The rear feet also bear a supernumerary digit, which, as far as can be learned from the X-ray photographs, is a development of the rudimentary digit found in the normal cat. It will be remembered that a normal cat has a tarsus of seven bones, four normal and one rudimentary metatarsals, and four digits, each made up of three phalanges. The foot of the abnormal cat does not show the rudimentary metatarsus, but in its place is the complete digit. It consists of a metatarsus approximately two-thirds the size of the others, and three phalanges. Externally, the digit occupies the same position as the pollex on the front foot of a normal cat.



FEET OF POLYDACTYLOUS CAT

A. Right front paw showing pads.
B. Left front paw showing pads.
C. X-ray of right rear paw.
D. X-ray of right front paw.
E. X-ray of left front paw.

TWO-HEADED SNAKES

BY V. EARL LIGHT
Lebanon Valley College, Annville

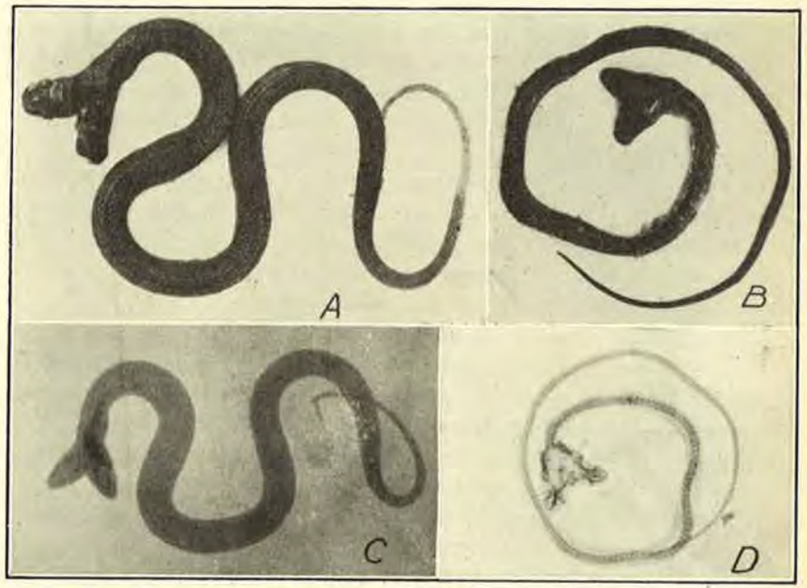
Two-headed snakes are not altogether rare, and accounts of their occurrence appear time to time. Abnormal animals such as these are at a decided disadvantage in their struggle for existence and this probably accounts for the fact that most of the specimens observed are very young. Mr. Ditmars, curator of reptiles in the New York Zoological Park, however, calls attention to a two-headed milk-snake which he had in captivity for several months and which in all probability was about a year and a half old.

Double-headedness in snakes has been observed in copperheads, bull-snakes, black, garter, milk, rattle, hog-nosed and king-snakes. The degree of double-headedness has been found to vary from a bare indication of double-headedness to a complete separation of the two heads for a distance of about two inches.

Two instances of double-headedness have come to my attention recently. The one—a garter snake (*Thamnophis sirtalis*) was loaned to me by the museum of the Department of Agriculture at Harrisburg. This specimen was found in the vicinity of Orbisonia, Pennsylvania, and has been preserved for some time. The other—a water snake (*Natrix fasciatus*) was found by several boys along the banks of the Quittapahilla Creek at Annville about the year 1850, and through the generosity of Mr. Thomas Stein is preserved in the Annville High School.

Both of these snakes are small and in all probability were found soon after birth. Nothing is known as to the behavior of either of the snakes, or as to the length of time they were kept alive. In each case the two heads are separate to a point a short distance posterior to the eyes. The mouths and eyes are distinct and fully formed. The basal plates of the heads are joined.

X-rays show that the bony skeleton of the garter snake is fully formed but only a trace of a bony skeleton can be seen in the head region of the water snake. If the snakes, being about the same size, were approximately the same age when found, then the X-rays reveal the fact that the bony skeletal structure of a garter snake is completed early in life while that of the water snake requires a longer time to change from a cartilaginous to a bony character.



X-RAYS OF GARTER SNAKE (*Thamnophis sirtalis*) AND WATER SNAKE (*Natrix fasciatus*). THE CARTILAGINOUS SKELETON OF THE YOUNG WATER SNAKE NOT BEING APPARENT IN THE X-RAY

A. Two-headed water snake (*Natrix fasciatus*).
B. Two-headed garter snake (*Thamnophis sirtalis*).
C. X-ray of water snake, does not show cartilaginous skeleton.
D. X-ray of two-headed garter snake.

CHROMOSOME NUMBER OF THE MALE OF THE FIRST FORM REPRODUCTIVE CASTE OF *RETICULITERMES FLAVIPES* KOLLAR

BY JOSEPH MOHNEY BENKERT
University of Pittsburgh

The cytological work done upon the male nymph of the first form reproductive caste of *Reticulitermes flavipes* Kollar is the first part of a study to determine whether or not there are any observable chromosomal variations associated with caste differentiation. It is hoped that an answer to this question will help solve the problem of caste origin which has puzzled zoologists for so long a time.

There are five castes distinguishable in a colony of these termites. Two of these castes are blind and sterile. The other three have eyes and are fertile. The most obvious character by which the various castes may be recognized is the presence or absence of wings or wing vestiges. The three reproductive castes are: (1) the first form reproductive caste, long wings possessed during the swarming period and afterward remaining only as short stubs, the so-called "scales"; (2) the second form reproductive caste, short scale-like wing pads, vestiges of wings; (3) the third form reproductive caste, absence of wings or wing pads. The two sterile castes are: (1) the worker, small head, small body, no wings, both sexes; (2) the soldier, large head with mandibles very much enlarged, small body, no wings, both sexes.

At present two views are held as to the origin of castes. The first and older view sponsored by B. Grassi and A. Sandias in their paper of 1893–94, entitled, "Costituzione e sviluppo della societa dei Termitidi." *Atti. Acad. Gioenia di sci. nat.*, Catania, and in their paper of 1896–97, entitled, "The Constitution and development of the society of termites; observations on their habits; with appendices on the parasitic protozoa and on the Embiidae," translated by T. H. Blandford. *Quar. Jour. Micr. Soc.*, Vols. 39–40, holds that the causes for variation are extrinsic, food and care, etc. The second and most recent view is sponsored by Caroline Burling Thompson in a paper entitled "Origin of the Castes of the Common Termite *Leucotermes flavipes* Kollar" and published in the *Journal of Morphology*, Vol. 30, 1917–18, holds that all termite castes are predetermined in the egg; that some castes are distinguishable, either by external or internal characters, at the time of hatching, while others may appear considerably later in the course of development. Thompson makes this statement, "Instead of assuming the presence of the charac-

ters of all the different castes in a single egg and in all the eggs, how much simpler is the assumption that there are different kinds of eggs, and that each egg contains the predetermined characters of a single caste. With this assumption, the structural differentiations of the various castes, or their protoypes, may be looked for at the time of hatching.'' If Thompson's assumption is correct, the genetic constitutions of the zygotes are the controlling factors in their differentiation into the various castes. Furthermore, it is not altogether improbable that there may be observable chromosomal variations associated with caste differentiation.

The nearly matured male nymph of the first form reproductive caste was selected as suitable material for perfecting the necessary technique. The reasons for doing this were that it could generally be found in the stock colony raised in the laboratory, and that the male reproductive organs gave better cytological preparations than the female reproductive organs. The gonads (about .3 millimeter thick) were dissected out and immediately fixed in Carothers' modification of Allen's B′ 15. This fixative is prepared and kept in two stock solutions. Solution A consists of 75 c.c. of a saturated aqueous solution of picric acid, 15 c.c. formalin, 10 c.c. glacial acetic acid, and 1 gr. of urea crystals. Solution B consists of a 50 per cent. aqueous solution of chromic acid. Four drops of solution B are added to every 5 c.c. of solution A just before using. Apparently tissue can remain in this fixative indefinitely without appreciable damage, although several hours was usually the time required for thorough fixation. Dehydration with alcohol was carried out in 5 per cent. steps. The tissue was kept in 70 per cent. alcohol at least 48 hours to remove the picric acid crystals. Before the tissue was cleared with aniline oil, it was stained lightly with alcoholic eosin so that orientation in paraffin could be accomplished more successfully. Either chloroform or xylol can be used in preparing the tissue for embedding in a low melting-point paraffin. Tissues were cut at two, four, six, eight, and ten microns. Sections from six to ten microns in thickness were found to be the best for study. The material was stained with Haidenhain's Iron Haematoxylin, by the Feulgen reaction, and with Flemming's Triple Stain. (The material stained with Flemming's tri-color was fixed in Flemming's strong osmic acid solution.) Several gonads were prepared using the smear technique with indifferent results. The primary spermatocyte metaphase plates showed most clearly when Carother's fixative and Haidenhain's Iron Haematoxylin were used.

The primary spermatocyte metaphase plates are of greatest interest. Over 100 counts were made of the polar views of the primary spermatocyte metaphase plates which showed 21 chromosomes. Variations of this number in several cases may be explained by the fact that the cells were cut at an angle to the plates, or that some of the chromosomes were covered by others. Assuming that the primary spermatocyte indicates the fusion of the diploid pairs into tetrads, the haploid number would be 21 chromosomes. Assuming the diploid number to be twice that indicated by the primary spermatocyte metaphase plates, the spermatogonial metaphase plates should indicate the diploid number of chromosomes or 42. With the exception of one spermatogonial metaphase plate showing a chromosome count of 51 (the chromosomes of one side of this particular plate are extremely minute and may be the result of fragmentation), the counts of the spermatogonial metaphase plates range from 35 to 42.

IS THE PASSENGER PIGEON EXTINCT?

By E. H. Nelson
Bloomsburg State Teachers College

(No abstract)

SOME FACTORS AFFECTING THE HATCHING OF THE EGGS OF THE EUROPEAN CORN BORER

By R. E. Springer
University of Pittsburgh

Investigation carried on at Sandusky, Ohio, under the direction of the U. S. Department of Agriculture has established the fact that a single female moth will not infrequently deposit in excess of 1,000 eggs and a group of fifty produce an average of more than 500 eggs per female.

The fertility of these eggs even under insectary conditions approximates 97 per cent. and usually slightly higher under field conditions. Hence the fecundity of these moths is exceptionally high. In spite of this fact an average of only 5.8 per cent. of the eggs deposited by this moth develop into larvae which become established in the host plant and survive to at least the third instar, which stage is completed in an average of nineteen days from the date of deposition of the eggs. Since less than 6 per cent. of these eggs live through the first three weeks, the approximate length of time required to complete the third instar, it is interesting to determine some of the factors at work to bring about this high mortality.

In Bulletin 1476 of the U. S. Department of Agriculture, entitled, "A Progress Report on the European Corn Borer," brief mention is made of the effect of sunlight on the hatching of these eggs. To quote, "Several leaves bearing clusters of fertile eggs were removed from life history cages and inverted in such a manner as to expose the eggs to direct sunlight. Under these conditions none hatched."

It is in an effort to add some systematic data to these rather meager facts that the following facts are offered:

The eggs used in this work were produced by moths imported from Sandusky, Ohio. A small percentage of these were transported in the adult stage but a far larger portion was brought as pupae and allowed to develop. These moths and pupae were kept as nearly as possible under optimum conditions of temperature and humidity. The adults and the pupae as rapidly as the latter reached the adult stage were transferred to a well-ventilated wire cage lined with semi-transparent paper, located in the cellar of the building in which the work was done. The adult moths deposit their eggs readily on this paper which was removed at 24-hour intervals. A fair sample of eggs from each 24-hour deposi-

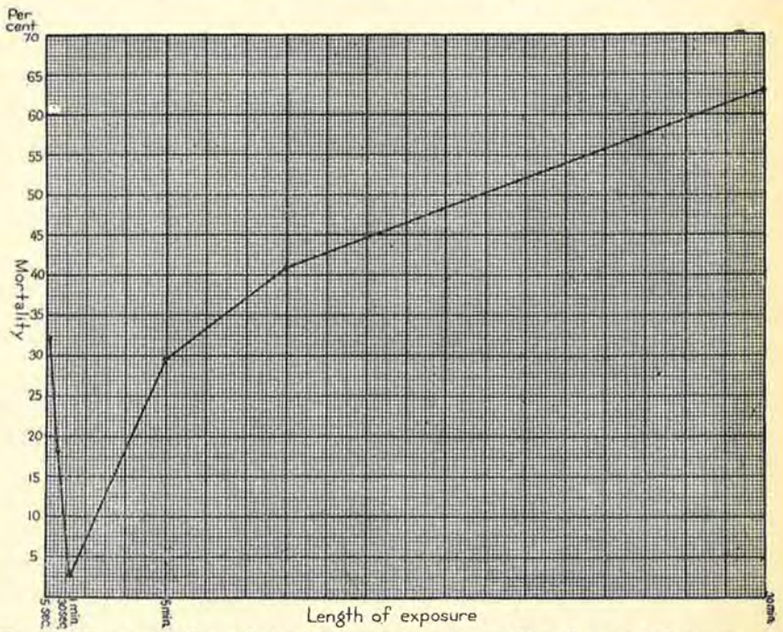


FIG. 4. Graph showing effect of temperature on mortality of ova of European corn borer.

tion was run as a control to determine the fertility, which was found to average 95 per cent.

The eggs are firmly attached to the paper in a shingle-like formation in clusters ranging from 6 to 50 eggs per cluster with an average of approximately 16 eggs per cluster. These bits of paper on which the clusters were deposited were cut from the large sheets of paper with which the cage was lined so that there was only the small bits of paper with the attached eggs with which we had to work. These bits of paper with the attached eggs were cut as small as possible without injuring or otherwise disturbing the egg clusters. The individual eggs in these clusters were then counted by means of the binocular scope and subjected to ultra-violet radiations in the following manner:

The clusters were placed in petri dishes, the bottoms of which were covered with dry blotting paper, and placed on the table of the ultra-violet lamp at a distance of 17⅞ inches from the tube. The lamp used draws 5 amperes on a 110-volt circuit.

The controls were placed along side the others in a separate dish and covered with a piece of glass so as to exclude all ultra-violet rays of the lamp. Hence both sets were subject to similar conditions of heat and humidity while the one was being exposed to the ultra-violet.

Immediately following the exposure the blotting paper on which the eggs were placed was moistened, the dish covers replaced and the whole placed in the cellar where conditions of temperature and humidity were near the optimum for development.

The temperature on the ultra-violet table was 90° Fahr., which fact is evidenced in the controls by a variation in the percentage that failed to hatch that ranges from 8.7 for those that were exposed 5 seconds to a maximum failure of 37 per cent. for those that were exposed 30 minutes. In order to dispose of this temperature effect as nearly as possible, the per cent. that failed to hatch in the controls is subtracted from the per cent. that failed to hatch in the exposed eggs and the following figures are obtained:

These figures indicate the number per hundred ova whose failure to hatch may be attributed to the effects of ultra-violet radiations.

In spite of the fact that a relatively small number of eggs were used in determining this curve, approximately five thousand, the trend is so pronounced as not to be overlooked, and quite in keeping with what might be expected, *i.e.*, a significant increase in viability followed by a rather rapid rise of the death rate.

In view of the fact that this insect as brought out in the work of Parks and Caffery is exceptionally sensitive to many factors in its en-

vironment, that sunlight is one not to be neglected and the fact that its spread westward has been approximately three times more rapid than its spread southward may be associated with and partly influenced by the amount of such light that it receives.

Temperature Effects of Ova of European Corn Borer

Time of exposure	Number exposed	Number hatched	Per cent failing to hatch
5 sec.	560	332	40.8
30 sec.	256	176	31.3
1 min.	410	323	21.3
5 min.	355	211	40.6
10 min.	444	137	69.2
30 min.	346	000	100.0
	2371		
Controls:			
5 sec.	323	295	8.7
30 sec.	265	229	13.2
1 min.	402	327	18.7
5 min.	362	255	11.0
10 min.	389	279	28.3
30 min.	381	239	37.0
	2122		

Ruling out heat as a detrimental factor by subtracting the per cent of exposed eggs that failed to hatch from the per cent of eggs in the controls that failed to hatch give the following which should represent the effect of the ultra violet radiation:

	Per cent.		Per cent.
5 sec.	32.1	5 min.	29.6
30 sec.	18.1	10 min.	40.9
1 min.	2.6	30 min.	63.0

VARIATIONS IN WING RETICULATIONS AND SIZE OF *ERYTHRODIPLAX BERENICE* WITH REGARD TO GEOGRAPHIC DISTRIBUTION

By S. Irvine Shortess
Bloomsburg State Teachers College

(No abstract)

RELATION OF PENNSYLVANIA LIMESTONE CAVES TO GEOLOGIC STRUCTURE

By R. W. Stone
Pennsylvania Geological Survey

In Pennsylvania ten limestone caves are open to the public on a commercial basis, and at least twenty other caves are known but undeveloped. Since September, 1929, all of these caves have been visited by members of the State Geological Survey and maps have been made of the ten commercial caves.

These caves are: Crystal, near Kutztown, and Onyx, near Shoemakersville, Berks County; Indian Echo, near Hummelstown, Dauphin County; Seawra, near Alfarata, and Alexander, near Reedsville, Mifflin County; Penn, Veiled Lady, and Woodward in the eastern end of Centre County; Historic Indian, at Franklinville, Huntingdon County, and Hipple, at Waterside, Bedford County.

This study of the caves has brought out some interesting facts regarding their relation to the geologic structure. Four of them, Crystal, Seawra, Penn, and Hipple are in steeply-dipping limestone beds that have a direct course and, because solution has taken place along the bedding, these caves are generally straight passageways. Seawra, Penn and Hipple caves are very linear because developed along a thin band of more soluble beds. Historic Indian seems very irregular when walking through it, but the map shows it to consist of four parallel courses on separate joints, and connected by narrow cross passageways.

In flat or nearly flat-lying limestone the development of cavities takes place along joint planes primarily and enlargement occurs where joints cross a more soluble bed. This tends to make caves in these beds irregular in plan, with branches shooting off from the main channels, or to be rectangular in general outline. At least right angle turns are found in the passageways in those rocks in which the main joints cross each other at approximately 90°.

Onyx, Indian Echo, Alexander, and Woodward caves are in comparatively flat-lying beds and exhibit these features. Woodward cave has a rectilinear pattern, Indian Echo has secondary galleries at right angles to each other, Onyx shows clearly the opening of fissures along joints, and the course of the underground river in Alexander Cave is very notably affected by the major vertical joints.

Of the 20 odd undeveloped caves, Delaney in Chestnut Ridge southeast of Uniontown, Fayette County, is by far the largest. It is in sili-

ceous limestone beds that dip with the slope of the mountain, and the caverns follow the dip. The main passageways are opened along joints and the rooms are broad, dip slope solution chambers partly determined by the intersection of joints. Bear Cave, farther north in the same ridge, is of the same character and in the same siliceous limestone.

Hartman Cave, near Stroudsburg, is in the crest of an anticlinal flexure, where the folding produced shattering and gave added impetus to solution.

CORRELATION OF PENNSYLVANIA ANTHRACITE

By Homer G. Turner
Lehigh University

Introduction

This paper discusses various methods of correlating Pennsylvania anthracite. It embraces a brief description of the methods that have been tried and suggests others. Particular attention is given to the possibility of using the morphological characteristics of the coal substance alone as a criterion.

The Use of Plant Impressions

Several years ago Dr. David White made a study of the Pottsville floras from a stratigraphic standpoint. He concluded that it was practicable to correlate individual beds where plant impressions could be found in the roof rocks.

No doubt this method would be practicable also if applied to the post-Pottsville beds. Difficulties would be encountered, however, in those mines where plant fossils are scarce or absent.

Aside from the difficulties arising from the absence of fossil plants this method has a further objection in that it can be used only where coal beds have been actually worked. It would be of little, if any, value in the correlation of diamond drill cores.

The Use of Cross-Sections

The coal operators in the anthracite field have been drawing cross-sections of their workings for many years. By noting the thickness of beds, the intervals between them, and to some extent the nature of the rocks above and below, they have arrived at conclusions as to which beds they have on their properties. In many cases they have very little knowledge of the relation of their coal beds to those of mines in the same

basins and are still further in doubt concerning the relation to beds in other basins.

When one considers the great variation in the number and thickness of beds from place to place in the same basin as well as variations from basin to basin, it becomes quite obvious that this method of cross-section study could not solve the correlation problem entirely. A fairly complete structural picture could be drawn, however, if all the sections that have been drawn by individual companies could be pooled and properly studied.

The Interbedded Rocks

During the last decade sedimentary petrography has been used very extensively as a means of correlating rock formations. Rocks which have appeared alike when studied by other methods have been found to be vastly different when subjected to petrographic analyses. It seems extremely probable that the similar appearing floor and roof rocks of different coal beds would exhibit definite differences when viewed under the petrographic microscope.

Ash Colors

Many attempts to correlate anthracite beds on the basis of ash colors have been made by various operators. The usual procedure consisted of pulverizing a lump of coal to pass 60 mesh, burning to an ash, grinding this ash to pass 200 mesh, and mounting on glue-coated paper or under glass for comparison.

The writer tried this method a few years ago using channel-cut samples from different places in the same bed instead of lumps taken at random. The resulting ash colors were not the same for the same bed although greater agreement was obtained than in cases where ash colors from a single lump were compared to colors from similar lumps in different beds. The omission of the final grinding to 200 mesh did not improve the results.

During this work it was found that ash colors varied from top to bottom of the same bed. In fact, it was possible to obtain almost as many colors as there were samples from a given bed. It was concluded, therefore, that ash colors were of little value in the correlation of anthracite.

Morphological Characteristics of Coal

All Pennsylvania anthracite is laminated to some extent. These laminations are due to three chief morphological constituents, namely: anthraxylon, attritus, and fusain. The anthraxylon when viewed under the microscope is seen to be composed of strips of woody matter. The

attritus is composed of plant materials of many kinds such as spores, leaf coatings, resin lumps, thin strips of wood, together with structureless degradation products and mineral matter. The fusain is the material known as mineral charcoal or mother of coal. It has the appearance of charcoal both under the microscope and to the naked eye. It occurs either as thin coatings on the bedding planes or in the form of lenses or angular chips.

The amount of each of these three main constituents in a given coal bed depends in part upon the plant types contributing to the original peat and in part on the condition of preservation of the ingredients after biochemical action has ceased and before dynamo-chemical action has started.

Since the coal beds of the anthracite region represent a series of ancient swamps differing in age before burial, as suggested by variations in thickness, and separated from each other by different time intervals, as indicated by variations of thickness and kind of sediments between beds, one would expect some differences in species of plants growing in each swamp as well as probably greater differences in bacterial decay due to variations of time and water conditions. Each swamp would have variations of kinds of plants from shore to center in their initial stages, but such minor differences would become less as the swamp reached maturity and might indeed be practically erased by the time sediments covered the swamp.

Many samples of coal were prepared and studied by the writer with the thought that the relative proportions and condition or preservation of the various constituents of anthracite as suggested by the foregoing theoretical considerations might serve as a basis for correlation.

Collection and Preparation of Samples

The samples used in this work were collected from collieries in the Western Middle Field and Southern Field where there was no doubt as to the identity of the beds in question. Samples were taken from top to bottom in those portions of the beds which were free from unusual features such as excessive bone, pyrite, or sheared coal. The beds studied were the Mammoth, Primrose, and No. 5. The Mammoth was sampled in the Cameron, Pennsylvania, and Richards Collieries over a distance of seven miles. The Primrose was sampled in the Cameron, Richards and William Penn Collieries over a distance of about seventeen miles in the Western Middle Field and in the Lytle Colliery in the Southern Field. Number 5 was sampled in the Cameron and Richards Collieries.

These samples, about three hundred in all, were prepared by cutting a flat surface at right angles to the laminations, using an ordinary hacksaw. These flat surfaces were further leveled by grinding on a coarse carborundum disk. They were then placed face downward on an iron plate which was heated to red heat over bunsen burners. In an hour or more the prepared surface became coated with ash so as to show clearly the structural details. It was found that there were variations in ingredient materials from top to bottom in each bed and that these variations were the same for each bed and different for different beds.

Conclusions

None of the methods of correlation mentioned in this paper have been carried far enough to give definite assurance of solving the problem. It may be found that no single method will answer the purpose and that ultimate success will require the use of a combination of all methods.

The use of morphological constitution of coal as described herein seems very promising. It has given very accurate results in the identification of the beds thus far examined. Whether or not it is reliable for all the beds can not be stated until they have all been examined. Its simplicity and ease of application make it sufficiently valuable to warrant further investigation. Incidentally, structures revealed by this method of examination may throw much light on combustion characteristics and other properties of different coal beds.

CHEMICAL COMPOSITION OF LIMESTONE

By B. L. Miller
Lehigh University

To be published in a report on Limestone in Pennsylvania, written for the Pennsylvania Topographic and Geologic Survey.

THE FORGOTTEN PART PLAYED BY A PENNSYLVANIAN IN THE EARLY DEVELOPMENT OF ALASKA

By Evan O'Neill Kane, M.D.
Kane

An historical paper, to be printed privately.

A MEDICAL CHEMIST LOOKS AT WATER

By Max Trumper, Ph.D.[1]

Water, like air, is so fundamental to our existence that we accept it as a matter of course and, like air, it arouses our interest only when its supply fails or becomes markedly contaminated. In securing water for large cities the first requisite formerly was quantity. There must be sufficient not only for the population but also for the city's industries. For industrial purposes also the quality of the water received more attention than the quality for human consumption. Manufacturers saw to it that the chemical constituents of their water supply were such as to cause a minimum of interference with the efficient operation of their machinery, especially boilers. The railroads were among the first to establish chemical analyses of their water. For drinking purposes water was considered satisfactory when through some method of purification it had been rendered free from known pathogenic organisms. The inorganic constituents of drinking water were given little consideration.

All physiologic actions take place in systems of which water is an essential component. Water is essential to most of the fundamental physico-chemical changes in tissues, upon which depend the maintenance of life and the functional integrity of the organisms. Among these are cellular permeability, osmosis, diffusion, filtration and electrolytic dissociation. Reference to certain properties of water will serve to illustrate its vital importance in physiologic processes.

The heat capacity or specific heat of water is higher than that of any other liquid with the exception of liquified ammonia. This important fact is intimately related to the question of the regulation of body temperature. Highly organized mechanisms are extremely sensitive to even slight alterations in temperature and some sort of buffer system is necessary for their protection from such changes. The heat produced as a result of the functional activity of various tissues, particularly muscular contraction, would cause a great elevation of body temperature were it not for the high specific heat of water, which constitutes as much as 80 per cent. of the substance of the more active tissues. A practical example of the importance of this factor is seen in conditions of dehydration which are frequently associated with fever, particularly in children in whom all metabolic processes are relatively accelerated.

The surface tension of water is higher than that of any liquid except mercury. This property plays an important part in physiologic proc-

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esses. It influences largely the supply of water which plants receive from the soil, since it enables water to reach the roots from a considerable distance, as far as five feet under ordinary circumstances.

The modern concepts of radiant energy in life-processes emphasize another property possessed by water, namely, its transparency to radiation. Liquid water is transparent to practically all the rays of the visible spectrum, the ultra-violet rays being absorbed to but a slight degree. This fact is of importance since radiant energy is thus allowed access to substances in solution in water without being changed to other forms of energy, particularly to heat. This is as essential, apparently, to the human organism as to the green leaf of plant life.

The remarkably solvent property of water renders it an integral factor in the maintenance of normal metabolic processes. There is no other liquid capable of dissolving so great a variety of substances. One has only to review the great number of substances in solution in the blood, urine, and other body fluids and secretions normal and pathologic to appreciate the vital importance of this fact. Only a few of these substances are soluble in other liquids to any extent.

The average daily intake of water varies with the activity of the individual as well as with the temperature and humidity of his environment. Ordinarily it totals 40 to 50 ounces a day, which includes all the water present in the food. Nature's own food, an almost complete food, namely milk, contains 87 per cent. water. All fruits and vegetables are characterized by their high water content, averaging approximately 90 per cent. In the course of a day, secretions are poured into the digestive tract in the form of saliva, gastric juice, pancreatic and intestinal juice and bile. Practically all of the fluid thus secreted is reabsorbed following digestion and it is thus evident that the available water of the body is rigidly conserved. The amount of fluid normally poured into the digestive tract in 24 hours is from 7500 to 10,000 c.c., which is three times the amount of fluid daily taken into the body, four times that excreted as urine, and about twice as much as the total blood volume.

Water constitutes approximately two-thirds of the body weight. The water content of various body tissues is almost directly proportional to their metabolic activity. For example, the brain with a high degree of metabolic activity is 80 to 90 per cent. water. Liver and muscle with a somewhat lower rate of metabolism are 75 per cent. water. Bone, which is a quite inactive tissue, averages 30 per cent. water, and fat, which is extremely inactive metabolically, is only 6 to 10 per cent. water. The percentage of water is lower in adult than in embryonic tissue, decreasing with advancing age of the tissues, and thus constituting another evi-

dence of the relationship between water content and metabolic activity. Living tissues which are exceptionally poor in water or which withstand desiccation such as "seeds and bacterial spores represent life latent but arrested to be resumed in full vigor upon addition of water."

As mentioned before water is essential to the maintenance of all body functions: 1. The regulation of body temperature is facilitated by the presence of circulating water and by the evaporation of water from the surface of the skin. 2. The mucous surfaces of the body cannot function normally unless they are in a moist state. 3. The kidneys can more satisfactorily eliminate toxic substances if such substances are well diluted. 4. The movements of joints are possible only when fluid is present. 5. Water is intimately related to absorption as in the digestive system. 6. The exchange of carbon dioxide and oxygen in the lungs is largely dependent upon a condition of adequate moisture of the alveolar epithelium.

Certain phases of the water problem are of popular as well as scientific interest. These are questions of water deprivation, water excess, water drinking with meals and the various types of water which are commonly used.

Rubner says that a fasting animal may lose all of its glycogen and fat and one-half its protein and still live, but if it loses more than one-tenth of its water, it dies. A lack of free water in the body brings about a rapid and marked increase in body temperature (as demonstrated by Woodyatt). It is also known that an abundant supply of water is necessary for the proper metabolism of fats, carbohydrates and proteins as well as for the maintenance of the normal physico-chemical equilibrium of the body. Thirst is the natural consequence of water deprivation. It is induced partly by increased concentration of the blood and partly by the dryness of the pharyngeal mucous membrane, but it may be caused by psychic abnormalities. Thirst caused by dryness of the nerve endings on the back of the tongue may be abolished instantaneously by cocainizing the tongue. In this connection it may be interesting to note that an excess of sugar in popular beverages instead of quenching thirst results in increased dryness of these nerve endings with resultant increased thirst.

In the words of Professor Hare, "Anything that is capable of doing good is equally capable of doing harm if used unwisely." This is no less true of such an apparently harmless substance as water than it is of drugs. The work of Rowntree and his co-workers has shown definitely that the production of an increased supply of water in the organism coincidently with a diminution in water output results in severe symptoms

of intoxication. An important practical illustration of this has been the recent studies of certain symptoms common to workers exposed to high temperatures. These individuals drink enormous quantities of water and as a result perspire very freely. This excessive perspiration carries with it large amounts of salts, particularly sodium chloride, the loss of which from the tissues results in symptoms which are now known to be those of salt deprivation. The addition of small quantities of salt to the drinking water causes a prompt disappearance of the symptoms. The same results may be obtained by the use of various cereal waters, especially if some extra salt is added.

In former years there was considerable discussion as to the advisability of drinking water with meals. As a result of researches conducted largely at the Jefferson Medical College it is now firmly established that from a standpoint of digestion and metabolic economy it is far better to drink water with meals than between meals.

There is a popular belief, unfortunately not restricted to the laity, that the ingestion of distilled water is productive of untoward effects. This belief was based on the absence of electrolytes in such water. However, the average diet contains more than a sufficient electrolyte content, so that, on this basis, no objection can be raised to the use of distilled water. On the other hand, when the question of the toxicity of distilled water was under discussion some years ago, evidence was presented showing that the injurious effect produced on seedlings grown in distilled water was at least partially due to the extraction of electrolytes from the roots.

There is likewise considerable discussion regarding the effects of drinking ice water. Objections have been raised chiefly on the ground that the lowering of gastric temperature and consequent delay in gastric digestion may cause serious digestive disturbances. However it is now generally recognized that the normal stomach, in the presence of normal circulation, is able to maintain the intragastric temperature between extremely narrow limits. Thompson found that two tumblers of ice water when swallowed slowly are warmed to nearly body temperature within five minutes. He says that swallowing ice water does not cool the stomach nor inhibit digestion by local temperature reduction nor by shock to the gastric nerves.

The purification of water from contaminating pathogenic microorganisms by means of chlorination and other disinfectants has marked a distinct advance in public health. However, considerable objection is always raised to the disagreeable taste of certain waters which is due to their high content of industrial chemical waste products or to disinfect-

ing agents. The Sanitary Water Board of this State is actively engaged in attempts to correct any condition which results in harmful pollution of water supplies. It is my belief that attention should be directed toward chemical examination of water from the standpoint of its inorganic content. We are just beginning to appreciate the importance of inorganic elements in metabolism and consequently have hitherto neglected the possible importance of these elements in our drinking water.

Manipulations of water balance as a therapeutic measure have recently been employed in medicine. A striking example of this is seen in the dehydration treatment of epilepsy. This condition is associated among other things with cerebral hydration which is believed to be one of the fundamental factors involved in the production of epileptic seizures. The production of dehydration by the restriction of fluid intake and the administration of dehydrating agents in many cases results in prompt and marked relief. Fay of Temple Medical School was the pioneer in the treatment of epilepsy by severe restriction of water intake.

THE POSSIBILITIES OF FORENSIC CHEMISTRY—AND ITS LIMITATIONS

By Robert T. Paessler
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Little argument will be caused by statements that America is becoming increasingly "crime conscious" or that, despite statistics presented by numerous commissions and well meaning individuals attempting to prove that everything from ingrown toe-nails to baldness is the cause of our national problem, a solution has not yet been reached. The subject is so complex and its ramifications so numerous that the thinking individual cannot fail to realize that only a partial remedy can be afforded by speeding up our system of justice, eliminating as far as possible our "fixed" juries, incompetent or dishonest officials, politics, and the desire by certain individuals to introduce sentiment into the punishment of prisoners.

For a number of years there has been a growing interest in English and Continental scientific methods of criminal investigation, and the amazingly reliable results obtained. Not that our own police systems have broken down, or are necessarily inefficient, but rather that officials are appreciating more and more that "third degree" examinations, "stool pigeons," and "red herring" methods leave much to be desired.

A number of municipal laboratories, already in existence in some of our larger cities, have more than proved their value, even though they are often held down to routine examinations and given but little chance to apply practically foreign methods to American conditions or institute original work of their own. The public is taking a real interest in these matters, and the press is keeping its readers well informed as to all types of scientific progress. It is not surprising, therefore, that insistent demands are being made for the establishment of more laboratories of this character, and that officials are making increasingly frequent requests for assistance from those already in existence.

Now, the average layman has an idea that the chemist is concerned only with the abstract structure of matter or the manufacture of some new tooth paste or food-product, and he (the layman), if he thinks of chemistry in relation to crime at all, associates the phrase "Forensic Chemist" with investigation of crimes of violence alone. As a matter of fact, the forensic chemist's field cannot properly be so circumscribed.

The forensic chemist of today uses not only chemistry, but many of the forms of apparatus common to physical determinations, such as the polariscope, spectroscope, refractometer, microscope and its accessories, together with both ultra-violet light and X-rays. Many of his determinations and analyses are made on so small a scale that they must be followed at considerable magnifications. He uses many methods of the biologist and bacteriologist and should be able to record his findings by photographic methods. His work is to apply such science as may lie within his sphere to the solution of any and all problems of a character solvable through demonstrable experimentation, and arising in connection with the administration of justice.

Modern toxicology rests upon a firm foundation; the precipitin test for human blood cannot be questioned if made under suitable conditions and with proper controls; metals can be compared; dusts examined; scrapings analyzed; residues identified; hairs and fibers classified; documents, paintings and antiques passed upon; oils and other incendiary materials determined; stolen articles traced; and a myriad other facts established, which will fill in the picture and make it complete.

Just as the methods of criminals change (and criminals are ever alert in applying the latest scientific methods to homicides, forgeries, burglaries, etc., displaying a profound knowledge of chemistry, biology, bacteriology, and the latest mechanical devices) just so must the forensic chemist keep pace with all advances in science and place them at the service of criminal investigation organizations.

It must not be forgotten that in this type of work, the cases vary so infinitely in character that it is verily impossible to follow any routine procedure. Each individual situation requires methods applicable to that particular case. One cannot foretell just what will be found or what evidence will be required to complete the case, and consequently the investigation must be of such a scope that no pertinent evidence will be overlooked. This necessitates a broad scientific knowledge, an ability to interpret discovered facts, and a great reserve of patience. Above all, the investigator must be unswerving in his honesty and conscientiousness, ever remembering that the life or liberty of another is at stake.

He would be rash indeed who would attempt to fix limits within which scientific research must necessarily be confined. It is a matter of common knowledge that in science the marvels of yesterday are the commonplaces of today. But the fact remains that writers of popular detective fiction commonly make claims in behalf of their detective-scientists that actual scientists know to be unwarranted at the present time. What is certain is this: scientific research is constantly advancing and achieving. For instance, the tracing of paternity by finger-prints and blood grouping is taking its place among the long list of accepted methods; criminal identification is well-nigh perfected; ballistic science has proved its accuracy and the biologist and psychologist have given us answers to many perplexing problems.

The greatest difficulties which confront this new application of scientific knowledge are, in my opinion:

1. *The proper understanding of basic principles by those officials in charge of our system of criminal procedure, and a cognizance of the inherent limitations of this new application of science.*

I well remember a case of some years ago, in which a young man was charged with the murder of his companion. The heavy stick of wood used and the shoes and clothing of the accused all bore an abundance of human blood and had been admitted as evidence. The defendant placed upon the stand a small-town physician who produced a standard medico-legal work and read into the record the well known fact that human pus, albuminous urine, exudates, etc., would give a precipitin test like that of human blood. Despite the fact that microscopic and chemical findings had definitely proved the stains to be caused by whole blood, it was impossible, in the few minutes available, to make the District Attorney understand why there was absolutely no question as to the truth and accuracy of reported finding of human blood on the exhibits. All of you who have had court experience understand the impossibility of volunteering information in an effort to make up for the lack of knowledge of the examining attorney and his consequent failure to ask the proper questions.

The judge and jury are entitled to reasons why it cannot be definitely stated whether blood stains come from a male or female; why the toxic substance isolated from the viscera of the deceased cannot be traced back to a particular bottle or container; why the chemist cannot prove that kerosene found in an arson case was purchased at the grocery in the next block rather than at the corner store; why he cannot swear that the blue silk fiber discovered in the finger-nail scrapings of the accused came from a particular garment, although such garments are manufactured in lots of hundred thousands. The witness should be given the opportunity to explain these matters instead of being left in an embarrassing position by the attorney. While it would seem perfectly plain and self-evident from the very nature of matter that, exclusive of certain exceptional cases, the composition alone of exhibits can be definitely established, the fact remains that until officials and juries really have a basic understanding of these facts, an explanation is necessary if the testimony of the expert is to be accepted without question.

2. *The use of unscrupulous pseudo-experts.*

I regret to say that I have come into contact with many individuals of this ilk during the last ten years. Needless to say, the illustrative cases are not to be construed as an arraignment of any profession, as these particular individuals would act in the same dishonest manner no matter what their vocation.

This type of individual has been the cause of the erroneous opinion held by the public that experts will testify to anything so long as they are paid, whether they know what they are talking about or not.

A man died under very suspicious circumstances. Negligence on the part of some one permitted his body to be embalmed before a post-mortem was held. The physician who examined the stomach reported the presence of strychnine. By the time I was asked by the District Attorney's office to check up this report, only a small quantity of stomach contents was available for duplicate analysis. In this material I found mercury salts but failed to discover any alkaloid. Exhumation of the body and analysis of the organs removed proved the presence of large quantities of mercury salts but not even a trace of strychnine. Subsequent investigation disclosed that the original diagnosis had been based upon the fact that a guinea-pig had died in convulsions a few minutes after the injection of a small quantity of the stomach contents of this embalmed body!

Again: For a number of years a reputable, qualified chemist had been employed by the county officials to make alcohol determinations and purity tests of samples taken in the course of prohibition enforcement activities. The fees of this chemist aroused the envy of the local druggist, who brought pressure to bear on these officials, stating that he was a taxpayer of the county and should receive the work. The change was made and the druggist retained until certain exhibits could not be found; the results of certain analyses were palpably wrong, and information as to prospective raids, after obtaining "buys," became common knowledge. Inquiry revealed the fact that the samples turned over had never been kept under lock and key, the alcoholic determinations had been made by taking the specific gravity of the undistilled liquid, and friendship together with the exigencies of business had caused information to be given out which should have been available only to the District Attorney.

Again: Officers of a State Police organization one day raided a small speak-easy. Shortly after the raid, it was learned that a customer who had left the place only a few minutes before had died suddenly. After a post-mortem and analysis of the stomach contents, the physician reported the death as due to wood alcohol poisoning. All liquor found in this place had been turned over to me for determination of the alcoholic content. The report of this death made a further examination of these samples necessary, particularly as the son identified one of the bottles in my possession as the identical one from which he and his father had been served. The results of the analyses proved that the liquor was a colored dilute alcohol, but nevertheless pure. I was then requested to "check up" with the analyst of the material taken at the post-mortem, and you can well imagine my surprise to find that all samples had either been entirely used up or destroyed, that no quantitative estimation of alcohol had been made, and that the report of wood alcohol poisoning had been based solely upon the color reaction obtained with morphine and sulphuric acid and a crude distillate of the stomach contents, no confirmatory tests being made!

I could continue with numerous illustrations of this character, but time will not permit. In closing I want to express my sincere hope that the movement for the establishment of suitable crime detection laboratories will be given proper and thoughtful consideration. No one appreciates better than I do that such laboratories will never prove to be a panacea for our national crime problem. They can only reasonably be expected to bring the accused before the bar of justice more quickly and surely and there present convincing scientific proof of his guilt or innocence. This surely is most important, and so I bespeak the invaluable assistance this organization can render in preventing the movement from becoming merely a popular and transitory fad. That it must suffer is most certain unless a juster estimate is placed upon the unwarranted and impossible expectations of officials and the public, who, because of lack of proper understanding, would have the forensic chemist consistently outdo the amazing and miraculous exploits of their favorite hero of detective fiction.

THE USE OF CERTAIN MODIFIED XANTHENE COMPOUNDS IN THE DIAGNOSIS OF MALIGNANT NEOPLASMS

By Donald C. A. Butts[1]

In an effort to satisfy an existing need of rendering early and disseminate malignant neoplasms visible to the surgeon or radiologist, the Emery Laboratory has concentrated its efforts for the past few years upon a method which, to date, offers promise in this branch of cancer research and experimental oncology.

Numerous observations previously made and reported by the writer and his colleagues, upon alterations associated with malignant cell metabolism (see bibliography) suggested the necessary physical, chemical and physiological properties an agent should possess to be absorbed selectively by malignant new growths in concentrations sufficiently high to be differentiated from surrounding normal structures.

After numerous attempts, we found that certain modified compounds of the xanthene group proved most suitable for our purpose.

The classification once suggested, the Emery Laboratory has concentrated its efforts for the past two years on a modification of one of this series, and for purpose of definite identification we have designated the material now under study as "E-47." In this nomenclature, the "E" refers to Emery, the "47" represents the forty-seventh material studied.

Although relatively in its early experimental stage, this compound has been studied in more than 50 rats with transplanted, spontaneous, or recurrent malignant lesions; three dogs with spontaneous and recurrent mammary carcinomata; and eight rabbits with metastatic malignant lesions. In addition to these studies, the action of this material has

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been tested on 31 normal guinea pigs, 84 normal rats, 2 monkeys, and lower forms of life, *i.e.*, gold fish, tadpoles, and germinated seedlings (allium cepa, milo maize, and lupinus albus).

Within the past eight months, the diagnostic value of "E-47" upon 43 human patients has been studied with results of considerable promise.

For sake of brevity, I will summarize a portion of the data accumulated to date from our researches.

Physical Properties. In vitro, a 1:20 aqueous solution of "E-47" is slightly more opaque to X-rays than a similar concentration of the sodium salt of tetraiodphenolphthalein, used for gall-bladder visualization.

In concentrations of 1:20 (the dilution employed to date in human administration) this compound has an average pH of 7.05, and a dynamic surface tension of 59 dynes per centimeter.

Preliminary tests tend to indicate that no appreciable alteration takes place in aqueous solutions of the compound upon standing.

Toxicity. The intravenous toxicity in rats is from 25 to 28 mgs. per 100 gm. body weight.

Quantities of 4.25 gms., injected intravenously into dogs, showed no appreciable affect upon the heart action or blood pressure, as demonstrated by standard physiological methods.

Patients receiving from 250 mgs. to 400 mgs. intravenously evidence no change in body temperature, pulse rate, or respiratory rate as the result of the administration of the above quantities of "E-47."

Since the development of "E-47," a total of seventy-four persons have received intravenous injections of this compound. In one case, the patient has received twenty-one injections, extending over a period of six months, with an accumulative dose of 5.024 gms. In no case has there been evidenced any harmful effect under any condition.

Local Reaction. In a large number of human cases injected with "E-47," there was experienced a more or less acute local reaction evidenced as a burning sensation in the region of the pathology. This reaction was manifested almost immediately and persisted for varying periods of time, in some cases for several hours following the injection.

In cases of gastric malignancy, nausea and vomiting frequently resulted from the injection.

Research is now being conducted in the Emery Laboratory to determine whether or not this clinical symptom is the result of a local temperature rise in the involved area, resulting from a direct and specific chemical reaction between carcinomatous tissue and the compound.

Absorption. Perhaps one of the most important researches in conjunction with "E-47" is that in the field of cytology. Although still in its early stages, I feel that sufficient work has been done to demonstrate selective absorption of this compound by the nuclei of the cells.

I regret very much that the observations made to this time have as yet not received sufficient confirmation to allow a comprehensive report to be presented.

Elimination. Although the time for complete elimination and the percentage and nature of the recovered material are still undetermined, experimental and clinical observations demonstrate the presence of a colored compound in the excretions of both the gastro-intestinal and urinary tracts. The chemical alteration, if any, which it undergoes in the body is still to be determined.

Special Characteristics. Researches by section, and examination of roentgenograms, tend to indicate that this material is absorbed selectively by malignant tissues. It is this phase of the work, taken in conjunction with its opacity to the X-rays, that to our mind, merits the further investigation in both laboratory and clinical fields.

Technic

The technic as employed to this time for the visualization of malignant growths is as follows:

a. In selected cases, a roentgenogram is taken of the affected area, twenty-four hours prior to the injection.

b. If the condition is one involving the gastro-intestinal or genito-urinary tracts, the patient is placed on a soft or liquid diet immediately following this preliminary study. If the gastro-intestinal tract alone is involved, the patient is purged early the following morning, at least three hours before the injection of "E-47." If the genito-urinary tract is involved, the patient is made to thoroughly empty the bladder immediately before every roentgenogram is taken.

c. In *all* cases, another roentgenogram is taken immediately before injection.

d. To date, no dose exceeding 400 mgs., in sterile distilled water, irrespective of weight, has been given. This dose is injected into the median basilic vein when conditions will permit.

e. After injection, roentgenograms are taken at 1, 2, 4, 6, 8, 12, 24 and 48 hours when possible.

f. Results of studies to date indicate a steadily increasing opacity in affected area or areas; until the maximum is reached.

Studies to date indicate that the time for maximum absorption and opacity varies in different organs and parts, and other conditions accompanying the individual case under study, such as extent and cellular type.

An interesting result has been clinical improvement in certain cases following the use of this compound for diagnosis. Although this may eventually prove to be only temporary, this comment has been made solely for the purpose of offering evidence that the material under study may be employed with absolute safety, and in no way favors the progress of the disease.

To date, forty-three cases of known or suspected malignancy have been studied in humans. The distribution of lesions studied covers practically every organ or part which might be affected with primary or metastatic pathologies of this nature: Lip, neck, lung, breast, esophagus, liver, stomach, bladder, rectum, uterus and involved lymph glands.

Of this number, we have considered 34, or 79 per cent., definitely positive according to this technic. In six, or 14 per cent., the result has been indefinite, and in three, or 7 per cent., negative.

Cases in which the diagnosis according to our method is considered doubtful or negative may be attributed to any one of six reasons:

1. Conditions studied were not malignant.
2. Case still incompletely studied.
3. Insufficient quantity of "E-47" used to produce the necessary opacity.
4. Time interval for taking roentgenograms incorrect for particular case under study.
5. The existence of unstudied remote metatases which absorbed a large portion of the compound at the expense of the known and studied existing neoplasm. Under these conditions opaque (metastatic) areas could readily have been overlooked in this preliminary study. However, with future research, this factor as a possibility in overlooking the existence of remote lesions will be eliminated.
6. The extent of the pathology was such that the dose employed was distributed in quantities insufficient to render the necessary opacity.

Studies of "E-47" so far tend to indicate that this material should not be employed following recent intensive roentgen or radium therapy. Under these conditions, it may bring about an excessive breaking-down of the involved tissues.

It is our intention to release, at the completion of additional laboratory and clinical studies, a report covering every phase of our researches, including the chemical nature of "E-47." The withholding of its identity at the present time is entirely for the purpose of allowing a thorough and uninterrupted scientific study to be pursued.

At the time of this writing, the preparation of another compound is being undertaken by the Emery Laboratory. The composition of this material has been suggested from the prolonged use of the present compound, and offers features which we hope may prove of outstanding merit in the great crusade now being waged throughout the civilized world against cancer.

In closing this report, I want to take this opportunity of expressing to the members of the Emery Laboratory Committee and the Scientific and Clinical Staff of the Emery Laboratory my sincere appreciation of their earnest and valuable assistance in this investigation.

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STANDARDIZATION AND IDENTIFICATION OF COLOR IN NATURE ACCORDING TO OSTWARD'S METHOD

By E. Alfred Wolf
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(Paper not submitted)

SOME EXPERIMENTS IN X-RAY TECHNIQUE

By B. F. Cary

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It is a well known fact that if we could completely eliminate the effects of secondary radiation in our application of the X-Ray in our diagnostic work we could produce radiographs marvelously rich in detail.

This is attained to a high degree in a mechanical way by the use of the Potter-Bucky Diaphragm—a device, however, not readily adaptable to all conditions and classes of work. We are, therefore, constantly looking for some other means of absorbing these troublesome secondary rays which fog our films and destroy their brilliancy.

We understand that secondary rays, which are thrown off from the cathode, anticathode and surface of our X-Ray tubes have the same velocity, but are of a longer wave length than the primary rays emanating from the focal spot of the target, the various angles of their deflection producing a cross fire effect. As secondary rays are capable of producing nearly the same photographic effect as that of our primary rays, the problem is rather complicated.

Taking into consideration that secondary rays are deflected laterally to a greater or lesser degree when they come in contact with a ray filter, such as a sheet of copper or aluminum, it occurred to us that a wire gauze filter might carry off a large percentage of these vagrant rays, at the same time offering only a limited resistance to the primary rays.

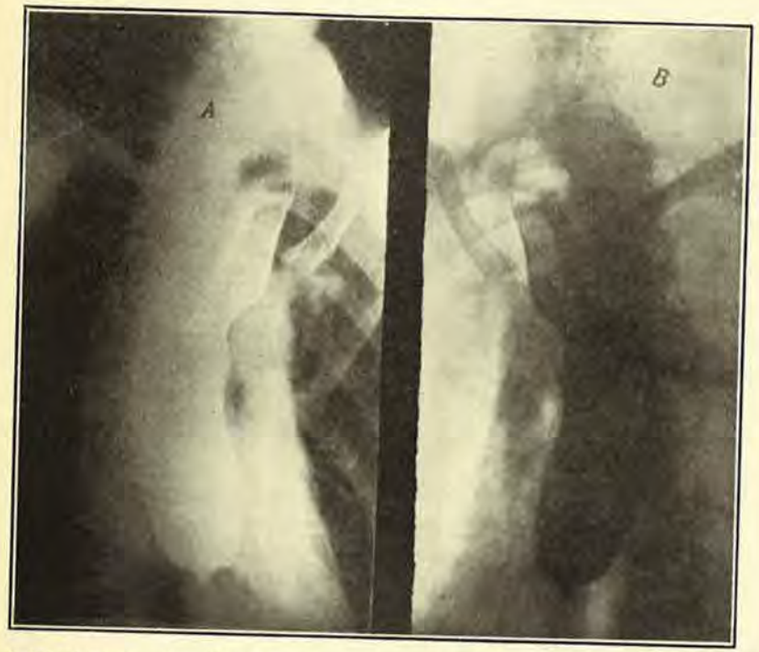
As a result of our experiments along this line, we were able to show veins and arteries in an elbow to a degree not attainable by routine technique and without the introduction of an opaque dye into the blood stream.

In the superficial investigation of some of the properties of the Ultra-Violet Ray as produced by the air-cooled mercury-quartz lamp, we find that with the lamp working at a voltage of 75, we can discharge a gold leaf electroscope at a distance of three feet with the chamber closed, in 52 minutes. With the chamber open but otherwise under like conditions, the discharge takes place in eight minutes.

As a result of this experiment and considering the comparatively close wave lengths existing between that of X-Ray (0.06–10.19 A.U.) and the Ultra-Violet Ray (360–3900 A.U.), it occurred to us that if we should direct a beam of Ultra-Violet Rays between the X-Ray tube and our subject, some of the soft secondary X-Rays might be neutralized thereby.

That this theory possesses some foundation in fact will be demonstrated by lantern slide reproductions of some of our experiments, all of which show a marked clarity of detail as compared with the control exposures made without the Ultra-Violet Ray cross fire. We shall also show some slides illustrating the value of plastic X-Ray effects in illustrating pathological conditions.

Plate VI



A. Original X-ray of a dilated esophagus showing a diverticulum in the upper third and a stricture at cardiac end. B. Radiographic copy of the original.

Finally, our last experiment enables us to produce a radiograph of an X-Ray film retaining the original detail to a high degree. This we believe will prove to be a great advantage over photographic prints where duplication is desired. No change of laboratory practice is required in their production.

That these X-radiographic copies are transparent and can be examined with an X-Ray illuminator in the usual way is a very desirable diagnostic feature.