PROCEEDINGS

OF THE

Indiana Academy of Science,

1894.

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1894.

EDITORIAL COMMITTEE.

STANLEY COULTER, R. ELLSWORTH CALL,
J. C. ARTHUR, A. WILMER DUFF.

INDIANAPOLIS, IND.
OCTOBER, 1895.

INDIANAPOLIS, IND.
WM. B. BURFORD, PRINTER.
1895.

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An Act to provide for the publication of the reports and papers of the Indiana Academy of Science.

[Approved March 11, 1895.]

Preamble.

Whereas, The Indiana Academy of Science, a chartered scientific association, has embodied in its constitution a provision that it will, upon the request of the Governor, or of the several departments of the State government, through the Governor, and through its council as an advisory body, assist in the direction and execution of any investigation within its province, without pecuniary gain to the Academy, provided only that the necessary expenses of such investigation are borne by the State, and,

Whereas, The reports of the meetings of said Academy, with the several papers read before it, have very great educational, industrial and economic value, and should be preserved in permanent form, and,

Whereas, The Constitution of the State makes it the duty of the General Assembly to encourage by all suitable means intellectual, scientific and agricultural improvement, therefore,

Publication of the reports of the Indiana Academy of Science.

Section 1. *Be it enacted by the General Assembly of the State of Indiana*, That hereafter the annual reports of the meetings of the Indiana Academy of Science, beginning with the report for the year 1894, including all papers of scientific or economic value, presented at such meetings, after they shall have been edited and prepared for publication as hereinafter provided, shall be published by and under the direction of the Commissioners of Public Printing and Binding.

Editing reports.

Sec. 2. Said reports shall be edited and prepared for publication without expense to the State, by a corps of editors to be selected and appointed by the Indiana Academy of Science who shall not, by reason of such services, have any claim against the State for compensation. The form, style of binding, paper, typography and manner and extent of illustration of such reports, shall be determined by the editors, subject to the approval of the Commissioners of Public Printing and Stationery. Not less than 1,500 nor more than 3,000 copies of each of said reports shall be published, the size of the edition within said limits, to be determined by the concurrent action of the editors and the Commissioners of Public Printing and Stationery: *Provided*, That not to exceed six hundred dollars ($600) shall be expended for such publication in any one year, and not to extend beyond 1896: *Provided*, That no sums shall be deemed to be appropriated for the year 1894.

Number of printed reports.

Proviso.

Disposition of reports.

Sec. 3. All except three hundred copies of each volume of said reports shall be placed in the custody of the State Librarian, who shall furnish one copy thereof to each public library in the State, one copy to each university, college or normal school in the State, one copy to each high school in the State having a library, which shall make application therefor, and one copy to such other institutions, societies or persons as may be designated by the Academy through its editors or its council. The remaining three hundred copies shall be turned over to the Academy to be disposed of as it may determine. In order to provide for the preservation of the same it shall be the duty of the Custodian of the State House to provide and place at the disposal of the Academy one of the unoccupied rooms of the State House, to be designated as the office of the Indiana Academy of Science, wherein said copies of said reports belonging to the Academy, together with the original manuscripts, drawings, etc., thereof can be safely kept, and he shall also equip the same with the necessary shelving and furniture.

Sec. 4. An emergency is hereby declared to exist for the immediate taking effect of this act, and it shall therefore take effect and be in force from and after its passage. Emergency.

OFFICERS, 1894-95.

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AMOS W. BUTLER.

VICE-PRESIDENT,
STANLEY COULTER.

SECRETARY,
JOHN S. WRIGHT.

ASSISTANT SECRETARY,
A. J. BIGNEY.

TREASURER,
W. P. SHANNON.

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A. J. Bigney,
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D. S. Jordan,
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T. C. Mendenhall,
J. L. Campbell,
J. C. Arthur,
John M. Coulter,
O. P. Hay,
J. C. Branner,
John S. Wright.

CURATORS.

Botany . . . . John M. Coulter.
Ichthyology . . . . Carl H. Eigenmann.
Ornithology . . . . Amos W. Butler.
Herpetology . . . . O. P. Hay.
Entomology . . . . F. M. Webster.
Mammalogy . . . . E. R. Quick.

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MEMBERSHIP.

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H. A. Huston.

NOMINATIONS.

J. C. Arthur, C. L. Mees,
C. H. Eigenmann.

AUDITING.

W. E. Stone, L. M. Underwood.

STATE LIBRARY.

C. A. Waldo, W. A. Noyes, A. W. Butler,
J. S. Wright, A. W. Duff.

LEGISLATION FOR THE RESTRICTION OF WEEDS.

J. C. Arthur, J. M. Coulter, J. S. Wright.

PROPAGATION AND PROTECTION OF GAME AND FISH.

C. H. Eigenmann, A. W. Butler, Ph. Kirsch.

EDITORS.

Stanley Coulter, R. Ellsworth Call,
J. C. Arthur, A. Wilmer Duff.

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L. M. Underwood, A. W. Butler, J. M. Coulter.

DIRECTORS BIOLOGICAL SURVEY.

L. M. Underwood, C. H. Eigenmann, V. F. Marsters.

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C. A. Waldo, A. W. Butler, C. H. Eigenmann.

FINANCE.

C. H. Eigenmann, Stanley Coulter.

OFFICERS OF THE INDIANA ACADEMY OF SCIENCE.

	President.	Secretary.	Asst. Secretary.	Treasurer.
1885-6	David S. Jordan.	Amos W. Butler.	. . . .	O. P. Jenkins.
1886-7	John M. Coulter.	Amos W. Butler.	. . . .	O. P. Jenkins.
1887-8	J. P. D. John.	Amos W. Butler.	. . . .	O. P. Jenkins.
1888-9	John C. Branner.	Amos W. Butler.	. . . .	O. P. Jenkins.
1889-90	T. C. Mendenhall.	Amos W. Butler.	. . . .	O. P. Jenkins.
1890-1	O. P. Hay.	Amos W. Butler.	. . . .	O. P. Jenkins.
1891-2	J. L. Campbell.	Amos W. Butler.	. . . .	C. A. Waldo.
1892-3	J. C. Arthur.	Amos W. Butler.	{ Stanley Coulter. { W. W. Norman.	C. A. Waldo.
1893-4	W. A. Noyes.	C. A. Waldo.	W. W. Norman.	W. P. Shannon.
1894-5	A. W. Butler.	John S. Wright.	A. J. Bigney.	W. P. Shannon.

CONSTITUTION.

ARTICLE I.

SECTION 1. This Association shall be called the Indiana Academy of Science.

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

Whereas, the State has undertaken the publication of such proceedings, the Academy will, upon request of the Governor, or of one of the several departments of the State, through the Governor, act through its council as an advisory body in the direction and execution of any investigation within its province as stated. The necessary expenses incurred in the prosecution of such investigation are to be borne by the State; no pecuniary gain is to come to the Academy for its advice or direction of such investigation.

The regular proceedings of the Academy as published by the State shall become a public document.

ARTICLE II.

SECTION 1. Members of this Academy shall be honorary fellows, fellows, non-resident members or active members.

SEC. 2. Any person engaged in any department of scientific work, or in original research in any department of science, shall be eligible to active membership. Active members may be annual or life members. Annual members may be elected at any meeting of the Academy; they shall sign the constitution, pay an admission fee of two dollars, and thereafter an annual fee of one dollar. Any person who shall at one time contribute fifty dollars to the funds of this Academy, may be elected a life member of the Academy, free of assessment. Non-resident members may be elected from those who have been active members but who have removed from the State. In any case, a three-fourths vote of the members present shall elect to membership. Applications for membership in any of the foregoing classes shall be referred to a committee on application for membership, who shall consider such application and report to the Academy before the election.

SEC. 3. The members who are actively engaged in scientific work, who have recognized standing as scientific men and who have been members of the Academy at least one year, may be recommended for nomination for election as fellows by three fellows or members personally acquainted with their work and character. Of members so nominated a number not exceeding five in one year may, on recommendation of the Executive Committee, be elected as fellows. At the meeting at which this is adopted the members of the Executive Committee for 1894 and fifteen others shall be elected fellows, and those now honorary members shall become honorary fellows. Honorary fellows may be elected on account of special prominence in science, on the written recommendation of two members of the Academy. In any case a three-fourths vote of the members present shall elect.

ARTICLE III.

SECTION 1. The officers of this Academy shall be chosen by ballot at the annual meeting, and shall hold office one year. They shall consist of a president, vice-president, secretary, assistant secretary, and treasurer, who shall perform the duties usually pertaining to their respective offices, and in addition, with the ex-presidents of the Academy, shall constitute an executive committee. The president shall, at each annual meeting, appoint two members to be a committee which shall prepare the programmes and have charge of the arrangements for all meetings for one year.

SEC. 2. The annual meeting of this Academy shall be held in the city of Indianapolis, within the week following Christmas of each year, unless otherwise ordered by the executive committee. There shall also be a summer meeting at such time and place as may be decided upon by the executive committee. Other meetings may be called at the discretion of the executive committee. The past presidents, together with the officers and executive committee, shall constitute the Council of the Academy, and represent it in the transaction of any necessary business not specially provided for in this constitution, in the interim between general meetings.

SEC. 3. This constitution may be altered or amended at any annual meeting by a three-fourths majority of attending members of at least one year's standing. No question of amendment shall be decided on the day of its presentation.

BY-LAWS.

1. On motion, any special department of science shall be assigned to a curator, whose duty it shall be, with the assistance of the other members interested in the same department, to endeavor to advance knowledge in that particular department. Each curator shall report at such time and place as the Academy shall direct. These reports shall include a brief summary of the progress of the department during the year preceding the presentation of the report.

2. The president shall deliver a public address on the evening of one of the days of the meeting at the expiration of his term of office.

3. No special meeting of the Academy shall be held without a notice of the same having been sent to the address of each member at least fifteen days before such meeting.

4. No bill against the Academy shall be paid without an order signed by the president and countersigned by the secretary.

5. Members who shall allow their dues to remain unpaid for two years, having been annually notified of their arrearage by the treasurer, shall have their names stricken from the roll.

6. Ten members shall constitute a quorum for the transaction of business.

MEMBERS.

HONORARY FELLOW.

Daniel Kirkwood	Riverside, Cal.

FELLOWS.

J. C. Arthur	Lafayette.
P. S. Baker	Greencastle.
W. S. Blatchley	Indianapolis.
J. C. Branner	Palo Alto, Cal.
A. W. Butler	Brookville.
R. E. Call	Cincinnati, O.
J. L. Campbell	Crawfordsville.
John M. Coulter	Lake Forest, Ill.
Stanley Coulter	Lafayette.
H. T. Eddy	Minneapolis, Minn.
C. H. Eigenmann	Bloomington.
W. F. M. Goss	Lafayette.
Thos. Gray	Terre Haute.
O. P. Hay	Chicago, Ill.
H. A. Huston	Lafayette.
J. P. D. John	Greencastle.
D. S. Jordan	Palo Alto, Cal.
V. F. Marsters	Bloomington.
C. L. Mees	Terre Haute.
T. C. Mendenhall	Hoboken, N. J.
D. M. Mottier	Bloomington.
W. W. Norman	Austin, Texas.
W. A. Noyes	Terre Haute.
J. T. Scovell	Terre Haute.
W. P. Shannon	Greensburg.
Alex. Smith	Chicago, Ill.
W. E. Stone	Lafayette.
M. B. Thomas	Crawfordsville.
L. M. Underwood	Auburn, Ala.
T. C. Van Nuys	Bloomington.
C. A. Waldo	Lafayette.
F. M. Webster	Wooster, O.
J. S. Wright	Indianapolis.

Deceased.

NON-RESIDENT MEMBERS.

D. H. Campbell	Palo Alto, Cal.
B. W. Evermann	Washington, D. C.
Charles H. Gilbert	Palo Alto, Cal.
C. W. Green	Palo Alto, Cal.
C. W. Hargitt	Syracuse, N. Y.
Edward Hughes	Palo Alto, Cal.
O. P. Jenkins	Palo Alto, Cal.
J. S. Kingsley	Tufts College, Mass.
Alfred Springer	Cincinnati, O.
Robert B. Warder	Washington, D. C.

ACTIVE MEMBERS.

J. Alex. Adair	Hanover.
R. J. Aley	Bloomington.
Timothy H. Ball	Crown Point.
H. H. Ballard	Terre Haute.
C. L. Barnes	Indianapolis.
George W. Benton	Indianapolis.
A. W. Bitting	Lafayette.
Alexander Black	Greencastle.
Henry L. Bolley	Fargo, N. D.
M. A. Brannon	Ft. Wayne.
Charles C. Brown	Indianapolis.
W. V. Brown	Greencastle.
H. L. Bruner	Irvington.
Wm. Lowe Bryan	Bloomington.
J. B. Burris	Cloverdale.
Noble C. Butler	Indianapolis.
J. T. Campbell	Rockville.
J. Fred Clearwaters	Greencastle.
H. J. Clements	Washington.
U. O. Cox	Mankato, Minn.
M. E. Crowell	Indianapolis.
Will Cumback	Greensburg.
Alida M. Cunningham	Kirkpatrick.
George L. Curtiss	Greencastle.
B. M. Davis	Irvington.
D. W. Dennis	Richmond.
Chas. R. Dryer	Terre Haute.
A. Wilmer Duff	Lafayette.
Joseph Eastman	Indianapolis.

E. G. Eberhardt	Indianapolis.
M. N. Elrod	Hartsville.
F. L. Emory	Ithaca, N. Y.
Samuel G. Evans	Evansville.
E. M. Fisher	Lake Forest, Ill.
J. J. Flather	Lafayette.
A. L. Foley	Bloomington.
Robert G. Gillum	Indianapolis.
J. R. Francis	Indianapolis.
J. B. Garner	Crawfordsville.
U. F. Glick	Newbern.
Katherine E. Golden	Lafayette.
Michael J. Golden	Lafayette.
W. E. Goldsborough	Lafayette.
C. F. Goodwin	Brookville.
S. S. Gorby	Indianapolis.
Vernon Gould	Rochester.
E. H. Heacock	Leadville, Colo.
Edwin Stanton Hallett	Corydon.
A. S. Hathaway	Terre Haute.
Wm. Perry Hay	Irvington.
Franklin W. Hayes	Indianapolis.
Robert Hessler	Logansport.
T. H. Hibben	Indianapolis.
George C. Hubbard	Moore's Hill.
J. W. Hubbard	Bloomington.
Thomas M. Iden	Irvington.
Alex. Jameson	Indianapolis.
A. E. Jessup	Carmel.
Sylvester Johnson	Irvington.
W. B. Johnson	Franklin.
E. M. Kindle	Bloomington.
J. G. Kingsbury	Irvington.
W. H. Kirchner	Minneapolis, Minn.
Ph. Kirsch	Columbia City.
Charles T. Knipp	Bloomington.
Daniel Layman	Indianapolis.
W. S. Lemen	Indianapolis.
Robert E. Lyons	Bloomington.
Herbert W. McBride	Chicago, Ill.
Robert Wesley McBride	Indianapolis.
Kate McCarthy	Wabash.
Rousseau McClellan	Indianapolis.
D. T. McDougal	Minneapolis, Minn.
F. M. McFarland	Palo Alto, Cal.
J. W. Marsee	Indianapolis.

W. J. Moenkhaus	Bloomington.
G. T. Moore	Crawfordsville.
Joseph Moore	Richmond.
Warren K. Moorehead	Columbus, Ohio.
J. P. Naylor	Greencastle.
Charles E. Newlin	Indianapolis.
E. W. Olive	Frankfort.
J. H. Oliver	Indianapolis
D. A. Owen	Franklin.
Elwood Pleas	Dunrieth.
A. H. Purdue	Chicago, Ill.
Ryland Ratliff	Fairmount.
D. C. Ridgley	Delphi.
George L. Roberts	Greensburg.
L. J. Rettger	Terre Haute.
Adolph Rogers	New Castle.
John F. Schnaible	Lafayette.
C. E. Schafer	Huntington.
Claude Siebenthal	Bloomington.
G. W. Sloan	Indianapolis.
Harold B. Smith	Lafayette.
F. P. Stauffer	Logansport.
M. C. Stevens	Lafayette.
Joseph Swain	Bloomington.
A. E. Swaim	Indianapolis.
Geo. A. Talbert	Laporte.
Frank B. Taylor	Ft. Wayne.
Erastus Test	Lafayette.
F. C. Test	Washington, D. C.
Wm. M. Thrasher	Irvington.
A. L. Treadwell	Oxford, Ohio.
Joseph H. Tudor	Baltimore, Md.
E. B. Uline	Lake Forest, Ill.
A. B. Ulrey	Bloomington.
W. B. Van Gorder	Knightstown.
Ernest Walker	New Albany.
F. A. Walker	Anderson.
W. O. Wallace	Wabash.
M. W. Wells	Indianapolis.
Wm. M. Whitten	South Bend.
J. R. Wiest	Richmond.
H. W. Wiley	Washington, D. C.

W. L. Wood . . . . Covington.
A. J. Woolman . . . . Duluth, Minn.

Honorary fellow	1
Fellows	33
Non-resident members	10
Active members	121
Total	165

TENTH ANNUAL MEETING OF THE INDIANA ACADEMY OF SCIENCE.

The tenth annual meeting of the Indiana Academy of Science was held in Indianapolis, December 27 and 28, 1894, preceded by a session of the Executive Committee of the Academy, 8 P. M., December 26.

The Academy met in general session, 9 A. M., December 27, at which committees were appointed and various other business transacted, after which there was an adjournment until 2 P. M., whereupon it met in two sections—biological and physico-chemical—for the reading and discussion of papers. After adjournment of the sectional meetings, at 5 P. M., the Academy again met in general session at 7 P. M., for the address of the retiring President, Prof. W. A. Noyes, subject, "Lavoisier."

December 28, 9 A. M., the Academy met in general session for the transaction of business, after which followed the reading and discussion of papers until adjournment at 1 P. M.

After the adjournment of the Academy the Executive Committee met with a committee of the Science Club of Indianapolis to discuss the publication of the proceedings of the Academy by the State.

FIELD MEETING OF 1895.

The 1895 Field Meeting of the Indiana Academy of Science was held at Wyandotte Cave May 15, 16 and 17. The business session of the meeting was held at 8 P. M., May 15. In the absence of the President and the Vice-President, Dr. P. S. Baker acted as chairman. The remaining time of the meeting was spent in the field.

WINTER MEETING.

Indianapolis, December 27 and 28, 1894.

PRESIDENT'S ADDRESS.

Lavoisier.

By W. A. Noyes.

On May 8, of this year was the centennial of the execution of a man who influenced profoundly the development of scientific knowledge. To Antoine Laurent Lavoisier belongs chiefly the honor of the saying that "Chemistry is a French science." a saying which possesses a certain amount of truth, though it does injustice to much good work done elsewhere, and is entirely false as regards the present condition of the science.

During many centuries, such workers in chemistry as there were followed mostly a vain search after gold and after the elixir of life. During this period of sordid aim many facts were discovered, but little real progress was made, for facts do not constitute a science. Then, for another century, chemistry was pursued mainly in connection with the study of medicine with the thought that the science would hold in its grasp the secret of all disease and its cure. During this period, too, there was some progress, for the aim was a little less sordid and base, and somewhat more rational means were used, but the chemistry of that day, very much like a good deal of the medical science even of to-day, labored under the difficulty of being an applied science without any satisfactory foundation in pure science. As in all such cases, the science was constantly confronted with the necessity of doing something immediately, when it had nothing but the crudest empiricism to guide it. The best deductions which were possible were made from a few and very imperfect data, and the conclusions were very often in error. Often years, or even centuries of experience are required for the discovery, by such methods, of the right course of procedure, which may, later, be known as a simple corollary from a single principle of pure science.

Pure science belongs to all time, and can wait for a fact or a principle till the time is ripe for its discovery. Applied science is essentially ephemeral, and must have *to-day* the best it can get. If it can not find certain knowledge it must guess to the best of its ability. And so it follows that only those forms of applied science which follow in lines of pure science make great and lasting progress.

Nowhere has this been more clearly evident than in the development of chemistry. Medicine, during the era of medical chemistry, probably killed more of its patients than it cured, and the applied chemistry of to-day makes greater advances in a decade than were made during whole centuries of empiricism.

It is scarcely more than two centuries since a few men first began to search into the composition of bodies with the pure, high aim of an endeavor to extend human knowledge. From this period dates the beginning of chemistry as a pure science, and in this sense those who refer the beginning of chemistry to Lavoisier do injustice to such men as Boyle, Stahl, Black, Scheele, Priestly, Cavendish and many others.

These men worked with the same spirit and purpose, and often in the face of far greater difficulties than those which later workers were compelled to face. These were the real pioneers of pure chemistry.

In the hands of these workers we find for the first time in the science one of the best and highest characteristics of any pure science, the proposal, development and general acceptance of an important theory—a theory which coördinated and explained from one point of view many and diverse phenomena—a theory conceived in a pure philosophical spirit—one step in the constant endeavor of the highest minds to tear away from before our eyes the things which are fortuitous and misleading and to get a little closer to the realities which lie at the basis of all material existence. I refer, of course, to the theory of phlogiston.

In outward appearance ordinary combustion is of the nature of a decomposition and this view of the phenomena was held from the earliest times. Building, as every founder of a theory must, on the best knowledge which was possessed, and recognizing the close connection between the oxidation of metals and ordinary combustion the chemists of this time proposed the theory that all bodies capable of combustion or oxidation contain a common substance or principle called phlogiston, and that combustion consists in the escape of the phlogiston leaving behind that with which it was combined.

In accordance with this view, wood, charcoal and similar substances are rich in phlogiston and mostly disappear in burning. Metals are composed of phlogiston and the metallic calex or what we now know as the oxide—the metal being considered compound and the oxide as one of its parts.

At the time when the theory was proposed and developed it gave a quite satisfactory explanation of most of the phenomena then known. It served as a means of bringing together under one point of view very many and diverse facts and of coördinating them all under a system which was clear and intelligible. As new facts were discovered they were explained and systematized as far as possible in accordance with the theory. And so it happened that, while the theory contained only a partial truth, and even that half-truth was so badly distorted that we have some difficulty even now in recognizing it, the development of the science was comparatively rapid during this period. And we may be sure that this theory furnishes one important reason why chemistry made more progress during the century of its proposal, development and general acceptance than during many centuries before. But, as often happens, a theory which was extremely valuable for a time and which was probably the best which the science of its day was capable of accepting, outlived its usefulness and was generally believed after the facts necessary for its overthrow had been discovered. At such times there comes the necessity for a man with a profound reverence for facts as of supreme importance and as beyond and underlying all theories—a man, too, with great power to see through all external phenomena and grasp their true explanation in spite of any preconceived notion or any theory no matter how generally accepted. I think it not without significance that the man who could do all this for chemistry was produced in France during that period before the revolution when the country was full of the fermentation of those ideas which led to that tremendous revolt against all forms of dogmatism and authority when men were ready to question ideas and beliefs which had been held sacred for centuries and when the feeling was prevalent that all knowledge and even all forms of society must be torn down and rebuilt from the very foundations.

Lavoisier was a fit product of such an age—a man capable of proposing a heresy in the face of all orthodox scientists and with the ability, too, to prove, in the end, that his heresy was true and orthodoxy was false.

Lavoisier was born in 1743. His father was a wealthy merchant, who was, himself, interested in science, and personally acquainted with some of the most noted scientific men of Paris. The son received a thorough education under the best teachers of the city. He seems to have been especially interested in mathematics and chemistry, but studied carefully other sciences as well. He was first known to the scientific world through his competing, when 21 years old, for a prize offered by the French government for the best method of lighting a great city. The prize of two thousand livres was awarded to Lavoisier, but he caused the money to be divided between three of his competitors to repay them for their outlay in making experiments. He received, however, through the French Academy, a medal granted him by the king in recognition of his services, and it was largely in consideration of this work that he was chosen a member of the Academy at the early age of twenty-five. While Lavoisier devoted most of his time and energy to the prosecution of researches in pure science he seems always to have retained a lively interest in technical applications of scientific knowledge, and often rendered valuable services to his country in such matters. For a long time he had oversight of the manufacture of saltpeter and gunpowder for the French government, and it is remarked that during this period the gunpowder of France was the best in the world, while after his death it became much inferior. We can scarcely find a better answer to those who would have us think that an interest in technical applications is beneath the dignity of those who are devoted to the development of the higher departments of science. We find, on the contrary, that scientific men of the very highest rank have shown great interest in the material advantages which would result from their discoveries and have frequently taken time for the careful study of technical problems. While the absorbing consideration of material results, which is required of those who are engaged in technical pursuits, is undoubtedly incompatible with any high scientific attainment, I believe that the scientist who occasionally studies carefully and thoroughly some technical application of his science will find that his mental horizon has been broadened by the process. We have too many men nowadays who are so absorbed in some narrow corner of their science as to lose all breadth of view and all true sense of relative value and importance in scientific work, and who become one-sided and seriously dwarfed in character. It is, after all, important that one should be a man, and retain broad human interests as well as that he should attain high rank as a scientist.

In speaking of Lavoisier's work in pure science I shall not attempt an exhaustive catalogue of his researches, for it is not my purpose to give a history of his life, but rather, if possible, to gain a clear conception of his character and his work and of the relation which these bear to the development of the science of chemistry.

The first work in which we can see some clear relation to his later achievements was published in the memoirs of the Paris Academy for 1770. It concerned the conversion of water into earth. The mere fact that such a topic should require careful experiment and serious discussion gives us a glimpse of how very radically different from ours was the opinion of the best science of that day upon such fundamental subjects as the indestructibility and interconvertibility of matter. From the earliest times it had been believed that water may, under various conditions, be converted into earth. In later times it was thought that this view had been confirmed by the work of many careful experimenters. Glass vessels were almost universally used for the distillation and evaporation of water, and many different observers found that even water which had been repeatedly distilled left behind, on evaporation, small amounts of earthy matter which were thought to have been formed by the section of heat upon the water. To test the matter Lavoisier placed some water in a sealed vessel so arranged that the water could be boiled in the lower part, while the steam would condense above and run back. He kept three pounds of water boiling in this way for more than three months. At the end of the time he evaporated the water and obtained from it 20.4 grains of earthy matter, while the vessel used had lost 17.4 grains in weight. The difference he considered as due to unavoidable errors of experiment, and from the imperfect data he drew the correct conclusion that water can not be changed into earth. Such results as these must have given to Lavoisier the feeling that he could not trust the observations of other chemists, but must test every experimental fact for himself. This attitude, which was, undoubtedly, not without some reason, is closely connected with one of the worst sides of his character— a tendency to belittle the work of others, and even to appropriate as his own discoveries made by others. We find that Lavoisier repeatedly described discoveries which had been made by some one else in such a manner as to give the impression that the discovery had been made by himself. It is true that in some cases the discovery acquired in his hands an entirely different meaning. This is especially true of the discoveries of oxygen and of the composition of water. Lavoisier was, undoubtedly, the first to see the true significance and importance of these discoveries, and the very great value of the discoveries to the scientific world depends far more on the labors of Lavoisier than on those of Priestley and Cavendish. Yet this can not lead us to condone the desire which was shown of appropriating for himself the honor which belonged to others. Indeed, we can not but feel that such conduct is more than usually reprehensible in one whose own work was really so very great and who, of all men, had so little need to seek for honor that was not entirely his own. There was certainly something lacking in the moral fiber of the man which detracts very much from our opinion of his personal character however much we admire his scientific achievements.

Lavoisier's study of the conversion of water into earth was of especial interest because of the way in which he attacked the problem. Previous to his time very few chemists paid any attention to quantitative relations in chemical phenomena, and his use of the balances in studying the question proved in his hands the beginning of a new era. Too much has often been made, however, of this distinction between the chemistry of the era of phlogiston and that which immediately followed the downfall of that theory. Cavendish spent a great deal of time on quantitative experiments, and many of his results exceeded in accuracy those of Lavoisier, yet all of his work was conceived and his results were interpreted in terms of the theory of phlogiston. Methods of quantitative analysis similar to those still in use were developed by Bergmann and by other contemporaries of Lavoisier who still held entirely to the old theories. The quantitative method was "in the air" as it were, and was coming into more and more extended use in the hands of many different chemists. And, even after Lavoisier's views were generally accepted, quantitative results were usually very inaccurate till some time after Dalton's atomic theory had given a sharp means of control. Lavoisier's greatness was not so much in the introduction of a new method, as in that wonderful insight which enabled him to see through the appearances on the surface and find the real reasons which lay beneath.

The beginning of his most valuable work seems to have been made in 1772, when he was not yet thirty years of age. In a short note written at this time and published in 1773, he states that the oxidation of metals and also the combustion of phosphorus and sulphur is accompanied by an increase of weight and by the absorption of a large amount of air, also that on the reduction of metallic oxides a large amount of gas, or "air" is evolved. In these crude and imperfect statements, we see the germ of all his greatest discoveries. In 1774 he described more accurately his experiments with tin. He placed the metal in a retort, sealed it hermetically and weighed the whole. He then heated the retort till the tin was oxidized, and then weighed the whole again, showing that there was no change in weight. On opening the retort, air entered, and there was an increase of weight which he says was exactly equal to the gain in weight of the tin due to oxidation. We know that this could not have been strictly accurate, for oxygen had been absorbed, and air, which is specifically lighter than oxygen, had entered, but we see once more the great power which the man had of drawing correct conclusions from imperfect data. A chemist of some standing has recently said, "that it is not the province of science to explain anything," and "that the business of science is to *describe* phenomena in a simple manner, to seek actual relations between measureable quantities, to deal only with things which can be handled and measured." How erroneous and imperfect such a view of the province of science is, was never better illustrated than in the present case. Essentially the same fact in almost all of its details had been observed by Boyle one hundred years before, and many others had observed that metals increase in weight when oxidized. The fact alone was barren, the fact in conjunction with its correct explanation became fruitful in wonderful scientific developments.

In these first experiments Lavoisier does not seem to have recognized but what air, as a whole, was absorbed in processes of oxidation and combustion. On August 1, 1774, Priestley, in England, discovered oxygen gas, and visiting Paris

1. J. E. Trevor, Jr., Am. Chem. Soc., *16*, 520.

soon after, he described his discovery to Lavoisier. Priestley, with the other chemists of his time, held to the theory of phlogiston, and expressed his discovery in terms of that theory. In accordance with that theory he called oxygen dephlogisticated air, and nitrogen, or in general, air which had lost the power of supporting combustion, whether pure nitrogen or not, phlogisticated air. The thought conveyed by these terms was that air possessed a certain capacity for absorbing the phlogiston which was supposed to be given off during combustion, but that ordinary air already contained a considerable amount of phlogiston. If this phlogiston were removed the capacity to take it up again would, of course, be increased, and the resulting substance which we call oxygen could properly be called dephlogisticated air, while nitrogen, which was supposed to have taken up all the phlogiston which it could hold, was called phlogisticated air. It is evident, at once, that while the honor of the discovery of oxygen really belongs to Priestley, the new substance was not to him a separate and distinct element in any such sense as we now understand it, but was rather a sort of modified air. The theory of phlogiston dealt chiefly with outward appearances and qualitative phenomena, and the time had now come when the theory was inadequate and a hindrance to further progress. Lavoisier seems to have been the only chemist of the time who recognized this. After Priestley had told him of his discovery he repeated the experiments for himself, and soon came to a comparatively clear and correct view of the composition of air, and the real nature of oxidation and combustion. But while even at this early date he must have begun to see that the theory of phlogiston was unnecessary, and probably fallacious, his open conflict with the theory does not seem to have begun till several years later. He contented himself with a description of his experiments and explanation of his results, rather ignoring than directly combatting the prevailing theory. He had acquired reputation by this time as a careful experimenter and as one thoroughly acquainted with the history and theories of his science. He was recognized, therefore, when the time came, as one competent to criticise current theories, and as one whose criticism must, at least, receive respectful attention.

During the ten years that followed, from 1775 to 1785, Lavoisier busied himself almost exclusively with experiments more or less closely connected with combustion and oxidation. Gradually he proved, by careful experiments made with a great number of different substances, that ordinary combustion consists in all cases of a combination with oxygen. He showed that "fixed air" is formed by the combustion of the diamond and of charcoal; that phosphoric acid, according to the nomenclature of the period which followed, is formed by the combustion of phosphorus, and also by its oxidation with nitric acid; that both sulphurous and sulphuric acids are compounds of sulphur with oxygen, and that "fixed air" is also formed by the combustion of candles and of other organic matter. These experiments led him to not only clear and correct views of the phenomena of combustion and oxidation, but they also gave rise to a radically new conception of the nature of acids and salts. The opinions which he developed were afterwards found to be imperfect, but they were a very great advance on anything which had preceded, and were of incalculable value in the development of chemical science. After finding from his own experiments and those of others that oxygen is a common constituent of carbonic, phosphoric, sulphurous, sulphuric and nitric acids he made the generalization that oxygen is the source of all acid properties, and called it by its present name, which means "acid former." To him an acid was simply a compound of carbon, sulphur, or some other element with oxygen, and a salt was a compound of such an oxide with an oxide of a metal. This view held practical sway in chemistry for sixty years, and is at the basis of many expressions which chemists still use. While doubtless less perfect than the view which considers acids as compounds of hydrogen, it nevertheless expressed clearly some truths which our modern chemistry does not quite so clearly express, for oxygen is still, as always, a great acid-forming principle, and salts contain metals as well as non-metals in an oxidized form. Lavoisier considered that the combination of a metal with an acid may take place in two ways. Either the metal combines with a part of the oxygen of its acid forming an oxide which then combines with the acid, or as we should say, with the anhydride of the acid; or the metal, by the aid of the acid, decomposes the water present, combining with its oxygen and liberating its hydrogen, and the oxide formed there combines with the acid. The first view may still be considered as essentially correct as an explanation of such cases as the action of concentrated sulphuric acid on copper; here copper oxide is undoubtedly formed, for some of it escapes combination with the acid, and sulphur tri-oxide is present as an independent compound at the temperature of the reaction, and very probably combines with the copper oxide as it is formed, to produce copper sulphate. As regards the second view, which applies to such cases as the solution of zinc in dilute sulphuric acid, there is still some diversity of opinion and some uncertainty in the minds of chemists. The common statement of our text-books is that the action consists in a substitution of the metal for the hydrogen of the acid, and this is undoubtedly correct, as a superficial view of the matter. The explanation which has been more recently proposed, however, and which has already gained many adherents, is that direct substitution takes place in such cases with very great difficulty, if at all, and that action takes place readily only when the acid has been dissociated into its ions, and that the real action consists in the exchange of charges of electricity between atoms of hydrogen and atoms of the metal, the atoms of the metal, with their newly acquired charge, becoming ions in the solution. Whatever may be the truth of the matter, the views of Lavoisier were of very great value in the development of chemistry. They contributed to a clearer conception of the nature of salts, and they laid the foundation for a rational nomenclature, which was introduced for the first time in connection with Lavoisier's system, though the principles of the nomenclature seem to have been proposed by De Morveau, and Berthollet and Fourcroy aided Lavoisier in their development.

Beside the theories of combustion and oxidation and of the relations of acids, oxides and salts, which must be considered as his greatest contribution to science, Lavoisier worked successfully in a number of other directions. He paid close attention to the heat relations involved in combustion; he studied carefully the alcoholic fermentation and gained a very close and correct conception of the process and made some attempts to determine the quantitative composition of organic bodies. These attempts were not very successful, but the methods used were correct in principle and laid the foundation for the better work which was done years afterwards. In the domain of physiological chemistry and in physics Lavoisier also did some excellent work.

His literary activity consisted chiefly in the preparation of papers describing his work. No less than sixty communications of this kind were published in the Memoirs of the Paris Academy from 1768 to 1787. Not till toward the close of his life did he gather the results of his work together in a systematic treatise on chemistry, which appeared in 1789. I can not refrain from quoting two extracts from this book, which give us a glimpse of the character of the man and show us something of the secret of his wonderful power. The first is from his preface.

After calling attention to the fact that in every day affairs our mistakes are constantly checked and corrected by the unpleasant effects which follow them, he goes on to say:

"In the study and practice of the sciences it is quite different; the false judgments we form neither affect our existence or our welfare and we are not forced by any physical necessity to correct them. Imagination, on the contrary, which is ever wandering beyond the bounds of truth, joined to self-love and that self-confidence we are so apt to indulge, prompt us to draw conclusions which are not immediately derived from facts; so that we become in some measure interested in deceiving ourselves. Hence it is by no means to be wondered that in the science of physics in general men have often made suppositions instead of forming conclusions. Those suppositions, handed down fromone age to another, acquire additional weight from the authorities by which they are supported, till at last they are received, even by men of genius, as fundamental truths.

"The only method of preventing such errors from taking place, and of correcting them when formed, is to restrain and simplify our reasoning as much as possible. This depends only on ourselves, and the neglect of it is the only source of our mistakes. We must trust to nothing but facts; these are presented to us by nature and can not deceive. We ought, in every instance, to submit our reasoning to the test of experiment, and never to search for truth but by the natural road of experiment and observation. Thus mathematicians obtain the solution of a problem by the mere arrangement of data, and by reducing their reasoning to such simple steps, to conclusions so very obvious, as never to lose sight of the evidence which guides them.

"Thoroughly convinced of these truths, I have imposed upon myself as a law never to advance but from what is known to what is unknown; never to form any conclusion which is not an immediate consequence necessarily flowing from observation and experiment; and always to arrange the facts, and the conclusions drawn from them in such an order as shall render it most easy for beginners in the study of chemistry thoroughly to understand them. Hence I have been obliged to depart from the usual order of courses of lectures and of treatises on chemistry, which always assumes the first principles of the science, as known, when the pupil or the reader should never be supposed to know them till they have been explained in subsequent lessons. In almost every instance these begin by treating of the elements of matter, and by explaining the table of affinities, without considering that, in so doing, they must bring the principal phenomena of chemistry into view at the very outset; they make use of terms which have not been defined and suppose the science to be understood by the very persons they are only beginning to teach. It ought likewise to be considered, that very little of chemistry can be learned in a first course, which is hardly sufficient to make the language of the science familiar to the ears, or the apparatus familiar to the eyes. It is almost impossible to become a chemist in less than three or four years of constant application."

These statements are no less true to-day than one hundred years ago. No less apposite is the following, referring to the work to be done in chemistry:

"This is a vast field for employing the zeal and abilities of young chemists, whom I would advise to endeavor rather to do well than to do much. * * * * Every edifice which is intended to resist the ravages of time should be built on a sure foundation; and, in the present state of chemistry, to attempt discoveries by experiments, either not perfectly exact, or not sufficiently rigorous, will serve only to interrupt its progress, instead of contributing to its advancement."

During the stormy days of the Revolution, as well as before, Lavoisier rendered frequent services to his country. In 1787 he was elected to the Provincial Assembly of Orleans. In 1790 he was a member of the commission which devised the metric system of weights and measures. In 1791 as a member of a commission he published an essay on the National Resources of France, which entitles him to high rank as a political economist. These facts show that he was a man of broad interests as well as a chemist of preëminent rank.

Some of his public acts, and especially those in connection with the collection of taxes rendered it easy to find some trivial complaint against him. And during the reign of terror, while the power of Robespierre was at its height, a trivial complaint was equivalent to condemnation. After sentence he asked for a fortnight's delay that he might complete some scientific experiments, but with the words "We have no more need of philosophers," he was hurried to execution. So died, on May 8, 1794, the greatest chemist of the eighteenth century. I had almost said of any century. For we can scarcely find in the history of thought another who has so transformed the science with which he worked. He cleared away the misconceptions and erroneous speculations of centuries and, building on a solid basis of experimental facts, he laid a sure foundation for rapid and permanent growth in chemical knowledge.

PAPERS READ.

Some Factors in the Distribution of Gleditschia Triacanthos, and Other Trees. By Ernest Walker.

The importance of winds as factors in the distribution of plants has always been recognized by all who have written on subjects connected with plant-geography. It seems, however, that their effectiveness has been appreciated only in the case of extremely fine and light seed, or those provided with appendages for suspension in air, while in the case of heavier seeds, unprovided with such appendages, they are held even by many of our most authoritative writers to be of little or no consequence. Such seeds are thought to be too heavy to be affected in the least by any wind short of a "violent storm" or real "hurricane." As these are only occasional, and as the direction of winds is thought to be so variable, it has become customary to speak of them as among the "occasional" or "accidental" factors in plant migrations.

Darwin objected to the term "accidental," and for the best of reasons, suggesting as a substitute the word "occasional." But to the writer it seems that the second term, while not quite as unscientific as the former, is in other respects no improvement. For even if the influence of winds in seed diffusion were limited to the lighter or appendaged seeds, it would still be objectionable, as must be obvious.

By no means, however, are we justified in holding that winds affect only lighter seeds, and that moderate winds have little or no influence on heavier fruits and seeds, which any one may readily demonstrate for himself by observation. The writer shared in the prevailing opinion until observations convinced him of the contrary, and showed that ordinary winds have sufficient force to transport even the heavier fruits and seeds, when borne on parts some distance above the ground, to considerable distances. In considering the value of winds as plant diffusing agents, several incidentals occur more or less influencing their effectiveness, which it may be well to mention.

As is obvious, height of the plant is an important factor. Were a fruit as large as the cocoa-nut to be borne on a low plant close to the ground, winds could have no appreciable effect on its fall; but growing as it does, on a tall tree, the strong winds, such as are common in the regions it inhabits, may drive the fruit in falling considerably from the perpendicular before it has reached the ground. Again, tall plan's are likely to travel more directly with winds in regions where these blow mainly from one direction during the fruiting season, owing to the fact that the direction of the wind is less affected by irregularities of land surface at some distance above the ground.

Rigidity of trunks and branches is an item worth considering. Flexible stems and branches will lean with the wind, and drop their fruit farther on the side from the wind than in the case of more rigid ones.

Weight, bulk and form of fruits have their values. Lighter unappendaged fruits and seeds may be carried a considerable distance by winds, even when produced upon low growing plants. Where the bulk of surrounding parts is large in proportion to the size of the seeds, it not only makes the force of wind more effective, but in some instances it is probable these bulky parts by their decay enrich the spot upon which the fruit finally rests, and thus helps in giving the young seedlings a start in life, and in traveling across infertile belts.

Peculiarities in form may enable the winds to drive some fruits before them even after the latter have fallen to the ground. The light, globular form of some pine cones when dried enable them to roll readily. In the case of other forms, the curvature of cylindrical cones or slight hooks at the tip of the scales tend to check motion due to gravity, or the influence of winds. Curvature or twisting in flat fruits is obviously an advantage in traveling before winds.

The time and duration of the fruiting season is a matter of the utmost importance; especially if what the writer shall suggest in regard to the direction of winds for certain regions and seasons shall be found to be true. Plants which fruit throughout the season would tend to spread in all directions, while those that ripen their fruit in a single crop at a stated season would be inclined to travel more in one or a few directions, and occupy particular ranges. Darlington always mentions the fruiting season; later authors but rarely, which the writer has often had occasion to regret.

Dehiscence of fruits may have an important bearing in the matter of seed dissemination. The forceful and sudden discharge of seeds in oxalis and violets makes these plants independent of outside help, and scatters the seed in all directions. In these cases the seed are discharged slightly upward as well as outward, enabling these plants to ascend, in time, even steep slopes. In violets cleistogamous flowers extend the fruiting season through even the hot months of summer. These fruits are produced for the most part under ground, and were they to remain there, would be of no value in spreading the species; but after ripe the stalk of the pod elongates and elevates the fruit during dehiscence, and the seeds are scattered as in the case of the pods of the ordinary flowers.

In *Œnothera biennis* the pods are only partially dehiscent at the top, and remain upright on the plant. The top of the plant bends with, and is shaken about by, winds. The seeds are thus scattered about during a considerable interval of time. This brings up the important point relating to the duration of the period seeds and fruits are carried or retained on the plant after their maturity. When long, it increases the chances of many of the fruits being carried to considerable distances by winds: it has relation to the direction of travel or dissemination, and may have an important bearing on the distribution or the range of some appendaged seeds which ordinarily would be thought to travel with the caprice of the lightest wind.

Liatris squarrosa affords an illustration. In this plant the heavily plumed achenes are carried on the dry receptacle till far toward January. So the distribution of the seeds of this and some other species of *Compositæ* is brought about by the prevailing fall and winter winds. Thus it is probable that the dissemination of even light appendaged seeds is not always as hap-hazard as is sometimes supposed.

The appendages and lightness, or minuteness of many seeds, is commonly thought to have relation only to a wide distribution of the species. But the character also has relation to habitat. Some such plants, as the cat-tail flag, *Typha latifolia*, grow only in particular places. Their habitat, as it were, is divided up into small portions and scattered all over the country. Their downy seeds are necessary mainly on this account. The seeds of such plants are scattered far and wide, floating away on the lightest breeze. Only those grow that find proper homes. This is true of the appendaged seeds of some trees, which grow mainly in certain situations, as in the case of those confined chiefly to water courses. Streams are supposed to carry such seeds and be the main agents in their distribution. This is said to be the case with most of the forest trees of Indiana. The writer believes, however, that the reason so many trees are found along water courses, is not because the streams have borne the seeds along, but because the seed germinate better in the fertile and waste conditions found along their borders. Many such trees have winged or downy seeds and are carried far across extensive regions. Many, and most of the seed fall over the dry belts between streams, but not finding the suitable conditions, never germinate. Those, however, that lodge along the streams, spring up.

The importance of winds as factors in plant distribution, and the truth of some of the statements already made, will be rendered clearer, however, by an account of some observations which the writer has made in relation to the influence of winds in scattering the fruits of the *Liquidamber* and *Gleditschia triacanthos*.

It is now twelve years since first the writer noticed near New Albany, Ind., an old gum tree standing alone on a slight elevat on in an old neglected field. The tree was an old one, with a trunk some 24 inches in diameter, but owing to its exposure, and the poverty of the soil, its crown had not penetrated farther heavenward than 40 feet; nor was the expanse of soil shaded by its branches above 30 feet in diameter. While making a list of the plants growing under and about the tree, it occurred to notice what became of the tree's own balls and seeds. The seedling gums springing up here and there around their parent then began to receive attention.

It was noticed that while seedlings of various ages grew in all directions around the old tree, they extended farther to the northeast than in other directions. Measurements followed. To the west and south 50 feet covered the distance between the trunk and the farthest seedling. On the northeast, however, numbers of these reached as far as 200 feet; some 250 feet, and one 300 feet.

Three or four years ago the old tree was cut down and the field cleared of weeds, etc., and plowed up. The part of the field north-eastward from the tree was not molested, however. So the young grove of gums, which nature planted, is still growing. It is evident that the prevailing strong winds for the fall months during the years in which these young gums were planted, came principally from the southwest.

Since that time gum trees in other places around New Albany have been noticed similarily situated and in open woods. Their story has been the same. The same tendency has also been observed in seedlings of *Robinia Pseudacacia.*

Still further observations made during the past two seasons in the fruits and seedlings of the honey-locust afford additional proof of the power of ordinary strong winds to carry even heavy fruits to a considerable distance, and show that for the fall months and fruiting season of this tree the prevailing strong winds are from the southwest.

The honey-locust in question stands alone on the top of a broad, low hill, which, with the exception of the "knobs," is probably the highest point around New Albany. The soil of the hill is clothed with thin grass; is poor, being clayey on top, with fine, clayey sand beneath. The tree is a handsome one, with a trunk some twenty inches in diameter, and a broad, rounded head reaching upward forty feet, with a like spread.

In September, 1893, it was noticed that there was an enormous crop of seeds. Many of them hung on the branches until toward December. In that month the spot was visited for the purpose of making observations. The pods lay thickly on the ground; and again they were found extending principally toward the northeast. Many were under the tree extending on the south, southeast and southwest, some twenty feet beyond the branches. On the northeast, however, they reached as far as 100 feet. I looked for seedlings. There were a number of various ages. A few were found about the tree on all sides. But the great proportion were northeastward. At a distance of 112 feet there was a small thicket of seedlings two and three years old. On the north some were found at 102 feet; on the northwest 41½ feet, west 39 feet, southwest 50 feet, east 76 feet.

The past summer has been one of the dryest in many years. In September the same tree was again full of pods. At this time new young seedlings four and five inches high were found growing about the tree by the hundred, seeming to indicate that a dry season is favorable to young seedlings of this tree. On the west, south and east these seedlings were numerous within thirty feet of the trunk.

Beyond this they were few and scattering, except on the northeast, where they were found at considerable distances. Owing to the difficulty of finding the young seedlings in the grass, measurements were not undertaken.

These items are full of significance. It is a very noticeable fact, and has often been remarked, that many of the plants of the North American flora have a northeasterly range. This is true of quite a list of heavy-fruited trees which ripen their fruit in the fall. Our observations show that ordinary strong winds, such as are common at the time the fruit of such trees is ripe, are capable of carrying it to a considerable distance, and that the winds carry the fruit, for some localities, farthest in the same direction year after year. The principal range of the gum, honey-locust, common locust and a number of other trees with more or less heavy fruits, and especially those of southern affinities, is from the southwest toward the northeast. This, coupled with the writer's observations, seems to indicate that for the broad belt of country extending from Texas and Missouri northeastward to Western New York and Pennsylvania, the strong winds of the fall months blow chiefly from the southwest. If this be shown by the records of meteorology to actually be the case, the northeastward tendency so noticeable in many of our plants will have been satisfactorily explained. The investigation of this matter is not full enough yet to warrant the definite statement. An examination of the Signal Service Records for a number of successive years will be necessary to settle the point. Reports for 1882-3 giving the weather tables for 1881-2 are all that have been examined. These bear out the suggestions made concerning the direction of the stronger autumn winds for the region mentioned. They show that these winds come chiefly from the southwest, and less frequently from the south and west. They also confirm (as far as they go) the opinion which had begun to spring up concerning other regions.

It is noticed that some of these heavy fruited trees and plants, instead of extending from the southwest northeastward, seem to be of northern relationship, and extend from the northwest portion of the country, mainly eastward from Dakota, across the great Lake Region to New England and Canada; or, again, from Dakota and Minnesota southeastward to Indiana and Kentucky, then northeastward to New England. This seems to indicate stronger west or northwest winds for the late summer or fall months in the northwest. In the case of those plants which come southeastward to Indiana, the winds would be from the northwest. In Indiana they would enter the belt in which southwest winds prevail in fall and be carried northeastward.

There are other regions in which the characteristic range of certain plants is in other directions. When fully investigated, the writer is inclined to think that it will be found that, in the majority of land-plants with heavy fruits produced at a less or greater distance above the ground, winds prevailing at the time the fruit is ripe, more than any other factor, determine the direction of their range. The slender investigation of meteorological tables so far made is in harmony with these suggestions, but the whole truth remains yet to be ascertained.

Botanists have often commented on the remarkable difference between the flora of the California coast and that of the Atlantic States; and the strange resemblances of our eastern flora to that of eastern Asia. There is a long list of trees, for instance, of similar or identical species common to east Asia and the eastern States of America, including representatives of the genera in which are found magnolias, lindens, sumacs, buckeyes, box-elder, yellow wood, honey-locust, pear, shad-bush, dog-woods, rhododendrons, holly, persimmon, catalpa, sassafras, osage-orange, planera, walnut, butternut, hazelnut, birch, alder, yellow and white pine, hemlock, arbor vitæ, bald cypress and yews.

Looking over this list, it is noticeable that most of them are trees with heavy fruits ripe in the fall; and have, for the most part, in the United States (in general) a northeasterly range. Many of them are of southern affinities, and some northern.

Now, as plants are known to be delicate indicators of climatic conditions, and as it is fair to suppose the same or identical species will always behave the same way under the same conditions, if we find them behaving in a certain manner in two different places or parts of the world, the logical inference is that the conditions of the two regions are the same, or approximately so. Again, knowing the conditions in the two places to be practically the same, and the plants common to the two regions, acting the same, we naturally conclude that the same forces are operating in the same manner in both places. Following this out, we see that the truth in regard to the influence of winds in shaping the range of some of our American trees having been ascertained, bids fair to throw some light on the similarity between our eastern flora and that of eastern Asia, and explain how similar species in the two continents came to occupy like portions of their respective homes.

Propagation and Protection of Game and Fish. By I. W. Sharp.

Anthropology: The Study of Man. By Amos W. Butler.

A New Biological Station and its Aim. By C. H. Eigenmann.

One of the most promising fields for biological research is variation. Variation not only in the adult individuals, but in every step of the ontogeny. Descriptive zoölogy, as far as the higher groups are concerned, is well nigh exhausted. The general distribution of most of the vertebrates of North America is fairly well known, and it remains but to fill in details. Closely allied to variation is heredity. To these two subjects much of the energy that has hitherto been devoted to systematic zoölogy may be profitably diverted. The subject of variation or method of evolution is not a new one. I want to propose a new method of studying this subject.

During the coming summer a new biological station will be established somewhere in Indiana, whose chief aim will be the survey of a base-line for future studies in variation. A limited and well defined area, such as is to be found in one of the smaller lakes of Northern Indiana, will be selected, and the animals, chiefly non-migratory vertebrates of such a limited area, will be studied in detail for a series of years, if necessary. This survey will serve as the base-line for the study of variation of the same animals in the other localities. For economic reasons the fishes and reptiles will receive most of our attention.

An attempt will be made to determine the kind of variation, continuous or discontinuous, and the limits of variation. These limits should be examined for a series of years, or at definite longer intervals to note the annual, or biennial, or triennial, etc., variations, if any, from a given mean. The study conducted in this way ought to demonstrate the methods of evolution. A most interesting part of the work will be the variation in the early stages of ontogeny, the segmentation, etc., and the relation of such variations to variations in the mature animal.

Very little could be done towards an understanding of meteorology by isolated observations of atmospheric phenomena, yet on just this sort of observation many of our ideas of the methods of evolution are based. In a few cases large series of individuals have been examined, which had been collected at different times and at different places, but so far we know little or nothing of the limits of variation of any vertebrate within a limited territory, a single locality or anything of the annual variation. It is just this knowledge that we must have to test the current views of the methods of evolution.

At a recent meeting of the Board of Trustees of the Indiana University I was granted the use of the apparatus of the zoölogical laboratory for a summer station. The station will be a part of the Zoölogical Department of the University and will afford specialists in this department opportunities in field and survey work.

While no fixed courses will be offered, embryology and zoölogy will be taught, but only animals found native to the region will be utilized. An opportunity will be given to teachers and others over the State to study zoölogy in the field at a time when animal life is most abundant and the places of the interrelation of organisms apparent.

THE FUNCTIONS OF THE SPINAL CORD FROM A CLINICAL STUDY. BY GEO. A. TALBERT.

In this day of great scientific research I know of no subject that presents such intense interest as some of the problems that confront the neurologist. This interest is not stimulated so much by the actual knowledge possessed as it is, perhaps, by the mist that envelops the subject. We might say that just enough is known to create enthusiasm for greater research.

The difficulties that observers have encountered are manifold, and for this very fact they have been led to be cautious many times in coming to a conclusion. The very methods that seem necessary to obtain the facts may defeat the end desired. The operator is never quite certain how near he has approached the normal condition. The artificial means that are often used must necessarily be rough imitations of the natural state. Let us take an illustration:

If the cerebral lobes of a frog are removed the animal seems to perform no movements except as a result of an external stimulus. The animal remains in a quiescent stage for hours and even days at a time. But if the proper stimulations are brought about the animal seems to possess the power of performing as complicated movements as a perfectly intact frog. There is a want of spontaneity. This would show that the seat of the will must be in the removed parts. If, however, the animal is kept alive for some time after the operation, we find that there are movements which point quite strongly to the guidance of an intelligent will. Some observers have found that if the frog is kept alive long enough it will catch flies and other food that comes in its way, and it is even known to bury itself in the earth at the approach of winter.

So from this we might have some doubt about our first conclusion. We probably would be led to think the shock that necessarily follows such an operation may to a certain extent give us abnormal phenomena, and really be a defeat of the normal condition. I have several times in my own observations looked upon the results with some apprehension. This furnishes us with an example of the many difficulties which are to be encountered in laboratory investigations. We are presented with similar barriers when we try to draw conclusions from clinical cases. We are never quite certain of the mischief that may result from the disease or injury.

Realizing fully some of the dangers that confront us, it will lead me to take a conservative position upon some of the points that I shall put forth in this paper.

I will now present some facts that I have been able to obtain from the study of a clinical case. I believe observation made in this way may in some respects be more valuable than experiments upon dumb animals in a laboratory, from the fact that we have an intelligent being to convey to us many valuable points, especially when it comes to the interpretation of sensations.

The following is a brief history of the case, as near as I have been able to ascertain:

In the summer of 1888 a man in Laporte County, Indiana, while trying to fix a binding pole on a load of hay, suddenly fell to the ground, striking with the greatest force upon what corresponds with the twelfth dorsal region. As a result the man was totally paralyzed below the point of injury both as to sensations and movement. He remained in this condition for ten months, when he was taken to Chicago and was operated upon by a distinguished surgeon. I have never been able to obtain the nature of the operation. At any rate the patient recovered to a certain extent. After this, however, there was no improvement up to the time the case came under my observation, which was four years after the accident and about three years after the operation.

The first time that I visited the patient I obtained all the data possible of the past history, and made quite a thorough examination to find the condition as it then existed. As a result I obtained the following facts:

There was total paralysis below the point of injury, except the inner side of both thighs as far down as the knees, and in the left limb down to the ankle; also, on a portion of the right side of the abdomen below the navel.

I did not see the patient again for about four weeks. In the meantime I consulted a physician, and we decided to try the effect of massage upon the paralyzed portions of the body. This treatment was kept up daily for about two weeks, when marked improvement was noted. The next time I investigated I found that the sensation of touch and temperature had been restored to the outside, as well as an increased amount on the inside of each limb. The sensations, however, were below the normal; as, for instance, the points of the dividers had to be placed from four to five inches apart in order to bring about a double sensation.

Power of movement was also partially restored, so that he was able to lift his limbs quite a distance from the bed; his toes, however, were still lax and possessed no sensation nor power of movement. Although the application of massage was continued for several weeks, the improvement seemed to be most marked during the first two weeks.

Let us now turn to the problem, and, if possible, ascertain its solution. I am, however, forced to confess that the more I look into the case the more complicated it appears.

In the first place it is very generally believed by physiologists that there are quite definite paths for the transmission of sensory and motory impressions in the cord. I do not intend to discuss here the disputed question of the position of these tracts, but it is sufficient to say that we are confident in this case that there were some obstructions at first in the cord, so that impulses could not pass from the brain to the limbs and *vice versa*.

It would seem at first sight that either this obstruction was removed, perhaps by the regeneration of the nerve tissue, or that the impressions had been educated into new paths.

The laboratory has given us quite undisputed evidence to show that abnormal paths are sometimes brought into use. For instance hemisection in the thoracic region of the right side of the cord of a dog will cause paralysis of the right limb. But, however, after the effect of the shock is passed, recovery is soon noted. Likewise hemisection a little higher on the left side of the cord brings about similar phenomena for the left limb. Again, if the experiment is tried still higher on the right side the story is again repeated. This compels us to believe that impulses would have to take a zigzag path. While this may be true of the dog we must not be too hasty in concluding that the impressions can take new paths in the human cord. It is a universal law that the higher we ascend the animal scale the greater is the precision of these paths, and injury to the most definite ones is more apt to have a permanent effect.

As to formation of nerve tissue we know it is more likely to take place in the lower than in the higher vertebrates. And if there was degeneration resulting from an injury then there might be grave apprehensions in regard to regeneration in so high a form as a human being, while it might be true in some of the lower forms.

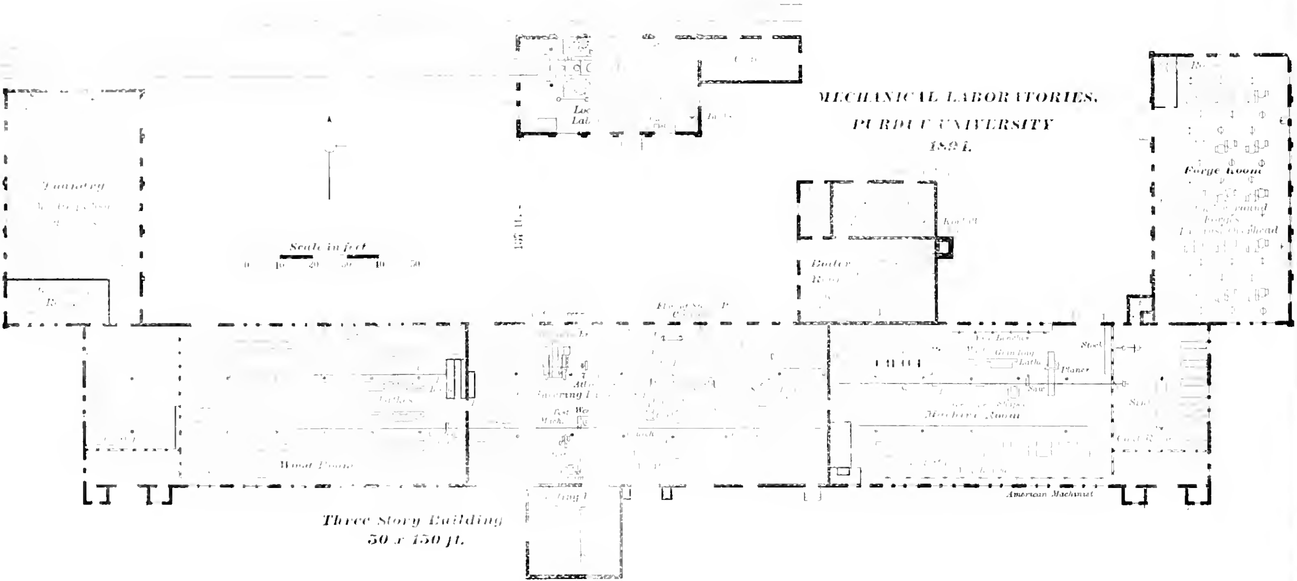
The suggestions given above hardly make it clear. We are still left in doubt as to the virtue of the application of friction. It makes it more complicated when we think of the length of time that the man was paralyzed and how sudden was the recovery after the application of the remedy. It certainly would lead one to think that the recovery would have been more complete if the case had been treated soon after the accident.

There is another way of looking at the problem, and perhaps it comes nearer if not quite to the solution. We said in the above that there was at first some obstruction, whatever that may have been, at the point of the injury in the cord, and as a result it caused the muscles below the point of injury to degenerate from disuse. The obstruction in the cord perhaps after awhile was removed, and it may have been at the time of the operation by the surgeon.

Let us now look to the laboratory and see if we can find evidence to aid us in solving the problem. It is a well known fact that there are nerve fibers that have a controlling effect on the calibre of blood vessels, or to state it more exactly, they hold the unstriped muscles in a certain state of contraction. It is known to physiologists as tone. This may be demonstrated by cutting the branches of the sympathetic system that supply the blood vessels of the ear of a rabbit. As a result the ear becomes flushed with blood, showing that the tone of the vessels is lost. It makes it more certain if the end of the severed nerve that supplies the ear is stimulated artificially, when it once more returns to the normal. If the stimulant be strong enough, it will so contract the coats of the vessel that the ear will appear pale. When we turn to the skeletal muscles, it does not appear quite so clear that they are influenced by the tonic effect of nerves. The observations of different investigators are at variance on this point. I believe that the preponderance of evidence goes to show that there is a tonic effect, or at least nerves which control the nutritive functions, or have what is known to physiologists as a trophic action. Taking, for instance, the severance of the sciatic nerve of an animal, and we will find that the muscles become flabby and that they do not possess the resistance that is noticed when the nerve is intact.

Time will not permit me to go into the argument showing that trophic centers exist in the cord. But assuming that these centers do exist, let us see how they carry out their work. In the first place, reasoning from the analogies of the action of the heart and other centers, we might with some reason suppose that the trophic centers, by virtue of their own metabolism, send out *de novo* efferent impressions to the muscles, thus having a nutritive effect. If we carry the analogy farther, we will have as good a reason for assuming that there are afferent impressions that pass to these centers and, as it were, modify the efferent impressions. There is experimental evidence to show that this is true. For instance, if the posterior root of a nerve is severed, while the anterior root is intact, it results in a loss of tone to certain muscles.

to assert themselves. In a few weeks after the fire new machinery was running


MECHANICAL LABORATORIES,
PURDUE UNIVERSITY
Forge Room
Scale in feet
Boiler Room
Machine Room
Planer
Saw
Wood Room
Three Story Building
50 x 150 ft.
American Machinist

Let us turn back to our clinical case. We have tried to show that as a result of the injury there was a loss of tone, and, we shall now try to show that its return to the muscles was due to the remedy that was applied.

It does not seem improbable that the application of massage caused the afferent impressions which acted upon the trophic centers of the cord; and this in turn sent out efferent impressions to the toneless muscles, and by that means they were restored to a condition so that they were able to respond to certain motory impulses.

Such an investigation of necessity has its limitations. The most essential facts needed will, of course, be in the dark as long as the patient is alive. An examination of the cord, in order to obtain the extent of the lesions, would make it more clear. Even had we the opportunity of examining sections of the injured portions, there might still be some doubt as to the revealing of all the facts in the case. We do not know to what extent the injured parts affect those which are apparently healthy.

Although the citation of this interesting case may not settle definitely the great problem whether there is skeletal tone, it will at least shed some light on the subject.

Does High Tension of Electric Current Destroy Life? By J. L. Campbell.

The Purdue Engineering Laboratory Since the Restoration. By Wm. F. M. Goss.

A little less than a year ago, Purdue University lost by fire, the larger part of its mechanical laboratory. The building was a fine one, only just completed, and was occupied by the Departments of Mechanical Engineering, Civil Engineering and Practical Mechanics; it had more than an acre of floor area, and was filled with an expensive equipment. The disaster was a trying one. Not only was the property loss apparently irrecoverable, but fear was felt that the uncertainty and delay in restoration would result in a loss of the prestige so honorably won by the University and a diversion of its student constituency in other directions. In this emergency the wisdom and courage of President Smart were quick to assert themselves. In a few weeks after the fire new machinery was running in temporary quarters and the permanent building was in progress of construction. No work prescribed in the catalogue has been omitted from the course of any student.

The accompanying plan shows the laboratory as it now stands restored. The portion which was burned included the forge room, machine room and engineering laboratory; also, a three-story front containing offices, recitation rooms and drawing rooms. The outline of the old building has been preserved in the new, but the construction of the front has not yet been undertaken. All laboratory rooms have been entirely finished and equipped. A room has been added for experimental work with natural gas, and the locomotive testing plant has been provided for in a separate building. Not only has the capacity of the structure been increased, but the equipment also in every department has been improved. Time will not permit an enumeration, but the floor plan shows the location of apparatus now in place and in daily use.

It will be seen that while other lines of work have not been neglected, the equipment of the engineering laboratory is especially complete for work in steam engineering. The several engines shown are mounted as separate plants. This arrangement avoids any chance of interference among different groups of students who may be working with different engines at the same time. The Buckeye, Straight Line and Baldwin engines occupy the floor space, which before the fire was taken by the plant now in the annex. The Baldwin consists of a pair of 9½ and 16x18 Vouclain Locomotive Engines fitted up for the purpose of experiment. These engines are supplied with steam from the laboratory boilers and are run under the load of a friction brake.

The locomotive testing plant in the annex laboratory has been much improved. The plant shows Purdue's locomotive, Schenectady, in place, but the arrangement of the plant is such that any locomotive may be received and tested.

The engineering laboratory contains thirty-six steam cylinders aggregating over 1,500 horse power.

Method of Determining Sewage Pollution of Rivers. By Chas. C. Brown, C. E.

[Abstract.]

In 1888 I began work for the State Board of Health of New York on the investigation of the purity of water supplies drawn from rivers, with a detailed inspection of the water-shed of the Croton River from which New York City derives its supply. This was almost entirely an inspection of the actual sources of pollution, though a study was made of the chemical side of the question. The investigations were continued during the following five years on the Hudson and Mohawk rivers, and reports of the work are to be found in the annual reports of the New York State Board of Health since 1888. The inspection of sources of pollution showed what went into the rivers, but the chemical analyses failed to show with sufficient definiteness the effect of this pollution on the water. We then tried the method of determining the numbers of bacteria in the water, and while that was fairly satisfactory when the conditions were simple, we found it to be absolutely necessary that there be no disturbing conditions whatever, so that it was difficult in most cases to find a time when the method could be applied.

We are told by the bacteriologists that the bacteria which are objectionable in drinking water are the bacteria introduced by sewage. We therefore concluded that we should determine the proportion of such bacteria in the water. At this juncture Dr. Theobald Smith, of the Bureau of Animal Industry, Department of Agriculture, at Washington, suggested a method of making this determination, which he was developing, and we applied the method to our study of the rivers with results that are so far quite satisfactory.

The method rests upon the assumptions that *Bacillus coli communis* is a species which is very common in sewage, which does not proliferate under ordinary conditions of running water, and whose numbers may therefore be assumed to bear a fairly definite relation to the amount of sewage pollution. Numerous check observations uphold these assumptions.

The method of determining the numbers of "coli" in a given sample uses the fermentation tube, now frequently called the Smith tube in bacteriological laboratories, as the use of the tube in bacteriology has been developed by Dr. Smith.

The tube, as shown by the pictures, is a bent tube with one end closed and a bulb at the other. It is filled with a clear bouillon of beef with peptone, salt and 2 per cent. of glucose, properly neutralized, or made slightly alkaline. The tube and filling are sterilized by boiling on three successive days, the air driven off into the closed end of the tube, being decanted so as to leave the liquid in the tube sterile, and that in the closed end of the tube without oxygen. The liquid in the bulb is now inoculated with bacteria and the tube placed in an incubator kept at 98° F. for 36 to 48 hours. Classifying the bacteria likely to be found in water as motile and non-motile, and as aerobic and facultative anaerobic, it is readily seen that non-motile and aerobic germs will develop in the bulb only, and will leave the liquid in the tube clear. Motile bacteria that can develop without oxygen will reach the tube and change the character of the liquid. The temperature of 98° at which the tube is kept will prevent the development of nearly all the common water bacteria. Certain bacteria produce gas from media containing glucose in varying amounts, the composition of this gas varying from 0% CO_2 to 100% CO_2.

Bacillus coli communis and two others, much less common but also sewage bacteria, produce 0.4 to 0.7 of a tube full of gas, of which 0.5 to 0.7 is CO_2. All others observed produce amounts of gas and of CO_2, readily distinguishable from those, and are, therefore, easily dropped from consideration.

The process in examining a sample of water is to prepare a sufficient number of tubes of sterile bouillon, and an incubator. The sample of water is distributed among the tubes, an equal amount in each, the amount varying according to the impurity of the water. With a pure water 1 c.c. may be used. With sewage $\frac{1}{200}$ c.c. may be found to be too much. The tubes are placed in the incubator and left at the constant temperature of 98° for thirty-six hours or a little more. They are then taken out and the proportion of gas in each tube is determined. Those promising to contain *Bacillus coli communis* or its companions are treated with an alkali to absorb the CO_2, and the propor ion of CO_2 is thus determined. From the two determinations the number of *Bacillus coli communis* in the sample is derived, and thence the number in a c.c If much more than half the tubes inoculated from a sample contain "coli" the amount of water used in a tube has been too large to produce a result which will compare closely with other determinations. Likewise, if the sample has been diluted with sterilized water before inoculating the tubes, too small a number of tubes with *coli* shows too great dilution to produce results that will check up with others from the same sample.

Many results have been obtained by this method in the last three or four years which seem to give closer determinations of the amount of sewage pollution than any method heretofore used. The method has not yet had wide enough application to demonstrate its value under various conditions, but we feel certain that it has great value in the examination of streams used or proposed as sources of water supply for cities.

I have not time in the limits of this paper to give the results, and give the methods only, as perhaps the more suitable for the purposes of this association at this time.

PSYCHOLOGICAL LABORATORY OF INDIANA UNIVERSITY. BY W. L. BRYAN.

INTERESTING DEPOSIT OF ALUMINA OXYHYDRATE. BY GEO. W. BENTON.

[ABSTRACT.]

1. Report of trip to Southwest Missouri, March, 1894.

2. Alumina found in pool of spring water.

3. The springs brought in the deposit.

4. A careful survey of the region proved that the deposit is forming, and is not stored up in quantity.

5. The source a pure aluminum silicate which abounds in quantity in that region.

6. Some possible uses of the deposit and the silicate.

7. Theory of the decomposition.

OBSERVATIONS ON THE GLACIAL DRIFT OF JASPER COUNTY, BY A. H. PURDUE.

The writer begs to state that his experience in glacial geology, the time spent in field work on the material herein presented and the territory explored are all limited; and that he does not claim for the paper any more than its title indicates, viz.: observations on the glacial drift of the locality named. It is proper to state further that these observations have been confined mainly to that part of the county lying south of the Iroquois River.

Jasper County is situated in the northwestern part of the State, with Porter County intervening between it and Lake Michigan, and is separated from the State of Illinois by Newton County. It is, therefore, in one of the most active fields of all the glacial epochs. Mr. Collett claims (Twelfth An. Report Geol. and Nat. Hist. of Ind., page 66,) that glacial erosion has removed from fifty to two hundred feet of rock from the entire surface of the county. This great erosion, and subsequent glacial action, has left it practically level, and with poor drainage, so that numerous peat marshes abound in all parts of the county, varying in size from a half acre and less to several thousand acres. Notably among the larger ones are "Gifford Marsh," a swamp of 12,000 or 15,000 acres, lying twelve miles northeast of Rensselaer, and the "Blue Sea," a similar marsh, lying in the southeastern part of the county. Only the former of these has been visited by the writer. It is an old glacial lake filled up with peat and muck, varying in depth from three to fifteen feet, the monotony of which is broken by numerous accumulations of sand, which in form imitate drumlins.

Many wells have been drilled in all parts of the county, but no compilation of the data furnished by them has been made, so that nothing is known of the subglacial topography. It might be stated, however, that the drift varies in depth from a few feet, as at Rensselaer, to two hundred feet. The latter extreme depth has been found nowhere, so far as I have learned, except on the moraine which extends in a northeasterly direction across the county, passing one and a half miles north of Rensselaer.

This moraine is possibly the most marked topographic feature of the county. In width it will average probably a mile, and in height it varies from twenty to eighty feet. It is said by Mr. Leverett, of the U. S. Geological Survey, to extend northeastward into Pulaski County and southwestward through Newton County into Illinois, and is thought by him to possibly be interlobate between the Saginaw-Erie lobe from the northeast and the Lake Michigan lobe from the north.

One of the first things to attract attention in the study of this locality is the great number of sandy ridges everywhere prevailing. With reference to direction it appears that there are two classes of these. One class extends almost parallel with the above mentioned moraine. I have observed them in Pulaski and Jasper counties, northwest of Monon, and in passing over the Monon Railway from two miles northwest of Rensselaer to Parr. The other class, which I have observed only south of the moraine, have an average course of about S. 30° E., and consequently run in a direction almost at right angles to it. It is the latter class to which we wish to invite attention.

These ridges are of two types, each frequently passing into the other. For convenience we will speak of them as the symmetrical and the unsymmetrical.

The most common form is the symmetrical. These are low, broad, symmetrical ridges. They vary in width from forty yards to an eighth of a mile. Though frequently running into each other they are in the main parallel, and often are crowded so close together as to give the surface a billowy appearance. The troughs between them always contain rich, black soil, formed from the decay of peaty matter, and indicating former shallow lakes. An excellent view of this type is presented along the "Line Road" from Rensselaer to Remington for a distance of five miles south of the former place. The view along this road shows them to run east and west, but a short distance to the east they swing to the south and southeast. All the ridges of this class are composed largely of sand, though they contain enough vegetable mould to prevent shifting by winds, and permit of an excellent yield to the farmer. I have never noticed any gravel in them except north of the Iroquois, in the vicinity of the large moraine. Bowlders are sometimes seen along and near their bases, but seldom on the swell of the ridge, except also in the vicinity of the large moraine.

The unsymmetrical type differs from the symmetrical in size and shape, in being composed more largely of sand, and in not being so numerous. They are much larger than the symmetrical, varying in height from five to twenty-five feet above the general level. The average is probably about ten feet. The south and west slopes are gradual and more or less broken, while the north and east slopes are steep and even. Horizontally these slopes are very sinuous, resembling the banks of winding streams; but the fact that at their bases, often stretching to the north and east for a mile or more, are extremely level expanses frequently covered with peat, forcing upon even the unobserving the recognition of old lake beds, dispels the idea of their being such. At the same time the winding course of the ridges prohibits the idea of their having been thrown up by wave action from the lakes. In many places these ridges are too sandy to be cultivated with profit, in others the soil is good, and at a few points, to be mentioned later, gravel has been found. They are frequently cut through by what apparently were escapes for the water confined by them. In these cuts, which usually reach to or near the base of the ridge, bowlders can pretty confidently be searched for. Bowlders are also occasionally found along their bases.

Only in the gravel pits above referred to has the writer seen any indication of stratification. Two of these pits are situated a mile and a quarter west of Rensselaer, near the Iroquois River. There are three others a mile and a half south of Rensselaer. Places in these show attempts at sorting by rapid and changeable currents, but the greater part of the material is unsorted, and it would seem that their deposition was effected almost wholly by direct glacial action.

Let it be repeated that the two types often grade into each other. A ridge that in places presents the most rugged aspect of the unsymmetrical, may, in the course of a mile, grade into the most feeble of the symmetrical type; and at a point about three miles north of Remington an unsymmetrical ridge grades into a low, flat ridge covered with numerous bowlders, and evidently a moraine.

Of course, the thing of interest in connection with these ridges is the question of their origin. It has been claimed (Twelfth An. Rep. Geol and Nat. Hist. of Ind., page 66) that they are dunes formed along the northeast and east shores of former lakes, and were produced by southwesterly winds. While the examination of numerous cuts has not disclosed the least sign of lamination by either wind or water, there seems to be no doubt that the unsymmetrical ridges are due very largely to aeolian action; but it does not seem that the low, flat, symmetrical ridges, so frequently connected, or passing into each other and forming the rims of ponds could have been produced in this way. The fact that the two types grade into each other indicates a common origin at least of their basal portions. Also the fact that bowlders are more numerous along and near the bases of these ridges, especially the symmetrical type, than elsewhere, together with the fact that bowlders are liable to be found in the cuts through the large ridges is considered significant. It would also seem that the parallelism and continuity of the ridges of both types are greater than could be expected of deposits determined alone by wind. In the gravel pits south of Rensselaer there is nothing to indicate that the adjoining portions of the ridges were formed in a manner different from those portions where gravel is found.

The above facts suggest the possibility of the symmetrical ridges having been formed directly by glacial action as the glacier receded to the northeast; and in some cases they have served as lodgment tracts for the accumulation of wind-blown sand, in that way largely determining the course and extent of the unsymmetrical or dune type. But more field work is necessary before considering this beyond a hypothesis.

There are at least two bowlder belts in the county, but because of limited time I have not been able to follow them out. One of these is north of Remington and the other is east and southeast of Rensselaer. The latter I have traced from the junction of the Iroquois and Pinkamink rivers southeastward for a distance of three miles. It will probably be found to extend southeastward and eastward into White County, forming the southern border of the old lake through the bed of which the Monon Railroad passes, from Lee to Pleasant Ridge. The careful location of these bowlder belts will probably throw light on the glacial phenomena of the locality.

Concerning a Burial Mound Recently Opened in Randolph County. By Joseph Moore.

Southern Randolph and the adjacent portion of Wayne, is in the main a level tract, the land during ordinary seasons being rather wet.

Besides a number of well-defined made mounds in the neighborhood of Lynn Station on the G. R. & I. R. R. there are frequent examples of natural mounds. These are usually much larger than the artificial mounds. They may be compared to drift islands surrounded by flat areas of dark colored soil. Some of these mounds of modified drift have been utilized by ancient peoples as burial grounds. The one of which I speak is a fraction over a mile west of Lynn Station. It is about 150 yards in circumference and 18 to 20 feet high, and is so symmetrical as to have the appearance of a made mound; but in a wide cutting made through it by the gravel haulers the structure clearly shows an aqueous deposit from top to bottom. In this mound the workmen say they have opened "more than a hundred graves." They "counted till they reached seventy." Quite a number of the skulls were sufficiently preserved to bear handling, even after being for a short time exposed to the air. Some of them on being treated with a solution of glue have rather a fresh, recent look. Very many of the bones were broken to crumbs by visitors in sport. Some of the skeletons were in a sitting posture with the chin crowded upon the knees.

The depth of the graves was from a yard or less to twelve feet and more. The skeletons were of both sexes and various ages, some quite young. It was alleged that a horse's bones were found, but I was unable to find the least scrap. They also tell of a dog's skull with the teeth all perfect. This is possibly so, but it would seem more likely that it was the head of a wolf, which is quite similar. Quite a number of implements were found, some of which are here on the table. One skeleton was found with a large dart in each hand.

They assert that a scapula was found pierced by a flint dart and that the dart was lodged in said bone, but that the bone immediately crumbled from about it. There were beads of bone, shell and copper but few of the latter also copper rings, tube pipes and various other things, the uses of which are not very well known.

You will see in the skulls presented for your examination that there is quite a diversity. Two of them are of the brachycephalic or short-head type, one barely so, the other extremely so. The one has the lateral diameter in the proportion to the fore and aft, as 86 to 100, the other of 92 to 100. The others are all orthocephalic, though one of them approaches to the long-head type.

You will note, not only the extent to which the teeth are worn, but also the peculiar manner of the wearing. It will also be seen that decayed teeth, caries of the bone and also signs of gum-boils and abcesses are not confined entirely to civilized races.

The upper wisdom teeth in one of the skulls show, each, examples of enamel tubercles on the fangs, a rather rare phenomenon, as I understand.

You will note also in one of them an extraordinary double suture at upper border of occiput.

A question of interest: Did such diverse skulls belong to the same tribe, or did different tribes at different times bury in the same grounds?

Reversal of a Current in the Tepler Holz Electrical Machine. By J. L. Campbell.

A FLORIDA SHELL MOUND. BY C. F. GLICK.

These old shell mounds are quite numerous on the Atlantic coast of Florida, and are located principally on both shores of the salt water lagoons, the greater number being found on the western or mainland shores and near the water.

The mound in question is on the western shore of the Halifax lagoon, and within the town limits of Daytona, Valusia County, Florida. It is an enormous "kitchen midden" or back door refuse heap, covering at least an acre of surface ten feet thick, and containing something like four hundred thousand cubic feet of shells, bones and pottery. We had a good opportunity of studying the mound, measuring sections, etc., as it was being hauled away to construct streets and roads. More than half this enormous pile of rubbish has been removed in the past two years, opening up the mound in its various features to the curious student and archaeologist.

The contents of the heap are arranged in layers or strata of shell and soil, the layers varying in thickness in different sections (as per chart), the rule being a layer of shells from two to three feet in thickness, and resting on this from eight to ten inches of soil. There are two or more such formations of decomposed shell soil found between the bottom and top, the first being from three to four feet above the general level, which is from three to four feet above low tide in the lagoon near by. Above this soil strata is another of shell two feet thick, followed by another of soil, several feet more of shell reaching to the top. The surface of the mound has quite recently been covered with a heavy growth of forest trees, such as live oak, water oak and wild orange, some of these several hundred years old. A portion of the mound is enclosed, and forms part of the grounds of a Daytona resident. These grounds are rich in tropical and semi-tropical plants and trees, the aloe, banana and tropical pawpaw growing luxuriantly with the fig, oleander and orange. Shells, bones and pottery form the principal part of the contents of the mound, about 95 pt. shell, 5 pt. bone, pottery, roots, etc. The orange and live oak roots find their way through the ten feet of shell and soil into the moist earth beneath, making all imaginable crooks and angles on their way down.

The oyster is the shell found in greatest abundance. The small salt-water clam, conch, quahang clam and sea-snail follow in the order named. When the water is not too fresh, the oyster is found in the Halifax lagoon. The other shells belong to the ocean. The inflow of fresh water often destroys the oyster. Evidence of this is seen in the mound by a layer of oyster shells being covered by one of the small clams from the ocean beach. The rough (Fulgar Canaliculatas) and smooth (Pyrulus Canaliculatas) conches are distributed throughout the heap. The larger of these are often broken into, to more easily obtain the animal, the large sea-snail being treated in the same manner. The question may be asked as to how the thick, heavy walled shells were broken, as no stone implements were found. By examination of the rough exterior of the conch (Fulgar canaliculatas), in it may be found an excellent implement for the purpose. Bones and pottery are also found throughout the mass. The bones are chiefly those of animals taken in the chase, deer, bear, lynx, alligator, dog and fish, of the latter only the vertebræ remains. The greater portion of these bones crumble to pieces on exposure to the air. The pottery is almost entirely fragmentary, no whole vessels being found to my knowledge, however, the restorations which have been made from large fragments would indicate vessels of ten to twelve gallons capacity. The pottery of the lower layers is rude and rough, and without any ornamentation whatever, while that taken from the upper strata is better made and with some efforts at ornamentation.

The size of these aboriginal cooking vessels would seem to prove that the living shell was heated or boiled to more easily obtain the animal. Shells of the quahaug clam (Venus mercinaria), abundant in the refuse heap, are now rare on the adjacent coast. Attempts have been made to determine the age of these ancient heaps of rubbish, but such determination in the light of present data, may be quite conjectural. However, from the evidence it is obvious that they are not recent, but must run far back into the dim ages of the past. It is hoped that further investigation may throw more light upon the manners, customs, habits and history of the people through whose instrumentality these immense accumulations were formed.

A Note on Rock Flexure. By E. M. Kindle.

The phenomenon of rock flexure is familiar enough, as it occurs in anticlines and synclines in many regions. These natural bendings of rocky strata, however, afford no data for determining the actual values of the factors producing them, the pressure and the time during which it has acted. The time factor required to produce bending without fracture in a solid stone is so large as to have prevented any except accidental experiments in this direction.

Such an experiment I discovered two or three years ago in progress in a country cemetery one-half mile south of the village of Nineveh, Ind. Over one of the graves there has been placed a horizontal marble slab, which was formerly supported by a brick wall eight or ten inches high surrounding the grave. At the time of my first visit this wall had crumbled down along the greater portion of each side of the slab, leaving it supported mainly by the portions which still remained intact at the ends of the slab. The long continued support of the slab at the extremities alone had caused it to sag to such an extent as to be quite noticeable even to the casual observer.

Recently I revisited the place to determine exactly the amount of flexure which the slab had undergone. I found it had been broken into five or six pieces by vandals. On one of the pieces, which had formed a portion of one side of the slab near the middle, I measured carefully the amount of flexure. This piece measured two feet eight and one-half inches along the original edge of the slab. The flexure along this direction was one-tenth of an inch. The dimensions of the original slab were: Length, six feet one inch; breadth, two feet; and thickness, one and four-fifths inches. The measurement of the fragment will not permit of an exact estimate of the amount of flexure in the original slab, but would seem to indicate a flexure of not less than a quarter of an inch, and possibly more. The slab bears the name of Sarah Mullikin, and gives the year 1847 as the date of her death. I ascertained that the stone had been put in position shortly after this date. The flexure could not have begun, however, until the decay of the middle portion of the supporting wall had made considerable progress. This we may presume to have been not less than ten years after its construction. If we suppose the gradual bending to have been in progress since 1858, about ten years after the stone was put in position, then we have a flexure of about one-fourth of an inch in a slab one and four-fifths inches thick, produced by the stress of the stone's own weight, acting through a period of thirty-seven years.

The Alternate-Current Transformer With Condenser in One or Both Circuits. By Thomas Gray.

Elastic Fatigue of Wires. By C. Leo Mees.

A Warped Surface of Universal Elliptic Eccentricity. By C. A. Waldo.

Accurate Measurements of Surface Tension. By A. L. Foley.

Effect of the Gaseous Medium on the Electrochemical Equivalent of Metals. By C. Leo Mees.

SOME NEW LABORATORY APPLIANCES IN CHEMISTRY. BY H. A. HUSTON.

[ABSTRACT.]

A machine for use in making solutions of difficulty soluble substances at various temperatures was described. Also a new form of stirring machine for use in precipitating ammonium magnesium phosphate and similar work.

Cuts are necessary for a full understanding of the paper.

VOLUMETRIC DETERMINATION OF PHOSPHORUS IN STEEL. BY W. A. NOYES AND J. S. ROYSE.

THE ACTION OF AMMONIA UPON DEXTROSE. BY W. E. STONE.

[ABSTRACT.]

Dextrose is commonly regarded as belonging to the class of chemical compounds known as *aldehydes*. Several of the characteristic reactions of this class of compounds are, however, not given by dextrose or have not been heretofore observed. Chief among these are the reaction with a decolorized fuchsin solution and the formation of ammonia compounds.

This paper describes the preparation and properties of a crystallenic compound of dextrose with ammonia which seems to belong to the class of aldehyde-ammonia derivatives. Its importance lies in the contribution of this new proof of the aldehyde character of this typical sugar and that without much doubt a whole series of such derivatives can be prepared from the other so-called glucose sugars.

ACTION OF ZINC ETHYL ON FERRIC CHLORIDE AND FERRIC BROMIDE. BY H. H. BALLARD.

THE SUGAR OF THE CENTURY PLANT. BY W. E. STONE AND D. LOTZ.

[ABSTRACT.]

The "maguey" plant or *Agave Americana* furnishes the materials for many important industries in Mexico. Its juices obtained at the flowering period contain about 15 per cent. of a fermentable sugar. By their alcoholic fermentation are produced several beverages of more or less intoxicating nature. The fibre of the leaves is utilized in many ways and the juices of the plant when treated with ash lye make a kind of soap.

The paper deals more especially with the character of the sugar present which has already been described by two Mexican chemists as a distinct and new kind of sugar. The results given in this paper go to show that this sugar is not different in any way from that of the cane or the beet-root or the maple. That it is a definite chemical compound known as sucrose and that without much doubt the announcement of the Mexicans of the discovery of a new sugar was based upon erroneous observations.

CAMPHORIC ACID. BY W. A. NOYES.

ACTION OF POTASSIUM SULFHYDRATE UPON CERTAIN AROMATIC CHLORIDES. BY WALTER JONES AND F. C. SCHEUCH.

A NEW PHOSPHATE. BY H. A. HUSTON.

DIP OF THE KEOKUK ROCKS AT BLOOMINGTON, INDIANA. BY E. M. KINDLE.

In the course of some stratigraphical studies in Monroe County it became desirable to ascertain, as accurately as possible, the dip of the Keokuk strata. As is generally the case with Indiana rocks the Keokuk strata are not sufficiently inclined to admit of the use of the clinometer in determining their dip. It was therefore necessary to determine the relative elevations of two points lying in the direction of dip in some stratum, and separated by a known distance. It is essential in this method of estimating dip that a stratum or horizon be selected which can be positively identified at different points.

The contact of the Keokuk with the Knobstone is readily recognized wherever it outcrops in Monroe County, both by the striking paleontological and lithological differences between the two groups. The Keokuk is everywhere at the contact with the Knobstone an impure fossiliferous limestone, while the Knobstone is a massive sandstone entirely without fossils. I therefore selected the contact of the Keokuk with the Knobstone as the most convenient stratum, from which to determine its dip. The ravines north of Bloomington afford numerous exposures of the contact. Two points for the comparison of elevations were selected, one a mile and a half north of Bloomington on the North Pike, the other in a ravine nearly due east of the first. A surveyor's transit was used to determine the difference in level between the two points. For assistance in this work I am indebted to Mr. C. E. Siebenthal and Mr. George Champ. The distance between the two points was estimated by stadia measurement. A reduction of the data obtained showed the points to be 1½ miles apart, and the dip of strata between them to be at the rate of 63.6 feet to the mile. This result was so much larger than was anticipated that the ground was gone over a second time by Mr. Champ and myself. The second survey, with a "Y" level, confirmed the correctness of the first, thus showing the Keokuk strata to have a dip west of nearly 64 feet to the mile in the neighborhood of Bloomington.

Wave Marks on Cincinnati Limestone. By. W. P. Shannon.

In the southwest part of Franklin County, three miles west of Oldenberg, in the bed of Salt Creek, are good examples of wave marks on Cincinnati limestones. These wave marks are nothing new. They have been referred to by different students of the Cincinnati strata, and are characteristic, since they occur at all horizons of the Cincinnati rocks. This does not signify that every stratum or layer is so marked, but that such marks are rarely found in other than the Cincinnati limestones. Another stratigraphic character of the Cincinnati rocks is the alternation of strata of limestone and shale. The strata are thin, each one being usually made of a single layer or ledge.

Within a distance of one-quarter mile up and down the bed of the creek, four wave-marked strata are exposed, and according to the law of the Cincinnati formation, each one is overlaid by a stratum of shale. Of these four wave-marked strata the three uppermost are consecutive, not consecutive strata, but consecutive limestone strata.

In no two strata are the wave marks in the same direction or of the same size. All four of these strata are fine grained, compact limestone, showing that they were made of calcareous sand or mud. A description of two of these wave-marked strata will be sufficient, the two which have the greatest exposure. One forms an uninterrupted floor to the stream for a distance of 100 feet; the width of this floor is 25 feet. The wave marks are transverse to the course of the stream, and if we stand at the lower end of this area and look up stream it is hard to keep from thinking that we are looking at real undulations in water. It requires a conscious effort to keep from identifying the effect with the cause. If we measure these waves, they are about two feet from crest to crest, with a vertical distance of about three inches from crest to hollow. Besides wave marks this ledge shows mud cracks, which have checkered the surface into roughly hexagonal areas. The existence of mud cracks in limestone is a valuable note. In the American Geologist, Vol. IV., No. 6, is an engraving of a slab of Cincinnati limestone, showing mud cracks. The specimen was found by Prof. C. W. Hargitt near Moore's Hill, and is now in the Moore's Hill College. The association of mud cracks and wave marks in the same ledge is, no doubt, a valuable note in working out the conditions which gave rise to alternating sediments of limestone and shale. The wave marks are evidence that the sea was so shallow that slight undulations touched bottom. The mud cracks are evidence of some form of land, a low tide island, at least. The two together seem to show a marked shallowing of the sea during the history of one limestone stratum, or a transition from lime-depositing to shale-depositing conditions.

The other wave-marked stratum to be described presents a surface of exposure about 100 feet by 50 feet. The waves are about three feet from crest to crest, and the hollows are about three inches deep. These wave marks differ from those of the other three strata in that they are curved like rainbows. These curved waves are evidence that the undulations of water that caused them were modified by neighboring shoals or land, the results of a shallowing sea.

In this paper I have given only certain facts of structure and have assigned what I believe to be the immediate causes of these structures. The great problem of the Cincinnati formation is the invariable alternation of limestone and shale strata. The structure noted may be helpful in working out this problem.

STRUCTURAL GEOLOGIC WORK OF J. H. MEANS IN ARKANSAS. BY J. C. BRANNER.

CORRELATION OF SILURIAN SECTIONS IN EASTERN INDIANA. BY V. F. MARSTERS AND E. M. KINDLE.

SOME NEW INDIANA FOSSILS. BY C. E. NEWLIN.

EXTINCT FAUNA OF LAKE COUNTY. BY T. H. BALL.

The object of this paper is to present, so far as is known, some account of animals, supposed to be native, that no longer are found in the county of Lake.

1. I may as well name first one that has surely been extinct quite a number of years, the mastodon, remains of which were found near an old beaver dam

about three miles west of the present town of Crown Point. The portions found were the teeth, weighing some four pounds each. I am sorry not to have in my possession any of its bones, but the remains of a huge quadruped were found there without a doubt.

2. I name next the beaver, *Castor fiber* or *americanus*; remains of the works of these busy toilers having been found in different parts of the county, and some rodent bones, supposed to be of beaver, were exhumed at the head of Cedar Lake, along with human remains, October 1, 1880, the human skeletons having been there more than two hundred years. No living beaver have been seen in the county for more than sixty years, the settlement of the county bearing date of 1834.

3. There is some evidence found in the records of the early French explorers that the buffalo or American bison roamed over the prairies and marshes of northwestern Indiana two hundred years ago, but that animal, in the region named, has certainly been extinct beyond the reach of the knowledge and memory of two generations of hunters and trappers.

4. Some individuals of the black bear species, *Ursus americanus*, were found in the county some sixty years ago by the very earliest settlers. One was shot by Solon Robinson where is now the town of Crown Point. The few seen were probably stragglers, their proper domain just touching the broad prairie region beginning in the northwestern corner of the State.

5. Elk horns have been found at Cedar Lake and in the West Creek marsh, one of which is now in my possession, showing that once, perhaps a hundred years ago, this stately animal fed beside these waters.

6. The earlier inhabitants of the county found a few wild cats, probably *Felis catus*, one of which species was killed at the head of Cedar Lake, in an alder thicket or swamp, early in 1838. A large and formidable looking animal he seemed to me to be, as, with the eyes of a young hunter boy eleven years of age, I looked upon him. For years that thicket, which was on my father's land, was known as Wild Cat Swamp. These cats may be called extinct since 1840. Individuals also of the lynx species or variety, *Lynx rufus*, it is claimed, were seen and heard in early times, fifty years ago. I myself saw in the night, going down from a tree to which we had chased it, an animal that, judging from its movements, might have been a lynx, but none were then killed. Miss Belle Dinwiddie, of Plum Grove, is authority, and competent authority, for the statement that an animal of the cat kind and called a lynx was killed near her home a few years ago. It is probable that only one species of *Felis* was native.

7. The common American deer, *Cariacus virginianus*, was once very abundant in the county. The following is one of Lake's historic records: "When putting on the roof of the Rockwell house in Crown Point, V. Holton and others saw, coming out from Brown's Point and passing out across the prairie to School Grove, a drove of deer, one bounding after the other, according to their best count in number one hundred and eleven."

I never myself saw so many at one time, but I have ridden in among them by night and have seen them by day in numbers sufficient to delight the eyes of a hunter or of a naturalist. But not one can now be found on these five hundred miles of area. Several years ago there was a cold, hard winter. The snow was quite deep, and on the snow came what is called a crust. On the top of the crust the dogs, the boys and the men pursued the almost helpless deer and slaughtered them without mercy. Few survived, and now, as I have said, of these beautiful animals and of the spotted fawn that could be seen in the spring time, in all the island groves and wild pastures there is left not one.

8. The habitat of the timber wolf, *Canis lupus*, extended into the south-eastern part of Lake County, into what is called Eagle Creek Township. These have been considered as not actual denizens for fifty years, but a few individuals have made occasional visits, some in 1872, and three or four in 1893, one of which was killed by Mr. O. Dinwiddie, of Plum Grove.

9. The bald eagle, *Haliaetus leucocephalus*, once a native, for a nest of this grand bird, perhaps its last, was found in 1835 in the eastern part of the county, and gave name to a stream and the stream to a township, I name next, as now extinct. One fine specimen of this species that was shot on my father's place at Cedar Lake in 1857, measured from tip to tip of its outstretched wings seven and a half feet. It is possible that one may now and then fly for an hour over the southern shore of Lake Michigan, but they do not sit now, as in boyhood I used to see them, on the great oaks at Cedar Lake to watch the fish hawks; their native home is in the county of Lake no more.

10. I name, last, a reptile that the citizens of Lake may well hope has become extinct, although possibly some few yet linger amid the growing civilization, the ground rattle snake, perhaps *Crotalus horridus*, quite poisonous, and fifty years ago very abundant. I had a dog that disposed of other snakes, but when he found one of these he backed out and kept away. The last one that I saw was killed some four years ago.

It is not always easy to trace a border line, and some other species I might call extinct of which a few individuals may still be found, but in addition to these ten species, some of which made not a little wild life, I will name as approaching extinction the prairie wolf, *Canis latrans*, of which in boyhood I shot one and trapped one; the otter, the mink, and the raccoon; also the black squirrel, the pinnated grouse, the partridge and the quail. As a citizen of Lake County I may say, with most of them we dislike to part. We had them, some of them by the thousands, once, but now they are rapidly disappearing. Yet, notwithstanding our fourteen railroads, our thirty towns and villages, with their constant hum of business, and our thousands of farms, we still have of mammals, birds and reptiles, of both vertebrates and invertebrates, quite a rich fauna left for the study of childhood and youth, for the investigations of the naturalist; but very little now for the sportsman, the hunter, or the trapper, where, according to the estimate of E. W. Dinwiddie, "250,000" wild fowls have been shot in a single season, and some sixty thousand musk rats have been trapped in a single year; where a thousand ducks have been in one sportsman's house at one time; where the wild geese have been almost by the million, but where along our southern marsh they make their nests no more.

All these that I have named are becoming so rapidly extinct that they will soon no longer form a part of our fauna, and Lake County will lose its former renown as the sportsman's paradise.

THE SYNONYMY OF THE OHIO RIVER UNIONIDÆ. BY R. ELLSWORTH CALL.

[ABSTRACT.]

The Ohio River is the original source of most of the earlier described Unionidæ of North America. The French explorers collected these forms and sent them to Europe. Among naturalists there, who described these collections, was Lamarck, who thus becomes the original source of information. Later Say, Rafinesque, Conrad, Barnes and Lea severally studied the Unios collected in the Ohio and gave different names to the same forms. There has resulted a confusion of specific names that has greatly retarded a correct understanding of the shells of this river. This paper redescribes the shells of such species as are imperfectly known, gives the synonymy of the several forms, has complete bibliographic references to original publications and illustrations, and has full notes on the geographic distribution of the several forms throughout the drainage basin of the Ohio.

An attempt at a natural grouping has also been made. An early—the earliest described—form has been made the type of the several divisions which are to be taken, not as sub-generic divisions, but as arbitrary morphologic sections, each of which will include forms that are closely alike in essential details. Through this grouping the facts lead to a rather extensive synonymy.

THE STREPOMATIDÆ OF THE FALLS OF THE OHIO. BY R. ELLSWORTH CALL.

[ABSTRACT.]

This paper lists the various forms of the several genera which occur at this locality. Notes on habits and abundance, on synonymy and geographic distribution are included. The species found number only ten nominal ones, and of these several are synonyms. There are bibliographic references to original descriptions and to published figures.

The ten species found, are distributed unequally, among four genera.

The conditions at the falls of the Ohio are well suited to this form of molluscan life, and they may be summed up in terms of the rich development of the several species in the matter of number and perfection of form. The locality is one of optimum conditions for the development of strepomatid life.

THE SWAMPS OF FRANKLIN COUNTY. BY M. H. STOOPS.

To one entering Franklin County by rail, he gains the impression that he is far distant from a swamp. On either side of the White Water River are high hills, which overlook the river valley. At times the train seems to be rushing into one of the hills, when it suddenly glides around the side, leaving the traveler to gaze at the side of the hill, which rises abruptly to a hight of three hundred feet.

This river valley owes its origin to the glacial period. In this section of the State the drift extends south into Kentucky. It is doubtful whether the ice extended farther south than this point. The melting of the vast quantity of ice formed a mighty river that rushed to the south and cut out the White Water valley. The present White Water River was the main channel of the glacial river for southeastern Indiana. This river wore through the rocks to a depth of over five hundred feet. Although the present hills are only from three hundred to four hundred feet high. The valley has been filled with drift to the depth of about one hundred and fifty to one hundred and seventy-five feet at Brookville. On either side of the valley, after ascending the hills, the county is comparatively level in places, except close to the tributaries of the river. Some parts of the county are very level and can only be cultivated because of artificial drainage.

In the northeastern part of Franklin County was the swampy region. The early settlers in this county ignored that section, they settled the river valley and hills before any one had the courage to even try the highest portions of the swampy region at that time, what is now Bath Township, and the wealthiest township in

Franklin County was the home of the beaver, bullfrogs of immense size croaked through the early spring months with nothing to disturb their music except the quack of the wild duck and the squall of the goose. Bath Township is on the divide between the White Water and Miami river systems. Part of the land is drained by the Miami and part by the White Water river. The swamps were caused by large quantities of ice being left on the land to slowly melt, as it melted the water was carried off to the east, south and west, while a great part of their debris was left on the ground which partially buried the ice, this ice slowly melted and left large ponds of water all over the township.

As the soil carried down by the ice was an impervious clay, the water could not very easily escape except by evaporation, when the snows and rains of winter came they were again filled to overflowing.

They varied in size from a quarter of an acre to a hundred or more acres. As the settlers became more and more numerous they were pushed nearer and nearer the wet lands, as it was impossible to raise anything on this wet land the settler began to devise means to carry off this surplus water. He succeeded until there are only two or three swamps that have not yielded to his labor. Throughout the wooded portion of the township are low places which collect the spring rains and hold the water far into the summer, but only one large swamp remains, that is known as the "big swamp.' It is about a mile long and one-fourth of a mile wide at its greatest width. It is now covered with a tangled growth of vines, willows and soft maples. It was formerly covered with a coarse grass which grew four or five feet high. Each year the farmers plow a little closer to it or put in a new tile ditch so that they are gradually reclaiming some of the best farming land in the county. This swamp in the spring of the year is a miniature lake, after a heavy rain the water is often four feet deep in places. It abounds in thousands of frogs that can be heard on any mild day in winter. Around the edges chimney crawfish rear their chimneys in great numbers. Wild ducks only occasionally visit it, but snipe are common.

This swamp was formerly the home of the beaver. To have an abundant supply of water he built a dam at each end of the swamp. As they exist to-day, they are about seventy to eighty feet in length and four to five feet high. These beavers knew how to economise their labor, because they built their dam at the point where it would require the least work. The water runs out of this swamp in two directions. It is the source of Big Cedar creek that empties into the White Water, and the source of Sand creek which finds its way to the Miami river. When it was the home of the beaver, the water was probably ten feet deep. An open ditch at the south dam is ten feet below the surface; add to this the height of the dam as it now exists, and it is thirteen feet from the bottom of the ditch to the top of the dam.

The land that has been reclaimed from the swamp is a black vegetable mould that is very productive. Several wells have been made in the reclaimed land that furnish a strong flow of sulphur water, at a depth of four to six feet, out of a pure white sand. The soil is very porous, where it seems perfectly dry, water will soon fill your tracks, and the furrows made by the plow fill with water by the time the farmer can make a second round.

In traveling along the roads the existence of former swamps are very plainly seen. The soil is a grayish or white clay. The decayed vegetable matter in the swamps made a black soil which contrasts strongly with the white clay. Some farms are, however, all black soil. The amount of this soil always determines the value of the land.

The big swamp of late years has completely dried during the long continued droughts, as to the surface appearances, but a stick stuck in the soft loose soil comes out wet, and the hole soon fills with water. The old settlers say that numerous fish could be taken from it during the spring months, when there was plenty of water, and that a tall coarse grass covered it entire during the summer. In the fall, when the grass was dead, it was often fired, when it would burn for weeks at a time, burning great holes in the ground about the edges of the swamp. This swamp is undoubtedly of glacial origin, and formerly extended over more or less of Bath Township. It has been the home of the beaver. It is underlaid with pure white sand and furnishes abundance of sulphur water. Man has labored for seventy years to redeem it, and has almost conquered, making the wilderness blossom as the rose.

Water Culture Methods With Indigenous Plants. By D. T. MacDougal.

During the course of some extended experiments relative to the general nature and functions of the tuberous formations on the roots of Isopyrum it was found impossible to secure a normal development of this hardy plant in pots with customary greenhouse temperature. An examination of the habit of the plant reveals the fact that it starts into active growth at the close of the winter season, when the soil is scarcely above the freezing point, and by the aid of a few days of warm sunshine accomplishes its yearly growth, during a period when the difference between the soil and air temperature is greatest. The amount of such difference between the soil of a northern hillside and the air in April and May, the growing period of the plant, is very great in this latitude, 45°. With such facts in hand it was easily interpreted that the discoloration and loss of leaf by the plants in the greenhouse was the direct effect of an abnormal absorption of water induced by the unaccustomed high temperature acquired by the small quantities of soil in the pots. The attempt was made to give the plant more nearly the normal conditions of temperature, and at the same time grow it in culture solutions. Since it is found in very moist localities the latter condition offered no violent changes to the habits of the plant. Ordinary culture jars of a capacity of one liter, provided with zinc tops, were used. The diageotropic rhizomes were imbedded in asbestos fibre in a sunken chamber in the zinc tops in such manner that the fibrous roots depended into the fluid beneath. The jars were set their full depth in a roomy box full of porous soil. By means of a constant drip from a water tap the earth was kept saturated, and by reason of the initial low temperature of the water and the rapid evaporation the fluid substance was kept quite cool. So nearly does this meet the natural conditions of the plant that specimens several years old were lifted from the soil in the woods and successfully grown by this method. The writer now has several plants which have been under such treatment during a period of nine weeks. They are of normal size and stature, and at this date (December 18) exhibit a number of flowers, opening buds and maturing seeds, while the development of the roots can be followed with the greatest ease. This method has been used by students in water culture experiments with the cultivated plants very successfully, and by its use it has been found possible to bring under continuous observation during the winter season several species of hardy native plants. In investigations on material of this kind it is believed it will prove valuable.

WORK SHELVES FOR LABORATORY. BY KATHERINE E. GOLDEN.

These are shelves which were constructed in such a manner as to do away with all vibrations from the floor and walls. This object was attained by the use of iron pipe. Round holes were cut through the floor, through which were driven two iron pipes, two and one-half inches diameter, into the ground beneath to a depth of about three feet. If the ground were very firm, a lesser depth would do. The pipes were left a convenient height above the floor. Heavy planks had holes bored in the two ends, through which the pipes fitted closely, the planks being held firmly in position by means of clamps placed beneath them. By means of the clamps the height of the shelves can be varied at any time to suit one's convenience. This kind of shelf is preferable to that which is suspended from the walls of a building, as the latter vibrates with the building.

One pipe would be sufficient for a small table, so that one might thus utilize a small corner of a room. Pipes driven into the ground are, of course, practicable only when the laboratory is on the ground floor and does not require too great an extent of the pipe above the ground.

The special features of these shelves are their cheapness, the carrying of a number of shelves on the same pair of pipes, and the ease with which they can be fixed up, so that one might readily set up shelves for different pieces of apparatus.

I use the shelves for work where a plant is on a lower level than the apparatus used with it. This result is gotten by boring a hole through the shelf and fastening the rod of a ring-stand in the hole with a nut. The ring can then be adjusted to any height on the rod.

Figure 1. Respiration Apparatus.

New Apparatus for Vegetable Physiology.

By J. C. Arthur.

[Abstract.]

The following apparatus was described: (1) A respiration apparatus to determine the amount of carbon dioxide exhaled by breathing plants within a certain time at a fixed temperature, the baryta method being used; (2) a centrifugal apparatus for revolving growing plantlets at a high speed, to replace gravity with a similar force, that may be varied at pleasure, in order to determine its effect in giving direction to the forming organs of plants; (3) a gas chamber to supply different gases to living tissues under the microscope; (4) a slide with binding posts to convey a current of electricity through living tissues under the microscope; and (5) a hygrometer to exhibit the comparative rate of evaporation of water from the two sides of a leaf. An instrument of each kind was exhibited, except the first one mentioned, which was illustrated with a drawing.

1. The Respiration Apparatus consists of a small glass chamber in which the seeds or other growing parts are placed.

This is suspended by means of a brass cover, in an outer jar containing water of suitable temperature. The respiration chamber is connected through potash bulbs and a wash bottle with an aspirator, so that to begin with, all carbon dioxide may be removed from the chamber and afterwards a current of air free from carbon dioxide be forced slowly through the chamber. As the air leaves the chamber it passes through a long Pettenkofer baryta tube, containing a solution of barium hydrate, and then through a similar but smaller tube, also containing barium hydrate. Only one long and one short tube are used at a time. When the first period is ended the current of air is diverted to the other pair of tubes by the turn of a stopcock, and in the meantime the first pair of tubes is emptied, refilled with fresh solution and placed in readiness to be used when the second period is ended, and so on. The solution from the tubes is titrated, and by a simple calculation the amount of carbon dioxide exhaled by the plantlets ascertained for each period.

The apparatus is a modification of the one used by Prof. Pfeffer (Unters. Bot. Inst. zu Tübingen. I, 637), which in turn was an adaptation of Prof. Pettenkofer's apparatus for studying the respiration of animals.

2. THE CENTRIFUGAL APPARATUS is to illustrate Knight's famous experiment in geotropism. The essential part of the apparatus consists of a closed chamber kept moist by dripping water, in which a cork disk is made to revolve. On this disk are pinned germination seeds. This disk is revolved rapidly (from one hundred to five hundred revolutions a minute) for some time, and the position assumed by the growing roots and the stems observed. The moist chamber and revolving disk may be set horizontally, vertically or at any intermediate angle. The speed is found by moving a paper over a pencil point at the lower end of the spindle for a definite time. It may be run by any convenient power, as a small water motor, or an electric motor. The apparatus is an invention of the writer.

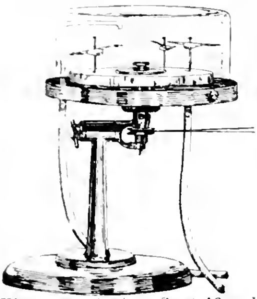


Figure 2. Arthur Centrifugal Apparatus.

3. THE GAS CHAMBER, for use on the stage of the microscope, consists of a shallow brass chamber, three inches long by one and three-fourths broad, with projecting metal tubes at either end. One side of the chamber is provided with a glass window, and the opposite side has a circular opening, which is to be closed when in use with the cover glass bearing the object for the experiment. The object to be examined is placed in a drop of water upon the center of the cover glass. The glass is then inverted over the opening of the gas stage, the margin having first been smeared with vaseline in order to

Figure 3.

make the glass fit air tight to the metal. The gas is now passed into the chamber from a generator or reservoir through one tube, escaping through the other. The apparatus has been in use some time in European laboratories.

4. THE GLASS SLIDE WITH BINDING POSTS, to be used when it is desired to pass an electric current through a microscopic object, consists of the usual form of microscopic slide, with a small brass binding post at either end, connected with a pair of clips. To put into use, two small wedge-shaped pieces of tin foil are placed under the clips, so that the points nearly touch. The object is then mounted between them and covered with a cover glass in the usual manner.

Figure 4.

5. THE AWN HYGROMETER is used to indicate the loss of moisture from a leaf surface. It consists of a thin glass chamber, across the mouth of which extends an adjustable metal rod. An awn of stipa is supported from the middle of the rod by a set screw, and from the other end of the awn an index projects at right angles. As the air of the chamber becomes moister the awn untwists, and the index is carried around. The most satisfactory way of using this instrument is to fasten a pair of hygrometers of equal sensitiveness to a leaf, one on either side, by means of a mixture of wax and oil. The leaf is either left attached to the plant or dipped into water to prevent wilting, as shown in figure 5a. The comparative rate of transpiration from the upper and lower surfaces of a leaf is thus obtained.

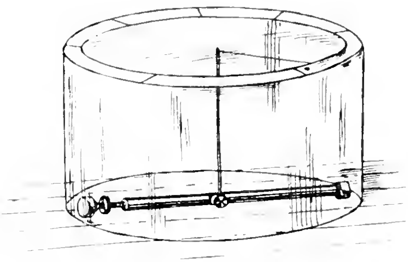


Figure 5. Darwin Awn Hygrometer.

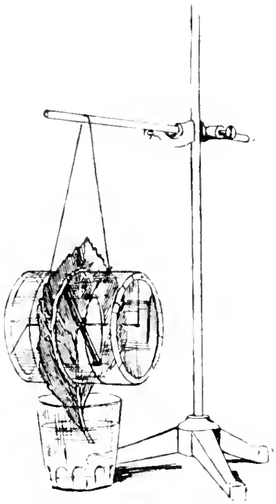


Figure 5a. Hygrometer in Use.

This instrument in the crude form was seen by the writer when visiting the laboratory of Mr. Francis Darwin at Cambridge in 1888, and has been in use in the physiological laboratory of Purdue University since that time. The present form is the result of this experience.

Collections of Plants Made During 1894. By M. B. Thomas.

It was thought that it might be of some interest to those working in various parts of the State upon the Biological Survey, to hear regarding the botanical work that has been accomplished in and about Crawfordsville during the past year. In connection with the regular required work of the senior year, the students are expected to devote much of their time, especially during the last term, to the preparation of papers upon some special topics. The results of this work last year were presented to the Academy in a short paper, and it is the purpose of this abstract to add a few notes regarding the additions that have been made during the year to the material that will ultimately enable us to obtain a fairly comprehensive knowledge of the forms of plant life in our region. It must be recognized that much of the work, covering as it does a wide range of subjects, can not be pushed with the speed or exhaustiveness that would be desired, but since in all cases material is preserved and stored away with accurate and complete notes, it will in time leave but examination and ultimate determination, an easy task in comparison with the laborious work of systematic collection and preliminary determination.

One of the subjects upon which faithful and earnest work was done included a study of the trees and shrubs of our flora. This work was carried on by Mr. L. M. Gentry, and his painstaking efforts resulted in quite a large list of these plants to our region. His tabulated statements show, collected up to June 20, 116 species and varieties of trees and shrubs, representing twenty-seven orders and sixty-seven genera. This, when compared with the whole number already reported in the state, will be seen to be quite a goodly representation for so small an area. By a careful system of taking notes and marking trees, a record is preserved of each locality to assist in further studies.

The next subject of interest was the work on the mosses of our region, by Messrs. C. Gentry and E. W. Olive. Careful collections were made and the material studied very faithfully, but it is expected since the determination of species was done without any great supply of literature and no herbarium for comparison, that some inaccuracies in naming will appear when the material is submitted for final examination. The list, however, shows thirty species, representing nineteen genera.

The other problem of a systematic character undertaken by the students was carried on by Mr. Tom Moore, and was a study of the filamentous algae. Comparatively nothing upon this subject has been published from this state, and the work started by Mr. Moore was almost pioneer in this locality. Notwithstanding the difficulties at present in the way of a systematic arrangement of the species of this group, because of the uncertainties in regard to the position of certain forms, Mr. Moore very carefully identified and preserved about twenty species. This represents a very small number of the forms studied, and as the work is now being continued by him under Dr. Farlow's direction at Cambridge, it is expected that some substantial record may be made to this part of our flora.

The list of parasitic fungi reported from our vicinity has been increased by Mr. Olive, much of it during the class work in this subject, until we now have 175 species and 250 hosts, twenty-seven species and forty-three hosts being new to the list published in the proceedings of last year. About forty species yet remain to be determined.

Work in the phanerogams has been continued and 204 species added to our local list. These do not include those in the report of Mr. Gentry on trees and shrubs.

The local list of pteridophytes now amounts to *nineteen*. We are yet far from the desired condition, but yearly additions are giving us better insight into our flora and enabling us to work to far better advantage than heretofore.

THE FLOWERING PLANTS OF WABASH COUNTY. BY A. B. ULREY AND J. N. JENKINS.

REVISION OF THE PHANEROGAMIC FLORA OF THE STATE. BY STANLEY COULTER.

[ABSTRACT.]

A review of work done during the year, including list of families studied in detail, collections examined, with presentation before Academy of work as far as completed. Suggestions were also offered concerning collection of certain forms in which existing herbaria were strikingly deficient.

REPORT OF THE BOTANICAL DIVISION OF THE INDIANA STATE BIOLOGICAL SURVEY FOR 1894. BY LUCIEN M. UNDERWOOD.

[ABSTRACT.]

Account of work in the field accomplished by the survey during the year. Necessity of having an organized body of correspondents throughout the state. Issue of *exsiccatæ*, with terms of distribution. Statement of work on the higher flora. Difficulties inherent in the collection of the lower plants. Acknowledgments.

An Increasing Pear Disease in Indiana. By Lucien M. Underwood.

[Abstract.]

Septoria piricola Desm., was first collected in the state by Dr. J. C. Arthur, in Tippecanoe County, in September, 1892. It was collected by the writer in Putnam County in October of the same year. Since that time its ravages are on the increase, and it has been seen in a number of pear orchards in central Indiana. The disease appears early in the summer and continues as long as the leaves remain on the trees. It manifests itself in the form of a series of brownish spots on the leaf where the chlorophyll-bearing tissue is destroyed by the fungus. On many leaves examined from one-fifth to one-half of the leaf was diseased. The effect was seen in the utter failure of the tree to produce fruit. In many cases it would be difficult to find a single leaf on a tree that was unaffected. It is evidently a good opportunity to introduce spraying with the usual Bordeaux mixture.

Value of Seed Characters in Determining Specific Rank.

The purpose of this study was to see if sufficient differences existed in the seeds of plants to enable us to determine specific rank. The plants taken for this work were those of the family *Plantaginaceæ*, including the ordinary plantain. The seeds were examined as to color, shape, size, and character of surface. The seed coats were also studied to see if histological differences of classificatory value existed, while incidentally any striking features in cell contents or peculiarities in response to the action of various reagents were noted.

The seeds were first studied as to external characters, and it was found that according to color and surface they could be separated into three groups: *P. major*, *decipiens* and *eriopoda* being black; *P. maritima*, *Patagonica*, *pusilla* and *cordata*, brown, and *Virginica* yellow. By outline of cross section it was found that they could be separated into four groups. By the combination of these two groupings we find that each species has at least one characteristic that is not found in any of the others. *Virginica* and *Patagonica* resemble in cross section, but differ in color; *major* is easily distinguished by outlines; *pusilla* is different from all others in cross section; *major* and *cordata* resemble in cross section, but are distinguished by color and surface; *decipiens* and *eriopoda* are similar in cross section and color, but differ in the position of the hilum.

The seed coats are somewhat diverse in structure, showing five general types, but after comparing the results in all cases it is apparent that the species examined do not show sufficient differences to enable us, in all cases, to distinguish one from another. For while the seed coat of one species may be unlike all others, and, therefore, readily distinguished, yet the second may be precisely like the third, thus rendering the seed coat valueless, on the whole, as a means of determining specific rank.

After a careful comparison of the results reached through these experiments, it is safe to say that the same harmony of structure exists in the seeds of species as in the leaf or the flower, while the same variety is found existing between seeds of different species. For although in the family under discussion each species resembles one or more of the others in some respects, yet it has at least one characteristic that is peculiarly its own. Thus *major* resembles *decipiens* in color, but differs from all the others in outline. *Virginica* and *Patagonica* are similar in cross section, but differ in color. And so on through the list studied, one may be distinguished by outline, another by color, another by cross section, or another by surface, yet the individual seeds of any one species are "as like as two peas." By these results we are impelled to the belief that the characteristics of seeds furnish as true an index to family, genus or species as do the leaf and the flower; and that it only remains for the botanist to school himself to read aright the lessons found in nature to be convinced that nothing is left to chance or accident, but that she has mathematical rules and chemical formulæ to which she is as constant as the needle to the pole.

Additions to the Fish Fauna of Wabash County. By W. O. Wallace.

Notes on Reptilian Fauna of Vigo County. By W. S. Blatchley.

Preliminary List of the Birds of Brown County. By E. M. Kindle.

Brown County lies about forty miles south of Indianapolis. Its boundaries correspond rather closely with natural features, and it may consequently be regarded as representing much more closely than counties usually do a faunal area. It has the geological distinction of being the only county in the state whose limits are confined entirely to the knobstone formation. The limestone hills of Monroe County approach to within a mile or two of the western boundary, while on the north and east, the southern limit of the drift corresponds approximately to the boundaries separating it from Morgan, Johnson and Bartholomew Counties. The county has a uniformly rugged and broken surface, which reaches the maximum of elevation in Bear Wallow and Weed Patch hills. Much of the county is still heavily timbered or covered with dense underbrush. The entire absence of ponds and marshes and of any large streams offers no inducement to water-loving birds to stop within the county. Bean Blossom and Salt Creek, which drain the county, are both small and unimportant streams.

The present list makes no pretension to being complete. It is offered as a first contribution to the ornithology of the county, which may serve as a basis for future work. The observations on which it is based have been made mainly in the course of several excursions to the county during the past three years. For the notes on nesting and the dates of first arrival of some migratory species I am indebted to Mr. Victor Barnett, a careful resident observer. Only those species are noted as breeding that have been observed nesting.

The list includes 106 species. Summarizing the more important facts concerning these species in their relation to the county, I find there are resident species 22, summer residents 47, winter residents 4, migrants 27. Fifty-three of these species are known to breed within the county.

My observations have not, perhaps, been sufficiently extended to warrant any remarks on species which do not occur in the county that might have been expected. I have, however, been much surprised at the apparent absence of one species, the summer red bird, inasmuch as it is common in Monroe County a few miles west of the Brown County line.

1. *Ardea virescens.* Green heron. A common summer resident.

2. *Rallus elegans.* King rail. Rare migrant.

3. *Philohela minor.* American woodcock. Old one with four young seen April 13, '94 (Barnett).

4. *Gallinago delicata.* Wilson's snipe. Migrant. March 24, '94.

5. *Totanus solitarius.* Solitary sandpiper. Common migrant.

6. *Ægialitis vocifera.* Killdeer. Summer resident. Breeds.

7. *Colinus virginianus.* Bob White. Common resident.

8. *Bonasa umbellus.* Pheasant. Common resident.

9. *Meleagris gallopavo.* Wild turkey. Almost if not entirely extinct. Formerly abundant.

10. *Ectopistes migratorius.* Passenger pigeon. Rare migrant. March 7, '94.

11. *Zenaidura macroura.* Turtle dove. Rather common resident.

12. *Cathartes aura.* Turkey vulture. Common summer resident. Breeds.

13. *Buteo borealis.* Red-tailed hawk. Common resident. Breeds.

14. *Haliaetus leucocephalus.* Bald eagle. An occasional visitor.

15. *Falco sparverius.* Sparrow hawk. Common summer resident. Breeds.

16. *Pandion haliaëtus carolinensis.* Fish hawk. Rare migrant. March 8, '94.

17. *Syrnium nebulosum.* Barred owl. A rather common resident.

18. *Megascops asio.* Screech owl. Very common resident.

19. *Conurus carolinensis.* Carolina paroquet. It is reported to have been formerly abundant along Bean Blossom by old settlers.

20. *Coccyzus americanus.* Yellow-billed cuckoo. A common summer resident. Breeds.

21. *Coccyzus erythrophthalmus.* Black-billed cuckoo. Rare.

22. *Ceryle alcyon.* Belted kingfisher. Common summer resident. Breeds.

23. *Dryobates villosus.* Hairy woodpecker. Common resident.

24. *Dryobates pubescens.* Hairy woodpecker. A more common resident than the preceding.

25. *Sphyrapicus varius.* Yellow-bellied woodpecker. A regular migrant. February 20, '94.

26. *Ceophlœus pileatus.* Pileated woodpecker. A rare resident.

27. *Melanerpes erythrocephalus.* Red-headed woodpecker. An abundant summer resident. Sometimes common in winter.

28. *Melanerpes carolinus.* Red-bellied woodpecker. Rather common resident.

29. *Colaptes auratus.* Yellow hammer. Common summer resident.

30. *Antrostomus vociferus.* Whip-poor-will. Summer resident. Breeds, April 16, '94.

31. *Chordeiles virginianus.* Night hawk. Abundant migrant. May 9, '94.

32. *Chaetura pelagica.* Chimney Swift. Common summer resident.

33. *Trochilus colubris.* Ruby-throated humming-bird. Common summer resident. May 2, '94.

34. *Tyrannus tyrannus.* King bird. Common summer resident. Breeds. April 18, '94.

35. *Myiarchus crinitus.* Great crested fly-catcher. Common summer resident. Breeds. April 28, '94.

36. *Sayornis phœbe.* Pewee. A common summer resident. March 10, '94.

37. *Contopus virens.* Wood pewee. Common summer resident. Breeds. May 4, '94.

38. *Empidonax flaviventris.* Yellow-bellied fly-catcher. One specimen taken on Weed Patch Hill August 11, '94.

39. *Otocorys alpestris praticola.* Prairie horned lark. A rather rare resident Breeds. Common in flocks in winter.

40 *Cyanocitta cristata.* Blue jay. A common resident.

41. *Corvus americanus.* American crow. Abundant resident.

42. *Dolichonyx oryzivorus.* Bobolink. Rare migrant. May 3, '94.

43. *Molothrus ater.* Cow bird. Common summer resident.

44. *Agelaius phœniceus.* Red-winged black-bird. Summer resident. Breeds. March 7, '94.

45. *Sturnella magna.* Meadow lark. Abundant summer resident. March 2, '94.

46. *Icterus spurius.* Orchard oriole. A common summer resident. Breeds. It migrates soon after the young are out of the nest.

47. *Icterus galbula.* Baltimore oriole. Rare.

48. *Scolecophagus carolinus.* Rusty blackbird. Migrant. March 14, '94.

49. *Quiscalus quiscula æneus.* Crow blackbird. Common summer resident. Breeds. March 6, '94.

50. *Carpodacus purpureus.* Purple Finch. Migrant. April 24, '94. A pair taken December 15, '94.

51. *Spinis tristis.* Thistle bird. A common summer resident.

52. *Poocætes gramineus.* Vesper sparrow. An abundant summer resident. Breeds. March 13, '94.

53. *Ammodramus sandwichensis.* Savanna sparrow. Migrant. April 29, '94.

54. *Ammodramus savannarum passerinus.* Grasshopper sparrow. Summer resident. Breeds. March 29.

55. *Chondestes grammacus.* Lark Sparrow. Rather a common summer resident. April 18, '94.

56. *Zonotrichia leucophrys.* White-crowned sparrow. A common migrant. April 28, '94.

57. *Zonotrichia albicollis.* White-throated sparrow. Abundant migrant in April and November.

58. *Spizella monticola.* Tree sparrow. An abundant winter resident.

59. *Spizella socialis.* Chipping sparrow. A common summer resident. Breeds. March 20, '94.

60. *Spizella pusilla.* Field sparrow. An abundant summer resident. Breeds. March 9, '94.

61. *Junco hyemalis.* Snow bird. An abundant winter resident.

62. *Melospiza fasciata.* Song sparrow. A common resident.

63. *Passerella iliaca.* Fox sparrow. A common migrant. March 6, '94.

64. *Pipilo erythrophthalmus.* Towhee. A common resident.

65. *Cardinalis cardinalis.* Red bird. A common resident.

66. *Habia ludoviciana.* Rose breasted grosbeak. Migrant. April 29, '94.

67. *Passerina cyanea.* Indigo bird. Abundant summer resident. Breeds. April 29, '94.

68. *Spiza americana.* Dickcissel. Common summer resident. Breeds. May 12, '94.

69. *Piranga erythromelas.* Scarlet tanager. Summer resident. April 29, '94.

70. *Progne subis.* Purple martin. Common summer resident. Breeds.

71. *Chelidon erythrogaster.* Barn swallow. Common summer resident. Breeds. April 17, '94.

72. *Lanius borealis.* Northern shrike. A rather rare winter resident. Two were taken November 18, '94.

73. *Lanius ludovicianus excubitoroides.* White rumped shrike. Migrant. March 13, '94.

74. *Vireo olivaceus.* Red eyed vireo. Common summer resident. Breeds. April 29, '94.

75. *Vireo noveboracensis.* White eyed vireo. Common summer resident. Breeds. April 27, '94.

76. *Vireo flavifrons.* Yellow throated vireo. Migrant. Taken once April 19, '94.

77. *Helmitherus vermivorus.* Worm eating swamp warbler. April 29, '94.

78. *Helminthophila pinus.* Blue winged yellow warbler. Common summer resident. April 29, '94.

79. *Dendroica æstiva.* Summer warbler. Common summer resident. April 4, '94.

80. *Dendroica cœrulescens.* Black throated blue warbler. Migrant. Rare. May 13, '94.

81. *Dendroica coronata.* Yellow rumped warbler. Abundant migrant. April 11, '94.

82. *Dendroica palmarum.* Red poll warbler. Common summer resident. April 23, '94.

83. *Seiurus aurocapillus.* Oven bird. Rare summer resident. May 5, '94.

84. *Geothlypis trichas.* Maryland yellow throat. Common summer resident. Breeds.

85. *Icteria virens.* Yellow breasted chat. Common summer resident. Breeds.

86. *Sylvania mitrata.* Hooded warbler. Summer resident. Not common. April 30, '94.

87. *Sylvania canadensis.* Canada warbler. Migrant. May 24, '94.

88. *Anthus pennsylvanicus.* American titlark. A common spring migrant.

89. *Mimus polyglottus.* Mocking bird. One specimen taken March 10, '93, by Victor Barnett, near Bean Blossom Creek.

90. *Galeoscoptes carolinensis.* Cat bird. Common summer resident. April 23, '94.

91. *Harporhynchus rufus.* Brown thrasher. Common summer resident. Breeds. March 23, '94.

92. *Thryothorus ludovicianus.* Carolina wren. Resident. Not very common.

93. *Troglodytes aëdon.* House wren. Common summer resident. March 16, '94.

94. *Troglodytes hiemalis.* Winter wren. Winter resident. Not common.

95. *Certhia familiaris americana.* Brown creeper. Common migrant. March 31, '94.

96. *Sitta carolinensis.* White bellied nuthatch. Common resident.

97. *Sitta canadensis.* Red bellied nuthatch. Common migrant.

98. *Parus bicolor.* Tufted titmouse. Common resident.

99. *Parus carolinensis.* Black capped chickadee. Common resident.

100. *Regulus satrapa.* Golden crowned kinglet. Common migrant. March 22, '94.

101. *Regulus calendula.* Ruby crowned kinglet. Migrant. April 18, '94.

102. *Polioptila cærulea.* Blue gray gnat catcher. Common summer resident. Breeds. April 17, '94.

103. *Turdus aliciæ.* Gray cheeked thrush. Summer resident. April 14, '94

104. *Turdus aonalaschkæ pallasii.* Hermit thrush. Common migrant. April 15, '94.

105. *Merula migratoria.* American robin. Abundant summer resident.

106. *Sialia sialis.* Blue bird. Abundant summer resident.

Notes on the Birds of 1894. By A. W. Butler.

In the study of the birds of our state, one steps over the boundary in many instances. On the south, the bird fauna is influenced by the Ohio River. On the east, the Big Miami and St. Joseph and St. Mary's rivers have some relation to bird life; on the north, Lake Michigan, with its tributaries, plays an important part in bird distribution; and on the west the Wabash and its western tributaries, besides the lower Kankakee, affect the distribution of birds both in Illinois and Indiana. The reports of occurrence of the migrations and of the breeding of birds without our state may thus be of value in the study of our own birds. This is particularly true in the State of Michigan. From the fact that it lies immediately north of us, many of its migratory birds may pass through this State. So, this year, I am enabled to present several notes on birds from without the State that have an important bearing upon the study of the birds of this State.

1. *Ammodramus henslowii* (Aud.). Henslow's sparrow.

Last year I reported the common occurrence and breeding of this species at English Lake, Indiana. At that time it had not been taken in Michigan. The first record from that State is given this year. May 12, 1894, Mr. L. Whitney Watkins reported six from Manchester, Mich. May 30, a nest containing five eggs was found in Jackson County, Michigan. The bird could not be identified. June 8, the female was shot as she was leaving the nest and proved to be this species. The locality was an open marsh bordering a lake. The nest was neatly though loosely constructed of coarse grasses and sedges lined with finer ones. It was situated in a tuft of grass about four inches above the wet ground. The eggs average .72 x .59 in., and were white with small reddish specks so numerous as to form an imperfect wreath about the larger end. Nest was hardly different from one of Maryland yellow-throat found in the same locality on the same day. Incubation nearly complete. An account of the breeding of the species as above noted has appeared in a number of the Nidiologist.

Mr. J. O. Dunn, of Chicago, found Henslow's sparrow very common at Bass (formerly Cedar) Lake, Starke County, Ind., late in July, 1894. They were apparently breeding, though no nests were found. One beautiful, clear evening, about 10:30 o'clock, Mr. Dunn says he heard one of these birds singing near camp. Thus we have another added to the voices of the night.

2. *Thryothorus bewickii* (Aud.). Bewick's wren.

In 1880 this species had not been reported north of Vigo, Putnam and Marion counties, in this State. May 1, 1894, Mr. G. G. Williamson reported one from Muncie, and he again noted it May 9. Messrs. L. A. and C. D. Test, of Lafayette, report it at that place April 12, 1894. They say it is tolerably common and breeds. Mr. W. O. Wallace informs us that he saw them at Wabash, Ind., April 23-25, April 25, April 27 and June 1, 1894. He notes them as abundant there. Mr. Jerome Trombley, Petersburg, Mich., reports one May 15, and again May 16, at that place. He says they are rare and breed. Mr. E. J. Chansler, Bicknell, Knox County, Ind., says it is a common summer resident. Perhaps some winter. Appear to be getting more numerous. Breeds. Thus will be noted further evidence of the rapid extension of the summer range of this species, and of its increase in numbers in localities where it has previously appeared.

3. *Charadrius squatarola* (Linn.). Black-bellied plover.

A rare migrant. Mr. J. E. Beesley reports two from Lebanon, Ind., the past spring; one May 3d, the other May 5th. Mr. Fletcher M. Noe reports one killed near Indianapolis, May 30, 1894, by Mr. C. W. Lambart.

4. *Protonotaria citrea* (Bodd.). Prothonotary warbler.

Lebanon, Ind., May 23, one. May 29, 1894, rare. (Beesley.)

5. *Calcarius pictus* (Sw.). Smith's longspur.

Mr. J. O. Dunn informs met that he found a specimen in a game store in Chicago from North Illinois. Mr. Jesse Earle, Greencastle, Ind., informs me, on March 29, 1894, in a certain pasture three miles west of Greencastle, he saw probably 60 Painted Longspurs. He collected two. These are the first recorded since Mr. E. W. Nelson found them common in Lake County, Ind., and Cook County, Ill., in 1875.

6. *Icteria virens* (L.). Yellow-crested chat.

Taken at Ann Arbor, Mich., spring of 1894, by A. B. Covert (Watkins, L. W.). Petersburg, Mich., two, May 3; two, May 17, 1894. Rare. Two nests found. Has not been noted here before since 1877. (Jerome Trombley.) Dunreith, Henry County, Ind., June 7 and 12, 1894, rare. (E. Pleas.)

7. *Branta canadensis hutchinsii* (Sw. and Rich.). Hutchins' goose.

Mr. E. J. Cransler says they are rare and seldom seen. They were quite common the winter of 1893. Could be seen in large flocks in company with Canada goose. He saw a large flock of Hutchins' geese in Gibson County in 1891. According to Dr. Brayton they were formerly common and bred in the State. (Trans. Ind. Hort. Soc. 1879, p. 178.) Not recently reported.

8. *Guara alba* (Linn.). White ibis.

Knox County, rare. An uncle of mine killed a bird of this species more than fifty years ago. Dr. Smith, of Bicknell, says he killed one in 1864.

9. *Catharista atrata* (Bartr.). Black vulture, carrion crow.

Knox County. Resident. Have become common since 1889. Previous to that date were seldom seen. They must breed, as they are present all the time. Quite common this fall, as there were many dead hogs for them to feed upon. (Chansler.)

10. *Elanoides forficatus* (Linn.). Swallow-tailed kite.

Knox County. Rare summer resident. I saw one in August, 1890, its mate was killed the day before and is now preserved by Mr. J. Freeman, Bicknell, Ind. April 11, 1894, one was seen by Mr. Harbin. (Chansler.)

11. *Conurus carolinensis* (Linn.). Carolina paroquet.

Knox County (?). Daviess County. Formerly a resident. My grandmother told me they were yet to be found about Grassy and Swan Ponds in Daviess

County in 1859. A neighbor of mine makes a similar statement. Another person says they were still found in Knox County and Daviess County in 1857–58. They say they flew in flocks arranged along two sides of a triangle after the manner of wild geese. They built their nests and roosted in woodpecker's holes or hollow trees. When roosting, it is claimed they hung suspended by their bills. They laid but two eggs. They remained about rivers, swamps and ponds. They lived almost entirely on cuckle-cockle burrs. One man said they would pile the burrs upon stumps, and after hulling out the kernel leave the empty burrs in a pile. They visited the orchards and did not injure the fruit trees as badly as generally claimed. (Chansler.) Mr. E. R. Quick informs me that Mrs. Laforge, an old lady who recently died, told him that she knew the paraquets quite well in Franklin County. She referred to the habit which she said was common, of splitting open apples with their bills in order to get the seeds for food, discarding the remainder of the fruit.

12. *Cistothorus stellaris* (Licht.). Short-tailed marsh wren.

July 24, 1894, Mr. Alexander Black obtained two of these birds from the reedy shore of the mill pond near Greencastle, which has become noted for the rare forms along its banks. He suspected a nest was hidden among the reeds. Next morning he continued his search and found the nest. This is the third breeding record for our state.

13. *Porzana jamaicensis* (Gmel.). Black rail.

July 27, 1894, Jesse Earle and Alexander Beach identified the black rail among the saw-grass about the "mill pond," Putnam County, Ind. It ran, but could not be induced to take wing, and finally hid. July 28, the bird was again seen, but could not be flushed. Although searched for, it could not be found until July 31. Then by the aid of a pointer dog it was flushed, but not shot. August 1, the dog caught a bird which proved to be a young black rail, too small to fly. Continuing the search an adult of the same species was flushed and secured. It was a male. This is the second account of its occurrence in the state, and the first account of its breeding. The same day a Virginia rail was caught, the first for that county.

14. *Xanthocephalus xanthocephalus* (Bp.). Yellow-headed blackbird.

Elkhart County, reported by Chancey Juday, from Millersburg.

15. *Spizella pallida* (Sw.). Clay-colored sparrow.

Several specimens taken by L. Whitney Watkins, September 3, 1894, at Manchester, Mich. There were about forty seen. But two former occurrences in that state are recorded. In Indiana it has been taken but once, September 27, 1890, at Terre Haute, Ind., by Professor W. S. Blatchley and reported by him at the meeting of this Academy in 1890.

16. *Ardea cærulea* (Linn.). Little blue heron.

Knox County summer resident; breeds. Saw one May 4, 1894. Mr. Harbin saw one on White River, June 5, 1894. Very shy (Chansler).

17. *Ardea candidissima* (Gmel). Snow heron.

Knox County summer resident; breeds. I have seen hundreds of these birds about the Swan and Grassy Ponds of Daviess County. They are often in company with the great blue heron.

18. *Ardea tricolor ruficollis* (Gosse). Louisiana heron.

Reported by Mr. E. J. Chansler, from Knox County. Second record from the state.

19. *Campephilus principalis* (Linn.). Ivory-billed woodpecker.

Mr. Harbin claims to have killed one in 1880. Reported by Mr. Warren from Southern Gibson County in 1893. (Chansler).

20. *Nyctea nyctea* (Linn.). Snowy owl.

Mr. Fletcher M. Noe reports receiving a fine snowy owl which was killed at Southport, Ind., six miles south of Indianapolis, November 18, 1894.

21. *Ardetta neoxena* (Cory.)

The capture of this rare species in Michigan the past summer, and the possibility of its occurrence in Indiana, make it worthy of special reference here. There were but nine specimens known.

1. The species was decribed from the Okeechobee Region, Fla. No date given. The Auk, Vol III., Apr., 1886, p. 262.

2. July 9, 1889. Thirty miles south of Lake Okeechobee. By Capt. J. F. Menge. He reported seeing three specimens, of which he was only able to get one The Auk, Vol. VI., Oct. 1889, pp. 317–318. In the same magazine is given Mr. Menge's account of the nest of the species found in the same locality, June 8, 1890.

3. May 18, 1890, in marsh near Toronto, Ont. Specimen now in collection, Canadian Institute. McIlwaith Birds of Ontario, 18, pp. 109–110.

4. May 19, 1890. Kissimmee River, Fla. By Mr. R. C. Stewart. The collector claims to have seen another, which he was unable to secure. The Auk, Vol. VIII, July 1891, p. 309.

5. June 28, 1891. Three miles south of Lake Okeechobee River, Fla. Male. By Capt. J. F. Menge.

6. July 15, 1891. Lake Flirt, Fla. By Capt. J. F. Menge.

7. August 15, 1891. Lake Flirt, Fla. By Capt. J. F. Menge. The last three are in the collection of Prof. W. E. D Scott. The Auk, Vol. IX., Apr. 1892, pp. 141–142.

8. May 20, 1893. Female. Toronto, Ont. By J. Ramoden. The Auk, Vol. X. Oct. 1893, pp. 363–364.

9. Aug. 8, 1894. Manchester, Mich. A specimen of this rare species was brought to Mr. L. Whitney Watkins by a neighbor's boy. Mr. Watkins at once wrote me of the peculiar dark Least Bittern that he had received. I suspected its identity and requested that he send it to me for examination. It had, however, been forwarded to Mr. W. B. Barrows, Agl. Coll., Mich. He determined it to be Cory's Bittern. It will be noted that six of those known have been taken in Florida and the other three north of the latitude of the northern boundary of Indiana. The peculiar extent of the range of Kirtland's Warbler, as noted last year before this Academy, finds a somewhat parallel peculiarity in this species.

The bird may be reasonably expected to occur in Indiana. Its dark color gives it the name of "Black Bittern" in Florida, to distinguish it from the "Least Bittern," which is called "Brown Bittern." They are about the same size.

Smith's Longspur, the Short-tailed Marsh Wren and nest, the Black Rail, have been very kindly deposited in my collection to verify the notes.

22. *Saxicola œnanthe.* Wheatear.

A specimen of this species was shot from among a flock of titlarks at Ann Arbor, Mich., October 4, 1894, by Adolphe B. Covert. The specimen is now in the U. S. Nat. Mus., Washington, D. C., No. 135,068, male, immature. (The Nidiologist, Vol. II., No. 3, Nov., 1894, pp. 42-43.)

23. *Anas penelope* (Linn.). Widgeon: European Widgeon.

The European Widgeon has not before been reported from Indiana. The first account of its occurrence is published by Mr. Ruthven Deane, in "The Auk," Vol. XII., April, 1895, p. 179: "The specimen in question was taken on the Kankakee River, at English Lake, Ind., April 13, 1893, by Mr. Landon Hoyt, of Chicago, Ill., and is now in his possession. When shot it was in company with a flock of Baldpates (*Anas americana*)."

The species has occasionally been taken in America, but I think its records in this vicinity are two in Illinois and one in Wisconsin.

24. *Ectopistes migratorius* (Linn.). Passenger Pigeon.

In 1888 Mr. Wm. Brewster visited the parts of Michigan well known as the breeding grounds of these birds. The flight was small, compared with what was reported in former years. They passed north of the lower peninsula to breed. At that time Mr. Brewster was of opinion that there were enough pigeons left to restock the nest, provided they could be protected by adequate laws. Whether or not that can be done is doubtful. If we may judge by the past legislation and its enforcement on behalf of our native game, it seems to me hardly probable that it will be done. The last passage of pigeons that could be dignified with the ame of "flight" occurred in 1877. That fall there were a great many observed about Hanover, Ind. Some notes which have recently come to hand may be of interest. The greater part of them relate to this year:

Manchester, Mich., June 13, 1894. None have been seen before in ten years. Breeds?

September 9 and 12, 1894. L. Whitney Watkins, Spearsville, Ind. One March 7, 1894.

April 5, 1894. Rare.—Victor H. Barnet.

Laporte, Ind., April 10, 1894. Saw flock of fifty or more. First large flock seen in several years.—Charles Barber.

Bicknell, Knox County, Ind. Migrant rare if not extinct. I have not seen one for ten years. They formerly were abundant. I can remember, during their migrations, the heavens would be covered for hours, yes, for days, in all directions with them. They formerly bred near here, and would cover the forests for miles, until the limbs would break down with their weight.—E. J. Chansler, spring, 1894.

Recently I received a letter from the same gentleman, containing the following notes:

"I saw a considerable flock of these birds 1st of September, 1894. Mr. Harlan saw a flock October 5, 1894. These were the first pigeons I have seen for years."

Grand Haven, Mich. One May 3, 1894. Very rare; used to be plentiful. Breeds.—E. Davidson.

Kentland, Ind. Mr. W. W. Pfrimmer says they were formerly very plentiful. Nested in the timber along the Kankakee River. Now scarce. Have seen none for two years. In 1892 I shot two.

Dunreith, Henry County, Ind. Mr. E. Pleas says twenty years ago wild pigeons came in vast numbers almost every spring.

Out of some four reports on the spring migration and ten on those of the fall but five reported the presence of the wild pigeon. A bird so conspicuous that if present could scarcely escape unseen. And even this report is better than for some years past. One pigeon in a year! Think of the change! Within the memory of men who are not yet old these migratory pigeons would obscure the sun and hide the sky for hours, sometimes for days in succession. The strange appearance was made more wonderful by the continuous rumble of the thunders of the oncoming clouds—the noise of the strokes of millions upon millions of wings. Some of the roosts covered many miles of forest. There, as they settled at evening, the gunners from miles around began the slaughter. After a number of shots over a considerable area, several acres, sometimes the whole roost would rise with a deafening thundering, which no one has attempted to describe, and soar out of sight in the dusk of the early evening, while from the rising cloud came a noise as of a mighty tornado. As the darkness settled the birds descended and alighted many deep upon the limbs of the trees, the weight being so great as to break many off. Then the scene changed. The slaughter began in earnest. The rapid firing of guns, the squawking of the pigeons, the breaking of the limbs of giant trees beneath their living weight, the continuous rumble arising from the whirr of countless wings, all illumined by the lurid lights from many fires, produced an effect which no words can convey to one who has not experienced a night at a "pigeon roost." Each year such scenes were re-enacted. Each year the slaughter went on. Less and less the numbers grew. Trapping and netting, supplemented by repeating guns, added to the power of destruction, and the pigeons, whose numbers were once so great that no one could conceive the thought of their extinction, have dwindled until they are rarely found, until they are only a memory.

Some Notes on the Blind Animals of Mammoth Cave, with Exhibition of Specimens. By R. Ellsworth Call.

The Batrachians and Reptiles of Wabash County. By W. O. Wallace.

On the Occurrence of the Whistling Swan in Wabash County. By A. B. Ulrey.

Birds of Wabash County. By A. B. Ulrey and W. O. Wallace.

Birds Observed in the Sawtooth Mountains. By B. W. Evermann and J. T. Scovell.

Animal Parasites Collected in the State During the Year. By A. W. Bitting.

Angling in the St. Lawrence and Lake Ontario. By Barton W. Evermann.

The Mammals of Indiana. By A. W. Butler.

One of the advantages of a work upon the natural history of a region is the opportunity it affords for criticism, correction and for the accumulation of additional material. One's friends after going over the paper will say they had not thought the occurrence of a given species of any importance. They are common in the neighborhood. A fruitless search for that fact has required much time in the investigation. Yet here is a per on who has had all the time the information sought, but thought it of no consequence. If we could only get together in a proper place the facts known by our members which are not considered of any special importance, what a great help it would be to our investigators. These meetings are the place for such a deposit of facts—a clearing-house in the various fields of research, especially in zoölogy, botany, geology, and anthropology. Since the publication of the papers on Indiana mammals by Prof. Evermann and myself, quite a number of notes which would have been very acceptable a year ago have come into my hands. Many of these were called out by the paper mentioned. From them I select some which may be of interest to the Academy, and possibly to the public generally.

1. *Didelphis virginiana* Shaw. Common Opossum.

I am enabled through the kindness of Mr. W. W. Pfrimmer, to report their occurrence in Jasper and Newton counties. In 1869 when he first knew them there, they were rare, and so continued until 1880. He recalls but two specimens that he had seen in that period. They have been increasing since, and are now tolerably common. Several have been reported the present winter from the vicinity of Lafayette by Messrs. L. A. and C. D. Test. Among them were three young.

Mr. E. J. Chansler, of Knox County, says: 'possums are becoming rare in that locality. About 1859, he notes, as an illustration of the abundance of the animal, one evening, after they had killed hogs, they killed eight opossums in the door-yard before bed time. They had probably been attracted by the offal of the slaughter. In those days, in that land of the persimmon, the edges of the prairies were the places where, in the fall and winter, the two were found together—the persimmon and the opossum.

2. *Erethizon dorsatus* (L.). Canada porcupine.

Knox County. Formerly found here, but rare. Stafford reports having seen two, the last one about 1834 (Chansler). Mr. Bruce reports seeing one that had been killed in Daviess County in 1837 (Chansler).

3. *Zapus hudsonius* (Zimm.). Jumping mouse.

Newton County (Pfrimmer).

Mahoning County (Ellsworth), O. (E. W. Vickers).

Sandusky, O. (E. W. Vickers).

4. *Geomys bursarius* (Shaw). Pocket gopher.

Newton County (Pfrimmer).

5. *Mus rattus*, (L.) Black rat.

Knox County. At one time numerous, but now extinct. Reported that it was last seen here in 1845 (Chansler).

6. *Mus decumanus*, Pallas. Brown rat; Norway rat.

Knox County. Very numerous; our common rat. Said to have been first seen in 1840 (Chansler).

7. *Castor fiber* (L.). Beaver.

Newton County. Formerly abundant. The remains of their work is yet seen (Pfrimmer).

Bartholomew County. About one mile from the intersection of the Decatur and Jennings County line is a place called the Beaver Pond. There they formerly built their houses (Miss Elizabeth Wright).

Tippecanoe County. Beaver skull taken from Goose Island, Wabash River, in the spring of 1894 by C. A. Schott (Prof. Stanley Coulter).

Knox County. Formerly found. Reported in 1839. Mr. Dubois reports seeing one that had been caught in a trap in 1840. Dams across some of our streams are still visible. Some claim that Montour's Pond was caused by Beavers damming Pond Creek (Chansler).

8. *Spermophilus tridecemlineatus* (Mitchill). Striped Gopher.

Newton County. Abundant along hedges and banks. Also in the grassy margins of the fields (Pfrimmer).

Tippecanoe County, 1894. L. A. and C. D. Test.

9. *Spermophilus franklini* (Sabine). Gray Spermophile.

Newton County. Think they are rare. Have seen two. Had one for a pet. They are called "Prairie Squirrels" (Pfrimmer).

10. *Sciurus hudsonicus* (Erxleben). Red Squirrel; Chickaree.

Lake County. Rare.

Newton County. Heard of; not seen (Pfrimmer).

1. *Condylura cristata* (L.). Star-nosed Mole.

Bartholomew County. A specimen described by Miss Elizabeth Wright, appears to be this species. It was taken in their garden near Grammer. In this connection I might quote from a recent letter from Mr. Ernest W. Vickers, of Ellsworth, Mahoning County, O., on the occurrence of this species in that state: "I have found the Star-nosed Mole at Canton, Stark County. One specimen. Another reported, Berea, Cuyahoga County. Common in onion muck. Weymouth, Medina County: Reported. Cuyahoga Falls, Summit County: Specimen found along Cuyahoga River during meeting of Ohio State Academy of Science, in 1892. Portage County: "I took a specimen near Suffield in June, 1894. In this township I collected six specimens in an area of less than four acres in the summer of 1893. This year, 1894, I have found none." (Richland County Geological Survey of Ohio, Zoölogy and Botany, Vol. IV., p. 179, foot-note.

2. *Blarina platyrhinus* (DeKay). Common Shrew.

Although no additional specimens have been reported in this state, I desire to call attention to its occurrence in Ohio. Mr. E. W. Vickers, of Ellsworth, Mahoning County, says: "I found one specimen last year, 1893. This year I collected five of this species on one farm in this township."

3. *Cariacus virginianus* (Bodd). Virginia deer.

Newton County. Extinct. Last deer killed was twenty years ago (1874). One was seen three years ago (1891).

Jasper County. Deer killed about 1890 (Pfrimmer).

Knox County. Found at one time in countless numbers. Now only met with occasionally in the cypress swamps of this county (Chansler).

4. *Cervus canadensis* (Erxleben). Wapiti; elk.

Knox County. Still found here in early part of this century. Mr. Brad. Thompson reports seeing a wild elk in 1830. Mr. Stafford says that he saw an elk that was killed on Pond Creek in 1829 (Chansler).

Daviess County. Mr. Bruce reports seeing elk horns in Daviess County as late as 1850 (Chansler).

5. *Bison bison* (L.). Bison; buffalo.

Knox County. The buffalo in an early day were very numerous. The trail along which they used to travel between the blue grass region of Kentucky and the prairies crossed the Wabash River near Vincennes. George Rogers Clark, writing from Vincennes, mentions the buffalo.

Mr. B. Thompson says his father reported buffalo here in 1808. Mr. A. Stafford tells me of finding buffalo horns on Collins' Prairie (Chansler).

Daviess County. Mr. Bruce reports finding horns that had been dug up by hogs in a marsh in 1840 (Chansler).

16. *Procyon lotor* (L.). Raccoon.

Newton County. Abundant. Have been known to bed up like hogs, two in a bed, on the edge of the marshes. Hunters follow along the marshes, and when the raccoons are found they at once take to the water to escape the dogs (Pfrimmer).

Knox County. Not so common as formerly. The fur traders say they generally get two or three black 'coons each winter (Chansler).

17. *Ursus americanus* (Pallas). Black bear.

Knox County. Moderately common within the memory of a few of our oldest citizens. An old friend told me that when a boy he met with bear quite often. He saw the last one in this county in 1845. The *Vincennes Commercial* in 1882 reported two young black bears having been killed at Montours Swamp that year (Chansler).

Daviess County. Mr. Bruce says the last black bear in this county was killed in 1837 (Chansler).

Newton County. Extinct.

Jasper County. About ten years ago (Pfrimmer).

18. *Lutra hudsonica* (Lacipede.) American otter.

Newton County. Reported within six months. One caught last winter (1893–4). I have seen signs within three years (Pfrimmer).

Lake County. Reported within last few years (Pfrimmer).

Porter County. Reported within last few years (Pfrimmer).

Tippecanoe County. One killed on Goose Island, Wabash River, by C. A. Schott spring of 1894. Skin sold in Lafayette for $9. The specimen has been seen and identification verified. Mr. Schott reports another slide in the same locality. He says he has seen several other otters. They are extremely shy and difficult to get (Prof. Stanley Coulter).

Knox County. Rare if not extinct. Hunters used to kill them in winter in the snow with clubs as they travelled from one pond to another. Older men remember a familiar slide (Chansler).

19. *Taxidea americana* (Bodd). American badger.

Newton County. Occasionally found.

Benton County. One killed about 1874 (Pfrimmer).

20. *Vulpes vulpes* (L.). Red fox.

Newton County. Along Iroquois River plentiful; elsewhere rare (Pfrimmer.)

Knox County. Common in last fifteen years; before that rare (Chansler).

21. *Urocyon cinereo-argentatus* (Schr). Gray fox.

Knox County. Common to fifteen years ago. Now rare (Chansler).

22. *Canis lupus* (Say). Wolf.

Newton County. One killed two years ago (Pfrimmer).

Knox County. Numerous in the early days. Last one was killed on Birch Run, between Bicknell and Edwardsport by Henry Maclin in 1853. One was killed within one and one-half miles of Vincennes, in Illinois in 1882 (Chansler).

Daviess County. Last seen in 1850, according to Mr. Bruce (Chansler).

23. *Canis latrans* (Say). Coyote, prairie wolf.

Newton County. One killed in November, 1894, along Monon Railroad. Observed in all parts of Newton County within last three years. More numerous in northern portion. A ride of half a dozen miles through the higher marshes will probably reveal two or three. Last year (1893) saw three at one time. They are destructive to poultry, pigs and sheep. This county paid over $100 bounty for wolves killed last year. The rate was $5 for each old one and $2.50 for each young one (Pfrimmer).

Knox County. Not so common as the gray wolf. Found as late as 1854. One authority reports seeing one near Vincennes in 1858. The species has not been authentically reported from the state before (Chansler).

24. *Felis concolor* (L.). American panther.

Knox County. Formerly found. Mr. A. Stafford reports seeing the last one in 1833. Mr. Thompson reports seeing one in 1825. Mr. Bruce reports it in Daviess County as late as 1830 (Chansler).

25. *Lynx rufus* (Guldenstadt). American wild-cat.

Knox County. Rare. One killed near Bicknell in 1832 by Mr. Robert M. Kinsley. Reported about Montours Swamp spring of 1894.

Wells County. One taken near Bluffton early in November, 1894. It weighed 56 pounds (F. M. Noe).

26. *Lepus aquaticus* (Bachman). Water Hare.

Knox County. Mr. Chansler says a brown rabbit has been seen there by different persons. It is said to be much larger than the common gray rabbit. It seems probable that two forms of swamp hares will be found in the lower Wabash valley, the one above noted, which ranges southwest to the Gulf of Mexico, and the smaller, *Lepus palustris*, Bachman, which ranges to the south and southeast. Careful investigation of the rabbits of southern Indiana is requested.

27. *Corynorhinus macrotis* (LeConte). Big-eared bat.

December 26, 1894, Dr. L. M. Underwood brought to me at the Denison House, Indianapolis, a specimen of this species taken from a cave five miles southwest of Greencastle, Ind., a few days before by Prof. J. P. Naylor. There was another with it, which was not taken. Returning to the cave another time no more could be found. The specimen is now in my collection.

Some Cases of Mimicry in Fishes. By W. J. Moenkhaus.

There are four different species of fish that show a most interesting similarity in their color pattern. They are *Etheostoma blennius*, *Etheostoma uranidea*, *Cottus richardsoni* and *Catostomus nigricans*. They belong to three different families, the first two, darters, to the *Percidæ*; the third, the *miller's thumb*, to the *Cottidæ*, and the last, the black sucker, to the *Catostomidæ*.

The color-pattern consists of four broad transverse bars extending downward and forward. The similarity of this pattern in the darters and the miller's thumb is almost perfect. The black sucker has this pattern only when young. The resemblance here is less perfect.

This remarkable coincidence of color-pattern can be explained on the principle of protective mimicry. The miller's thumb is a very horny, spiny and uninviting fish for food to any enemy that may live on small fish. It may, therefore, have found it advantageous to develop these four prominent bars as a mark to enable its enemy to recognize it and thus make fewer mistakes in capturing undesirable food. The darter and the young sucker on the other hand would be most excellent food for these same enemies. Thus they have found it to their advantage to mimic this miller's thumb and live off its reputation as an undesirable food fish.

This seems all the more probable from the fact that these fish inhabit the same streams.

LEUCISCUS BALTEATUS (RICHARDSON). A STUDY IN VARIATION. BY CARL H. EIGENMANN.

Nowhere else in North America do we find within a limited region such extensive variations among freshwater fishes as on the Pacific Slope. This is true whether we have reference to the extent of variation between the extremes of the same family or to the limits of variation in any given species.

A comparison of the members of the eight families of fishes having representatives on both the Atlantic and the Pacific slopes, show that, on an average, each of these families has four genera and sixteen species on the Pacific slope, and seven genera and thirty-six species on the Atlantic. Yet, although the number of species is more than twice as great on the Atlantic slope, the variation in the number of fin rays among the Pacific slope species is greater in all but two families. I have recently† made a detailed comparison between the members of the different families, and there attributed this great extent of variation to two causes. First: the fauna is of diverse origin; some of the members are of Asiatic, while others are of Atlantic descent. Second: the fauna is new as compared with the Atlantic slope fauna, and has not yet reached a stage of staple equilibrium. It is possible, as suggested to me by President Jordan, that the Pacific slope fauna has retained its primitive characters more nearly than the Atlantic slope fauna, which shows signs of degeneration in its fins and teeth.

This great variation between the members of the same families is not confined to the fin rays. It is equally true of other characters, but can best be demonstrated in characters whose variation can be numerically expressed. The pharyngeal teeth of the Cyprinidæ offer another striking example of these variations among the Pacific slope species. In a number of cases the variations of the Pacific slope species extend along definite and parallel lines. I have pointed out some of these in the paper quoted above. These lines are directed towards an increase of rays and towards a modification of rays into spines.

The following quotations from Gilbert and Evermann's recent work on the Columbia River basin,‡ illustrate the variation among the different specimens of the same species. "The range of variation seems to be very great, and characters which are of undoubted specific value when applied to Atlantic drainage

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Contributions from the Zoölogical Laboratory of the Indiana University, No. 11.

†Results of explorations in Western Canada and Northwestern United States. Bull. U. S. Fish Comm. for 1894, pp. 101 to 132, plates 5 to 8. June, 1894.

‡Report of the Commissioner of Fish and Fisheries on Investigations in the Columbia River Basin in regard to the Salmon Fisheries. Washington, 1894. A Report upon Investigations in the Columbia River Basin with Descriptions of Four New Species of Fishes.

species, do not possess any such value for classification of Pacific coast fishes. Each so-called species seems to be in a very unstable state of equilibrium, and not to have yet assumed or been able to retain, with any degree of permanence, any set of specific characters." "The crosswise series of scales [in Agosia nubila (Girard)] varies from 47 to 70 in number; the barbel [a generic character] is present or absent; the pharyngeal teeth vary from 1, 4–4, 0 to 2, 4–4, 1; and the dorsal fin varies much in position and somewhat in size. These characters occur in various combinations, and with some of these are often correlated peculiarities of physiognomy and general appearance, all of which may serve to put a certain stamp upon the individuals from a single stream, or even from one locality in a stream." These observations, especially those contained in the last sentence, accord exactly with the results obtained by me in another fish and confirm my statement which will be further re-enforced by the present paper, that "each locality has a variety which in the aggregate is different from the variety of every other locality."

The remarkable variation of the Pacific slope species, and more especially the varia ion in the fin rays, was first noted in preparing my account of the specimens collected in the Columbia and Frazer basins.* This variation was most pronounced in the species of the late genus Richardsonius. Of the species of this genus, I had about 250 specimens, collected in the Frazer and Columbia systems, from tide water to an elevation of 2,786 feet. The later explorations of Gilbert and Evermann have increased this number to 825, and these warrant a re-examination of the points stated by me. For all the date concerning the fin rays of the specimens collected by Gilbert and Evermann, I am indebted to them. Their examination of these specimens was made to test certain conclusions reached by me, and their data, therefore, join mine. In counting the anal rays, I counted the rudiments at the beginning of the fin. These were not counted by Gilbert and Evermann, and to bring their data in perfect accord with mine, it is necessary to add two to the number of anal rays. While the number of rudimentary rays is not always two, it is so often that the exceptions would probably not alter the general results.

At the time I began my studies of these forms, they were regarded as two species, forming a peculiar genus, Richardsonius. They were known to inhabit the Columbia river and the streams about Puget Sound. The compressed belly behind the ventral fins was regarded as the character separating them generically from the related forms. It soon became evident that, while some specimens possessed this, if constant, unquestionable generic character, others did not show

*This variation in the same species does not seem to be confined to the fishes. Professor Ritter, Proc. Cal.: Acad. Sci., 2d ser. Vol. IV., p. 37, finds the same in ***Perophora annectens*** a new tunicate described by him.

it at all, and the genus was relegated to the limbo of synonymy. The species *balteatus* and *lateralis* were distinguished as follows:

a. Base of anal, 4¼ in the length; A. 17 or 18; teeth 2, 5–4, 2. Lower jaw slightly projecting beyond the upper. Coloration plain, the sides bright silvery, crimson in males in spring. Scales 13–62–6. *balteatus.*

aa. Base of anal, 5⅓ in the length; A. 14; teeth 2, 5–5, 2. Jaws equal. Blackish above, a dark lateral band; the interspaces and belly pale; crimson in male in summer. Scales 13–55–6. *lateralis.*

No better distinguishing marks could be wished by any systematist. These characters were found to be so bridged, that the extremes could not be specifically sustained and one of them, probably out of deference to the authority of my friends Jordan and Gilbert, from whom the above diagnosis was modified, was retained as a variety of the other. Now I am inclined to regard *lateralis* as a synonym of *balteatus* with Gilbert and Evermann, but I must take exception to the statement attributed to me that I "considered *lateralis* a subspecies of *balteatus* occupying the same brook with its parent form." I found *balteatus* at the lower Frazer to Kamloops, *lateralis* at the headwaters of the Thomson River down to Kamloops. I see no reason why a subspecies should not occupy the same "brook" with its parent form, for some allied species—between which and subspecies there is, after all, but a mental difference—are, even by Gilbert and Evermann, admitted to live side by side (*Agosia falcata* and *umatilla* at Umatilla).

Leuciscus balteatus ascends the tributaries of the Frazer and Columbia as high as the falls will permit. No other species is found in the Frazer system nor in the Columbia basin proper. The specimens from Brown's Gulch were described as different from those of the lower Columbia, but a comparison of large numbers from other localities has shown them to be but one of the numerous local variations. Three other species, *L. hydrophlox*, *lineatus* and *aliciæ* are found in the Snake above the falls. The last two belong to a different section of the genus *Leuciscus* and are not closely related to *balteatus*. All three have probably entered the Snake River from the Utah Basin. As far as known the territories of *L. balteatus* and *hydrophlox* do not overlap, unless those specimens of *balteatus* with only 13 or 14 anal rays are in reality *hydrophlox*, and as far as my experience goes, the number of anal rays is the only ready means of distinguishing the two. *L. balteatus* extends up to or near to the first falls of the Snake, *hydrophlox* is found from this point to the headwaters. A comparison of *hydrophlox*, *balteatus* and *gilli*, the specimens from Brown's Gulch, makes it quite certain that they are all modifications of the same form.

Below are given a number of tables which show the variation in several characters. These tables are all from my own specimens.

TABLE OF VARIATION FOR TWENTY-SIX SPECIMENS FROM MISSION.

Number.	Length in MM.	Dorsal.	Anal.	Scales.	Teeth.	Depth.	Position of Dorsal.	Sex.	REMARKS.
1	140	13	18	12-59-6		[illegible]	(†)	Female.	Keel scarcely evident.
2	120	12	21	11-53-5	2, 5-4, 1	3	(‡)	Male.	Median keel scarcely evid't
3	110	13	19	12-64-6	2, 5-4, 2	3	( )	Male.	Median keel moderate.
4	105	12	20	12-58-6	2, 5-4, 2	3	( )	Female.	Median keel well developed
5	100	12	19	11-57-6	2, 4-4, 2	3	(†)	Male.	Keel typical.
6	102	12	18	12-60-6	2, 5-4, 2	3	(‡)	Male.	Keel moderate.
7	91	11	20	12-57-5	2, 4-3, 1	3	( )	Female.	Keel evident.
8	92	11	19	12-58-6	2, 5-4, 1	3	( )		Keel distinct.
9	88	12	19	12-61-6	2, 5-4, 2	3	( )	Male.	Keel well developed.
10	92	12	21	12-63-6	2, 5-4, 1	3	(‡)	Female.	Keel typical.
11	102	12	20	11-62-6	2, 5-4, 2	3	(‡)	Male.	Keel well developed.
12	87	12	20	13-59-6	1, 5-4, 2	3	(†)	Male.	Keel moderate.
13	86	12	20	11-59-7	2, 5-4, 1	3	( )	Male.	Keel well developed. *tanus*
14	83	12	20	12-61-7	2, 5-4, 1	3	(†)	Male.	Keel no more than in *mon-*
15	80	11	19	12-61-6	2, 5-4, 1	3	(†)	Male.	Keel distinct.
16	95	12	18	13-59-7	2, 5-4, 2	3		Male.	Keel evident.
17	90	12	17	13-58-7	2, 5-4, 2	3	(†)	(?)	Keel moderate.
18	80	11	17	11-60-7	2, 5-4, 2	3	(†)	Male.	Keel typical.
19	77	12	17	57	2, 5-4, 2	3	(†)	(?)	Keel well developed.
20	87	12	16	13-61-7	2, 5-3, 2	3	(‡)		Keel well developed.
21	81	12	22	12-58-7	2, 5-4, 2	3	( )	Female.	Keel moderate.
22	80	13	21	61	2, 5 ?	3	( )	Female.	Keel moderate.
23	74	11	16	. . . .	2, 5-4, 2			. . . . .	Keel moderate.
24	60	13	24	. . . . .	2, 5-4, 2	3	(†)	. . . .	Keel evident.
25	68	13	24	. . . .	. .			.	
26	64	12	23		. . . .	. .	.	. . . .	

I have frequently observed that the largest individuals among the minnows usually have abnormal numbers of teeth.

† Equidistant from base of middle caudal rays and a point above middle of pupil.

* Anterior tooth of main row on left side is large, dagger-shaped, and remote from the others, and points inward.

‡ Equidistant from base of middle caudal rays and upper angle of preopercle.

Equidistant from base of middle caudal rays and posterior margin of eye.

TABLE OF VARIATION FOR EIGHT SPECIMENS FROM SICAMOUS.

Number.	Length in MM.	Dorsal.	Anal.	Scales.	Teeth.	Depth.	Position of Dorsal.	REMARKS.
1	82	12½	19½	11-60-6	2, 4-3, 1	4	(*)	
2	92	12	16	11-62-6	2, 5-4, 2		(*)	Keel indistinct.
3	90	12½	14½	14-62-7	2, 5-4, 2	3	(†)	
4	87	12	17	12-60-5	2, 5-4	4		
5	85	12	16	10-62-5	2, 5-5, 3	4	(‡)	
6	80	12½	18	11-60-6	2, 5-4, 1	4	(*)	
7	85	12½	16½	11-59-5	2, 5-4, 2	4	(†)	
8	77	12	17	11-61	2, 5-1, 1	4	(*)	

* Equidistant from base of middle caudal rays and upper angle of preopercle.

† Equidistant from base of middle caudal rays and a point above middle of pupil.

Equidistant from base of middle caudal rays and occiput.

TABLE OF VARIATION FOR EIGHTEEN SPECIMENS FROM THE COLUMBIA AT GOLDEN.

Number.	Length in MM.	Dorsal.	Anal.	Scales.	Teeth.	Depth.	Head.	Position of Dorsal.	Sex.	Remarks.
1	115	12	15	12-63-6	2, 5-4, 1	3	4	( )	Female.	Keel nil.
2	104	11	16	10-61-7	2, 5-4, 1	4	4	(‡)	Female.	Keel evident.
3	103	11	18	10-55-5	2, 5-4, 2	4	4	( )	Female.	Keel evident.
4	103	11	17	12-59-7	2, 4-5, 2	4	4	( )	Male.	Keel evident.
5	95	12	15	56	1, 5-4, 1	4	4	(+)	Female.	Keel well marked.
6	92	11	15	. . . .	. . . .	4	4	(§)	(?)	Keel well developed.
7	91	12	17	57	2, 4-3, 2	3	4	( )	. . . .	Keel nil.
8	88	11	11	. . . .	. . . .	4	4	(‡)		Keel well developed.
9	85	12	16	. . . .	. . . .	4	4	(§)	. . . .	Keel scarcely evident.
10	82	11	16	. . . .	. . . .	4	4	( )	. . . .	Keel evident.
11	82	11	16	. . . .	. . . .	3	4	(+)		
12	77	11	15			4	4	( )	. . . .	Keel evident.
13	73	12	15			4		(‡)		Keel well developed.
14	72	10	15	. . . .	. . . .	4		( )	. . . .	Keel moderate.
15	68	11	16	. . . .		4		( )	. . . .	Keel well developed.
16	67	12	17	. . . .	. . . .	3	. . . .	(‡)	. . . .	Keel well developed.
17	65	12	15		. . . .	4		(§)		Keel strong.
18	62	11	17		. . . .	4		. . . .	. . . .	Keel strong.

* Equidistant from base of middle caudal rays and occiput (beginning of scaled region).
† Dorsal nearer base of middle caudal rays than occiput.
‡ Equidistant from base of middle caudal rays and upper angle of preopercle.
§ Equidistant from base of middle caudal rays and posterior margin of eye.

From these tables it will be noticed that the number of dorsal rays is quite constant, being from 10 to 13. The variation in the anal is enormous, but this I shall treat in detail. The scales are seen to vary from 10 to 14 above the lateral line; from 55 to 63 along the lateral line, and from 5 to 7 below the lateral line. There is nothing unusual in these variations, they are surpassed or equalled by other members of the same family. The variation in the teeth is great. With one exception, there are two teeth in the lesser row of the left side. The major row on the left side contains 4 or 5 teeth in the proportion of 1 to 6. In the right side 3, 4 and 5 teeth were found in 1, 30, and 2 specimens respectively. In the lesser row of the right side 13 specimens had one tooth, 20 had 2 teeth and 1 had 3. This last specimen with dental formula 2, 5–5, 3, exceeds, the dental formula of all the 175 Atlantic slope species of this family. Among these dental formulæ we find variations, the extremes of which have been taken as generic characters. The different combinations of teeth and the number of specimens having each number are as follows: One with 1, 5–4, 1; one with 1, 5–4, 2; two with 2, 4–3, 1; one with 2, 4–3, 2; one with 2, 4–4, 2; one with 2, 4–5, 2; one with 2, 5–3, 2; eleven with 2, 5–4, 1; sixteen with 2, 5–4, 2; one with 2, 5–5, 3. The usual or nominal formula is 2, 5–4, 1 or 2. The variation through ten different combinations is exceptional.

The proportions, while varying considerably, do not show any wider fluctuations than usual. The position of the dorsal, on the other hand, varies from midway from base of the middle caudal rays, and from a point behind to a point above the middle of the eye.

In the development of the keel behind the ventral fins we find again a great fluctuation in specimens from the same locality. In some, the keel is very sharp; in others it is entirely absent, and between these forms, we have all shades of variation. If uniform, it would be of generic value.

Now, as to the variation of the anal rays. The lowest number recorded is 13 (after adding 2 to Gilbert and Evermann's lowest number), and the highest is 24. This gives a total variation of 12 rays. This would be a large variation for any fish, but becomes phenomenal when it is considered that the variation in the number of anal rays of the 175 Atlantic slope species extends only from 6 to 14, a total variation of but 9 for 175 species as compared with the variation of 12 for a single species. The high number of rays reached is also phenomenal, for, leaving out of consideration the two rudimentary spines, the highest number of anal rays, 22, is ten more than the number found in any other Pacific Cyprinoid, and eight more than the number found in any Atlantic species. The average number of rays is seventeen. The variation to lower numbers extends through 4 rays to 13. The variation to higher numbers is much greater, extending through 7 rays to 24. Not only is the extent of variation greater towards higher numbers, but the number of specimens varying in that direction is much greater. Of 825 specimens but 22.3 per cent. have the average number of rays. This is the largest per cent. for any given number of rays. Thirty-four per cent. of all the specimens have fewer than the average number of rays, while 42.9 per cent. have more than the average number. A more striking illustration of determinate variation could not be wished.

Figure 1 graphically represents the variation of the species as shown by the 825 specimens examined. The total hight of the vertical lines represents the greatest possible number, 100 per cent., that could have the given number of anal rays indicated at the bottom of the lines. The curve shows the actual per cent. of specimens having each particular number of rays. Were the variation promiscuous the curve would be symmetrical. The symmetry shows the inherent tendency to a higher number of rays in this fish. It may be well to bear in mind that no other species has a higher number of rays—that no other species joins this curve on the right—while at least one, probably two, related species living in the head-waters of the Snake River have fewer rays, *i. e.*, joins this curve on the left. The curve of *Leuciscus hydrophlox* will not only join this curve, but overlap it, showing that in the number of anal rays *L. balteatus* and *L. hydrophlox* intergrade.

To facilitate the study of the local variations I give below all the data concerning the 825 specimens of this fish. The first column gives the name of the stream and locality; the second column gives the elevation of the locality; the third, the number of specimens collected at the given place; the fourth, the extent of variation in the anal rays in the specimens from the locality, and the succeeding columns, the number of specimens having the particular number of anal rays indicated at the head of the columns. The figures below the column representing the average number of rays for the specimens of the locality are in italics.

DETAILS OF THE VARIATIONS IN THE ANAL RAYS.

Locality.	Elevation.	Number of Specimens.	Variation.	Number of Anal Rays. 13	14	15	16	17	18	19	20	21	22	23	24
Payette River, Payette	2,150	154	9			3	25	29	*27*	28	25	12	3	2	
Boise River, Caldwell	2,372	99	9		2	4	11	17	*29*	19	10	5	3		
Frazer River, Mission	1	79	9				2	7	13	*25*	18	8	2	2	2
Little Spokane River, Dart's Mill	1,850	70	5	1	14	*30*	19	6							
Small Creek, at Sand Pt., Idaho	2,100	67	6			2	19	*36*	3	6	1				
Shuswap Lake, Sicamous	1,300	58	6		1	3	13	*28*	8	5					
Lake Washington, Seattle	1	47	7		1	16	*11*	13	4	1	1				
Umatilla River, Pendleton	1,070	26	5		1	5	*10*	9	1						
Grand Ronde, La Grande	2,786	23	4		2	6	*11*	4							
Umatilla River, Umatilla	300	22	6					2	6	*5*	1	6	1		
Colville River, Meyer's Falls	1,200	21	7			7	*5*	6	2			1			
Columbia River, Golden, B.C.	2,550	18	5		1	7	*5*	4	1						
Clear Water River, Lewiston	750	16	4						3	5	*7*	1			
Griffin Lake	1,990	14	4		3	*7*	3	1							
Brown Gulch, Silver Bow	5,344	14	4			2	*10*	1	1						
Skookumchuck River, Chehalis	204	15	6			2		1	*7*	2	1				
Spokane River, Spokane	1,910	11	5		1	1	*5*	1	3						
Hangman Creek, Spokane	1,910	11	4			2	*2*		2						
Flathead Lake	3,100	11	4			1	1	*6*	3						
Snake River, Payette	2,150	10	5						1	1	*5*	3	1		
Naches River, North Yakima	1,078	8	5		1		3	*1*	3						
Pend d'Oreille River, Newport	2,040	8	3				5	1	2						
Walla Walla River, Wallula	326	6	4						2	*2*		2			
Post Creek, Flat Head Lake	3,100	6	3					*4*	1	1					
Potlatch Creek, Lewiston	1,200	4	3						1	*1*	2				
Newaukum River, Chehalis	204	3	2					*2*	1						
Columbia River, Pasco	375	3	3							1	*1*	1			
Thompson River	1,178	4	3					1	1		1		1		
Columbia River, Revelstoke	1,475	1	1			*1*									

After a detailed examination of the specimens collected by myself I found that every locality has a variety peculiar to itself. The number of localities has been trebled by the explorations of Gilbert and Evermann, and the number of specimens raised from 250 to 825, and their detailed examination of these specimens bears out the above statement for every locality examined by them. Unfortunately they allowed themselves to be side-tracked by minor issues, and did not mention this fact of local variation except in connection with another species.

I collected at three localities in the Fraser basin. At Mission, B. C., I obtained seventy-nine specimens in water which is affected by the high tides. At Sicamous, at an elevation of 1,300 feet, I collected fifty-eight specimens. In Griffin Lake, at an elevation of 1,900 feet, I secured fourteen specimens. Four others were secured at Kamloops, but these are too few to aid us in our study.

The variation for these localities is represented by the three curves of figure two. The vertical lines stand for fin rays to total height of the figure for 100%. The various heights of these curves represent the per cent. of specimens having the given number of rays. The variation is seen to be much the greatest at Mission, a fact which is largely to be attributed to the greater number of specimens secured at this place. The variation from the normal, which is nineteen rays, to a higher number of rays, is as great as the entire variation for the next locality. At Sicamous a much larger per cent. has the normal number of rays, but the normal number has been decreased to seventeen The curve for Griffin Lake is interesting, because the normal number of rays has again been decreased by two. In other words, the higher the altitude the fewer the number of rays and the narrower the limit of variation.[*] Moreover, the curves are not symmetrical for any of the three localities, but in the aggregate the more gradual slope is on the side of an increase in the number of rays, a condition which, considering the general variation of rays on the Pacific Slope, seems to indicate that the number of rays of this species in the Frazer system is increasing, and that the increase is progressing from lower to higher altitudes.

A glance at the remaining curves will be sufficient to show that no two curves are alike, that the per cent. of specimens having a given number of rays differs with each locality. Naturally the curves constructed from a large number of specimens represent the true conditions better than the curves constructed from

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[*] In their recent paper Gilbert and Evermann have raised this specific statement, which occurs in my paper quoted above, into the dignity of a "theory" and "generalization," which it was never intended to be, and their arguments against it as a "theory" and "generalization" are, therefore, not appropriate.

but a few. The extent of the variation varies largely with the number of specimens examined; that is, the probability of securing extremes becomes greater with an increase in the number of specimens collected.

The greatest extent of variation for any locality as far as known is through nine rays. This has been found only when over seventy specimens have been compared. It decreases to about five rays with ten specimens. The total variation for the species has not been found at any one place.

The question of variation with elevation is an interesting one, and may be taken up in some detail.

In the following table *all* the localities are grouped according to their average number of rays:

Average Number of Rays.	Number of Localities.	Localities, With Their Elevations.
15	3	Little Spokane River, 1,850; Griffin Lake, 1,990; Revelstoke on the Columbia, 1,475.
16	8	Lake Washington, 1; Umatilla River, Pendleton, 1,070; Spokane River, 1,910; Colville River, Meyers Falls, 1,200; Columbia River, Golden, 2,550; Grande Ronde River, La Grande, 2,786; Silver Bow, Brown's Gulch, 5,344; Pend d'Oreille River, Newport, 2,000.
17	7	Newaucum River, Chehalis, 204; Natchess River, North Yakima, 1,078; Sicamous, 1,300; Hangman Creek, Spokane, 1,910; Small Creek, 2,100; Post Creek, 3,100; Flat Head Lake, 3,100.
18	3	Payette River, 2,150; Boise River, Caldwell, 2,372; Skookumchuck River, Chehalis, 204.
19	5	Mission, 1; Umatilla, 300; Walla Walla River, 326; Potlatch Creek, 1,200; Kamloops, 1,158.
20	3	Clear Water Lewiston, 750; Snake River, Payette, 2,150; Columbia River, Pasco, 375.

The lowest average, 15, is found in but three localities, the lowest of which is at an elevation of 1,475 feet. This last is of no value since only one specimen was obtained, and the chances are against an average specimen if only one is taken.

The second average is found all the way from tide water to an elevation of 5,344 feet. It is, however, notable that only one of the localities, Lake Washington, which does not belong to one of the two large water systems, is at a low elevation. The lowest of the other seven, all of which belong to the Columbian system, is at an elevation of 1,070 feet.

The third average, which is also the general average for all the specimens, is found in seven localities, the lowest of which is at an elevation of 204, the highest at 3,100. All but the first, which, again, does not belong to one of the large river systems, are at an elevation above 1,000 feet.

The fourth average ranges from 204 to 2,372 feet.

The fifth average, 19 rays, is found in five localities, three of which are below 1,000 feet, and the highest is at 1,200.

The sixth average, of 20 rays, varies from 375 to 2,150 feet; two of them are at an elevation of less than 1,000 feet.

This grouping does not show any uniform variation with the altitude. It may be emphasized that the lowest average is not found below 1,475 feet, that only one of the seven having an average of 16 rays is found below 1,000 feet, and that but one of the eight having an average of 17 rays is found below 1,000 feet. From the last but three specimens are known. It may be further emphasized that three of the five localities having an average of 19 rays are found below 1,000 feet, and that two of the three having an average of 20 rays are found below 1,000 feet. Generally the lower locality has the larger number of rays, to which there are several notable exceptions, Lake Washington and Snake River at Payette. These facts can be presented in curves for groups of localities.

Taking the specimens from the different groups of localities we obtain the following:

Elevation, Feet.	Number of Localities.	Number of Specimens.	Extent of Variation.	General Average of Anal Rays.
1 to 750	8	189	11	18.4
1,078 to 2,000	12	234	10	16.6
2,001 to 3,100	8	588	10	17.5
5,000 to ——	1	10	. . . .	16

Whether we consider the number of localities having a high average of rays or whether we consider the averages of all the specimens from a similar horizon, we find that the largest number of rays is found in the lower horizon. Furthermore, the extent of variation for the 189 specimens from 1 to 750 feet is greater than the variation for 234 and 588 specimens of the higher horizons. The variation for these three horizons is given in the three curves of figure 3.

In the above we have considered the localities regardless of the system to which they belong. Lake Washington and the Newaucum and Skookumchuck rivers belong to separate short water courses. Eliminating these and considering the localities of the Frazer and of the Columbia systems separately we get the conditions described for the Frazer system above and for the Columbia system the following—arranging the localities in the order of elevation:

Locality.	Elevation.	Av. No. of Anal Ray.	Locality.	Elevation.	Av. No. of Anal Ray.
Umatilla	300	19	Hangman Creek	1,910	17
Wallula	326	19	Pend d'Oreille	2,000	16
Pasco	375	20	Small Creek	2,100	17
Lewiston	750	20	Payette	2,150	18
Pendleton	1,070	16	Snake River	2,150	20
Yakima	1,078	17	Caldwell	2,372	18
Colville	1,200	16	Golden	2,550	16
Potlatch	1,200	19	La Grande	2,550	16
Revelstoke	1,475	15	Flat Head	3,100	17
Little Spokane	1,850	15	Brown's Gulch	5,311	16
Spokane	1,910	16			

Only one specimen.

Summarizing this: Below 1,000 feet the averages are 19 and 20; above 1,000 feet only one averages 20, only one reaches 19, two reach 18, four have 17, seven have 16 and two have 15. These figures "are not so unanimous in their indications" of a decrease of rays with an increase of altitude as those for the Frazer system. But the lower locality generally possesses a higher number of rays. Here, where we have data from many widely separated branches, a close variation of rays with altitude is not found. Local issues have modified national tendencies among these fishes in the Columbia system.

Among the locality curves (figures 4 and following) the ideal curve is most nearly approached at Caldwell. The variation from the average is here equally great in both directions, and the curve of the ascending variation is almost identical with the curve of the descending variation. Nearly as ideal conditions are found at Little Spokane, where the extent of variation is much smaller. *A priori* such symmetry or approach to symmetry is to be expected for each locality, but the deviations from it are many and great. The many shoulders and peaks in localities from which but few specimens have been collected, indicate probably nothing so much as the lack of a sufficient number of specimens. When but ten specimens are examined, each specimen, more or less, makes such a vast difference in the character of the curve that the localities with less than twenty specimens may be dismissed without further notice.

Aside from curves, such as that of Little Spokane, where a certain number of rays is the predominant one, we have curves, such as that of the Payette River, where the number of specimens having 16, 17, 18, 19 and 20 rays, is nearly equal. Still another type of curve is represented by the curves for Lake Washington, Colville and Umatilla, in which two numbers predominate, with the intervening numbers in minority. The conditions are most marked at Umatilla, where we have two incipient varieties with 18 and 21 as the predominatin number of rays.

I have given at the outset the probable causes which have brought about the great differences between the Pacific slope fishes.

We must look to other causes for the great variation between species of undoubted Atlantic origin and especially the variation in the same species, which reaches its culmination in *Leuciscus balteatus* and *Agosia nubila.* The climatic, altitudinal and geological differences in the different streams and even in the length of the same stream are very great on the Pacific slope. To these different environments we must attribute the conditions set forth in the present paper for *Leuciscus balteatus.* These differences in different localities in the same stream can only become established in non-migratory species. No such differences are to be expected for a migratory species. Isolation for the specimens of any locality when free intermigration is possible, seems strange. An analogous condition is to be found on the Galapagoes Islands. Dr. Baur tells me that islands within plain sight of each other harbor distinct varieties of the same species of birds which could readily intermigrate, but do not.

This raises the question of the sort of influence exerted by the environment. Is it merely selective, or is it directive? Is the variation promiscuous and inherent in the species, or is it determinate and forced in certain directions by the environments? The latter seems to me the better way of reading such conditions as are represented by the many curves which show a greater variation towards an increased number of rays than towards a decrease of rays. Here the variation is not promiscuous, but definitely determinate. See, in this connection, the curve for all the specimens.

The origin of new varieties is admirably illustrated by the curves for Lake Washington and Umatilla. In these, two distinct peaks are found. While no varietal value is claimed for these peaks, isolation of members of such peaks, either physiologically or locally, would tend to establish such incipient varieties as species.

EXPLANATION OF FIGURES.

The vertical lines in all cases stand for a definite number of anal rays. The total height of the figures represents 100 per cent., and the height of the curves at any point, the per cent. of specimens having the particular number of rays in the anal.

Fig. 1. Curve of variation for 217 specimens of *Leuciscus hydrophlox* from the upper Snake, and 825 specimens of *Leuciscus balteatus* from many localities, ranging from 1 to over 5,000 feet. The two series of specimens are combined in the broken line curve.

Fig. 2. Three curves showing the variation of the three localities represented from the Frazer system:

Griffin Lake, 1,900 feet, 17 specimens.

Sicamons, 1,300 feet, 58 specimens.

Mission, 1 foot, 79, specimens.

Fig. 3. Three curves showing the variation:

a, of 234 specimens from 1,000 to 2,000 feet elevation;

b, (broken line) 388 specimens from 2,000 to 3,000 feet elevation;

c, 189 specimens from 1 to 1,000 feet elevation.

Fig. 4. Variation of 99 specimens from Caldwell, 2,372 feet.

Fig. 5. Variation of 23 specimens from La Grande, 2,786 feet.

Fig. 6. Variation of 70 specimens from Little Spokane, 1,850 feet.

Fig. 7. Variation of 79 specimens from Mission, 1 foot.

Fig. 8. Variation of 154 specimens from Payette River, 2,150 feet.

Fig. 9. Variation of 26 specimens from Pendleton, 1,070 feet.

Fig. 10. Variation of 16 specimens from Clear Water, 750 feet.

Fig. 11. Variation of 14 specimens from Brown's Gulch, 5,344 feet.

Fig. 12. Variation of 67 specimens from Small Creek, 2,100 feet.

Fig. 13. Variation of 47 specimens from Lake Washington, 1 foot.

Fig. 14. Variation of 22 specimens from Umatilla, 300 feet.

Fig. 15. Variation of 21 specimens from Colville, 1,200 feet.

Fig. 16. Variation of 18 specimens from Golden, 2,550 feet.

Fig. 17. Variation of 13 specimens from Skookumchuck, 204 feet.

Fig. 18. Variation of 11 specimens from Hangman's Creek, 1,900 feet.

Fig. 19. Variation of 12 specimens from Flat Head Lake, 3,100 feet.

Fig. 20. *Leuciscus balteatus* from Mission, the specimen now in the British Museum.

Fig. 21. *Leuciscus gilli*, from Brown's Gulch.

Fig. 22. *Leuciscus hydrophlox.*

The last two cuts are reproduced by permission of Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries.

The Red-fish of the Idaho Lakes. By B. W. Evermann and J. T. Scovell.

Observations Upon Some Oklahoma Plants. By E. W. Olive.

The botany of Oklahoma is exceedingly interesting, because this territory is a borderland region between the Gray's Manual and Western Texas Manual regions. Until about five years ago the plants of this district were but little known to botanists, and the results of recent collections disclose a flora rich in interesting forms. Especially valuable is a "List of Plants Collected by C. S. Sheldon and M. A. Carleton in the Indian Territory in 1891," published as contributions from the National Herbarium in 1892.

The months of July and August, 1893, were spent in and about Payne County, in the very northeast of Oklahoma, about ninety miles south of the Kansas line through the Cherokee strip and about 150 miles west of Arkansas. This is in latitude about 97° west, and is but a few miles south of the parallel bounding on the north Tennessee and North Carolina, so that the collections were made just south of the line of the extreme southwestern limit of Gray's Man., 6th ed. About 175 species of Phanerogams and Pteridophytes were collected, about sixty of them being new to Messrs. Sheldon and Carleton's lists, most of these, however, the commoner plants, and thirteen of which are not reported in Gray's Manual. Of this thirteen four are not included in Dr. Coulter's Manual of the Texas Flora, nor nine of them in his Botany of the Rocky Mountain Region; but only *one* of the thirteen fails to be reported in *all* of these manuals of the surrounding regions. This is *Oenothera trifida*, L., determined by Prof. John M. Coulter and pronounced by him "probably *var. integrifolia*, Torr. and Gr., although the species and variety show various stages of intergradation." This plant was somewhat abundant in cultivated fields near Cimarron City.

These thirteen plants are *Talinum calycinum*, Engelm., found abundantly on the red sandstone rocks outcropping in ravines and along the Cimarron River; *Galactia mollis*, Michx., in dry sand along the river banks; *Acacia filicina*, Willd., abundant in the sandy woods; *Oenothera trifida*, L., var. *integrifolia*, Torr. and Gray; *Gaura villosa*, Torr., showing gradations into "forms;" *Sesuvium Portulacastrum*, L., in sand along the saline banks of the river; *Cymopterus pinnatum*, D. C., but one plant collected along a roadside; *Aster patens*, Ait., var. *gracilis*, Hooker, the variety not in Gray's Manual, very abundant in rich, sandy grounds near the river; *Baccharis glutinosa*, Pers., the fertile plant conspicuous by its very long and white pappus along the sandy river banks; *Eriogonum longifolium*, Nutt., on dry prairies; *Cooperia Drummondii*, Hook., near Stillwater on rich prairies; *Desmanthus Jamesii*, T. and G., very abundant on dry prairies; *Aphanostephus ramosissimus*, ? D. C. (Professor Coulter thinks this is probably this species, though the fruit is immature), found in abundance in sand and in the river bottoms; and *Marsilia vestita*, Hook. and Grev., in and along the mucky banks of a pond near Perkins. This marsilia was two to three inches larger than the type.

Probably all of these thirteen plants ought to be included in Gray's Manual, because of the great similarity of the flora of this region to that of southern Kansas. The climatic and geologic conditions are furthermore so very similar in both regions, and this, combined with the fact of the proximity of the Cimarron and Arkansas rivers, flowing southward through the Territory from Kansas, would tend to make the floras very alike.

If it is true, as has been said, that the Indian word *Oklahoma* means the "home of the red earth," then it is a very appropriate name, since the first thing that strikes the traveler's eye is this redness of the soil. A large part of northeastern Oklahoma is distinguished by out-cropping "red beds," which also extend northward into several counties of Southern Kansas, while salt marshes and gypsum hills are associated with the red beds in both regions. Much of the uplands is thus distinguished, while the lowlands are very sandy, some of the fertile river bottoms, however, bearing a rich and diversified flora.

Many of the plants collected show strikingly the transition from the eastern to the western plains flora. Many show also the special characters peculiar to the plants of sandy regions. They have to contend generally with an adverse environment—a dry, sandy or gravelly soil—from which the water is rapidly drained away.

Rainfall in this extreme eastern district of Oklahoma is extremely local. For example, during the summer of 1893, the crops along the river bottoms and in limited spots on the uplands thrived under the influence of the local rains, while but a few miles to the west, about Guthrie, the corn crops were much injured by the drought. The flora seems to reflect such local characteristics. The drier districts present singularly dwarfed forms and show the gradual assumption of protective characters. The plants are "protected against too rapid transpiration by thickened leaves and epidermis, sunken stomata, absence or narrowness of leaves, or an unusual amount of wooliness or hairiness."

There is excellent timber in some portions of this eastern part, but the trees look dwarfed compared with our Indiana trees. There is quite a number of the common oaks—Spanish oak, post oak, but most abundant in the upland reduced forests is *Quercus nigra*, L., the dwarfed, gnarled "black jack." There are some hickories, black walnuts, tall cotton-woods and elms along the river and creeks, the elms bearing abundantly large bunches of mistletoe.

A few observations as to the occurrence and habitat of a few plants may be interesting. In the rich sandy land along the river bottoms the commonest shrubs are the button-bush, or *Cephalanthus occidentalis*, L., *Stillingia sylvatica*, L., *Rhus copallina*, L., and others. On *Stillingia* was found an *Æcidium* which has not been reported on this host, as far as can be determined. Somewhat abundant in similar places were *Argemone platyceras*, Link and Otto, *Callirhöe involucrata*, Gray, *Dalea laxiflora*, Pursh., *Frœlichia floridana*, Moq., *Indigofera leptosepala*, Nutt., and *Aphanóstephus ramosissimus*, D. C. In wet and salty sand near the river, were *Pluchea camphorata*, D. C., *Sesuvium portulacastrum*, L., and in dry sand, *Cycloloma platyphyllum*, Moq., *Baccharis glutinosa*, Pers., and *Dalea lanata*, Spreng. The latter is reported in Gray's Man., to have "3–4 pairs" of leaflets, while 6–7 pairs were more usual on the specimens collected. On the high bluffs of the river *Yucca angustifolia*, Pursh., was occasionally met with.

In the woods which extend back from the river bottoms two or three miles are *Cassia Chamæcrista*, R., and *C. nictitans*, L., or "sensitive plant," flowering especially abundantly during July and August; *Clitoria mariana*, L., *Gaura villosa*, Torr., *Œnothera biennis*, L., var. *grandiflora*, Lindl., a beautiful passion flower, *Passiflora incarnata*, L., *Liatris squarrosa*, Willd., *Chrysopsis villosa*, Nutt., in many of its variable forms, *Asclepias verticillata*, L., and *A. stenophylla*, Gray, and low shrubs of buckthorn, *Bumelia lanuginosa*, Pers. One perhaps noteworthy point was the occurrence of *Ludwigia alternifolia* in sandy but perfectly *dry* ravines. Gray's manual reports the habitat of this as "swamps."

The whole prairie region is characterized by an abundance of plants belonging to the orders *Leguminosæ* and *Compositæ*. Particularly abundant on the prairies are *Petalostemon multiflorus*, Nutt., *P. violaceus*, Mx., *Amorpha canescens*, Nutt., *Desmanthus Jamesii*, T. and G., *Dalea aurea*, Nutt., *Solidago Missouriensis*, Nutt., *Helianthus mollis*, Lam., *Hieracium longipilum*, Torr. The fact is significant that of the 175 species collected, 33 were *Leguminosæ* and 32 were *Compositæ*. *Sabbatia angularis*, Pursh., *S. campestris*, Nutt., and *Buchnera Americana*, L., give a great deal of color to the prairies during June and July. *Linum sulcatum*, Riddell, *Ceanothus Americanus*, L., *Jatropha stimulosa*, Michx., *Euphorbia corollata*, L., *E. petaloidea*, Eng., *E. marginata*, Pursh., occur on the richer prairies, while *Œnothera Missouriensis*, Sims., *Houstonia angustifolia*, Mx., *Stenosiphon virgatus*, Spach., *Opuntia Missouriensis*, D. C., and *Gerardia densiflora*, Benth., are found on dry, sterile prairies. A very severe case of poisoning was incurred from collecting *Euphorbia corollata*, L. This, I believe, has been mentioned in the Botanical Gazette as one of our poisonous plants.

A very paradise for a collector of aquatic vegetation is a large shallow pond near Perkins, Oklahoma. Several *Sagittarias*, *Nelumbo lutea*, Pers., *Potamogeton fluitans*, Roth., the latter growing "rarely in ponds" (Gray's Man.), *P. hybridus*, Michx., are most abundant throughout, while near the edges *Heteranthera limosa*, Vahl., *Ludwigia cylindrica*, Ell., *Herpestis rotundifolia*, Pursh, and *Marsilia vestita*, Hook. and Grev., grow rife.

As before suggested, the special interest of this region lies in the fact of the meeting of two floras and the sometimes abrupt but generally gradual transition of one into the other. The flora can not be studied comprehensively except by an extended period of field work and carefully noting all the environmental conditions. The farther west one goes into the territory, the more sandy and desert the regions become, and such are the variations from some of the more eastern forms, no doubt the result of a change in habitat, that many are classed as varieties. According to Mr. Coville's suggestions in his "Botany of Death Valley Expedition," the shrubs and trees and, on the prairies, the *perennials*, should especially be noted to determine characteristic plants of the flora.

Grateful acknowledgments are due to Dr. John M. Coulter and Prof. E. B. Uline for kindly determining some of the species and checking most of the list of collections.

REDISCOVERY OF HOY'S WHITE FISH, OR MOON EYE. BY BARTON W. EVERMANN.

SAXIFRAGACEÆ IN INDIANA. BY STANLEY COULTER.

Represented in Indiana by nine genera, as follows: *Saxifraga* L., *Sullivantia* Torr. and Gray, *Tiarella* L., *Mitella* Tourn., *Heuchera* L., *Parnassia* Tourn., *Hydrangea* Gronov., *Philadelphus* L. and *Ribes* L.

The representatives of *Philadelphus* are evident escapes, and their inclusion in former lists is doubtless due to the youthful ebullience of the collectors. Both *P. inodorus* L. and *P. grandiflorus* L. are eastern and southern forms, the former ranging along the mountains from Virginia to Georgia and Alabama, the other along streams from Virginia to Florida. Both are of easy cultivation and escape readily in favorable localities, but so far as I have record have failed to maintain themselves. Until further evidence the genus and included forms should be excluded from state catalogue.

Saxifraga is certainly represented in the state by *S. Pennsylvanica* L., which has a fair distribution in the central and northern portions of the state, and which is represented by numerous herbarium specimens from this region. Possibly *S. Virginiensis* Michx.[1] may be added to the list, being reported from Dearborn County by Dr. S. H. Collins, but of which I have seen no specimen. The range does not make it impossible that it is found in the State, although certainly rendering the determination doubtful. The plant is "northward" in its abundant range, though found in Tennessee on the authority of Dr. Gattinger.

Sullivantia Ohionis Torr. and Gray has a definite locality of extremely narrow limits on a limestone cliff at Clifty Falls, Jefferson County. From this point all herbarium specimens have come. It is reported by Dr. C. R. Barnes, from near Washington, and by Baird and Taylor, from Clark County. It is, however, certain that the plant does not occur in any abundance, except in the Clifty Falls station. From my own experience in attempting to extend the range of Sullivantia, I am inclined to believe that the localities added by Professor Barnes and Messrs. Baird and Taylor were from an incorrect reference of immature forms. The plant is remarkable for its occurrence in widely separate stations. Although the manual range seems broad, an examination of the local lists shows that *Sullivantia Ohionis* is entitled to rank as a *rare* plant.

Tiarella cordifolia L. is reported by Dr. Phinney in his list, which embraces the counties of Jay, Delaware, Wayne and Randolph. I have seen no Indiana specimens of this form. The sixth edition of the manual includes Indiana in the range, which reads, "*Rich, rocky woods, New England to Minnesota and Indiana and southward in the mountains.*" Whether the inclusion of the form is based upon Dr. Phinney's report or not, I am unable to state. The habit of the plant would lead to its occurrence, perhaps, in this particular region, if it extends so far southward. Dr. Phinney reports it as "common" in rich woods. The state catalogue gives the plant, referring it to St. Joseph County, but not giving authority for its inclusion. The form is one of great interest, and efforts should be made in the direction of its rediscovery.

Mitella diphylla L. is fairly well distributed, being especially abundant in the central and eastern counties. It is definitely reported from the following counties: Jefferson and Clark in the south, Noble in the north, Putnam in the central, and Jay, Delaware, Randolph and Wayne in the east. It also occurs in relative abundance in Tippecanoe. It is not, however, reported from the southeastern, southwestern or western counties. Its mass distribution is evidently in the central and eastern regions of the State.

Heuchera is represented by three species, *villosa*, *Americana* and *hispida*.

H. villosa Michx. is reported only from Clark County. It was first collected by Dr. C. R. Barnes, whose determination of the form is verified by specimens in the Purdue herbarium. It was afterward reported from the same region by Baird and Taylor, who seem to have made no specimens. No notes are at hand concerning the abundance of the form in this single station and nothing concerning the local conditions. The extension of the range of this species from "Rocks, Md., to Kentucky and southward, in and near mountains" of the Fifth Edition of Manual, to "Rocks, Md., to Georgia, west to Indiana and Missouri," of the Sixth Edition, is doubtless, so far as Indiana goes, based upon this collection of Dr. Barnes.

The extreme paucity of notes accompanying, serve to emphasize certain features of the paper, which I had the honor to present to the Academy last year. Beyond the mere fact of the "Station" which might mean any point in an entire county, nothing definite is known concerning this plant, which is *rare* at least in the state.

H. Americana L., is much more abundant and more generally distributed than either *H. villosa* or *H. hispida*, indeed with perhaps the exception of *Ribes* and *Hydrangea* the most marked member of the family in the state. It is definitely reported from twelve (12) counties and is probably found in all parts of the state.

H. hispida Pursh has been collected from Vigo County by W. S. Blatchley and his determination is verified by a specimen in the DePauw herbarium. I have made no critical study of the form and am not able to pass upon the accuracy of the reference. The range of this species is somewhat strange. Its home seems to be in the mountains of Virginia, it is also reported from Illinois by Dr. Mead, from which point its range is northwestward. We now seem to have an intervening station in Indiana, somewhat the more remarkable as occurring in the lowlands of the state.

Parnassia Caroliniana Michx. occurs in the northern part of the state, being reported from Noble County by Van Gorder and Kosciusko by W. S. Blatchley, the latter collection being in the DePauw herbarium. The region reported is the one in which the form would be expected in our state. Its range would probably be found to cover most of our northern counties, if investigations were made during July–September.

Hydrangea arborescens L., as far as our present knowledge goes, seems to be fairly abundant from northern central counties, southward. It is not, however, reported from the northern tier of counties, although it may occur in favorable localities.

Ribes is our most important genus, not only in number of species, but also in individual representatives. Six species are reported as occurring within our limits.

R. cynosbati L. is our most common form and, probably, is to be found throughout the state, with the exception, perhaps, of the extreme southwestern counties.

R. gracile Michx. is reported definitely only from Vigo County, by W. S. Blatchley, his plant being found in DePauw herbarium. It is probable that some forms reported as *R. rotundifolium* Michx., by earlier collectors, may be referred to this form.

R. rotundifolium Michx. is reported from Jefferson County (J. M. C.) and Clark County (B. and T.) No herbarium specimens of these collections are available. It is probable, however, that this species does not occur within the state and that the forms should be referred to *R. gracile*, *rotundifolium* being an eastern and mountainous form extending from western Massachusetts and New York south to North Carolina, following generally the Allegheny range. It is probable that *R. rotundifolium* will have to be excluded from the state list.

R. oxyacanthoides L. is reported fom Noble (Van G.), Jefferson (J. M. C.) and Clark (B. and T.). Though no herbarium specimens have yet been seen, the form doubtless occurs in the state. Specific reports as to its occurrence, with confirmatory specimens, if possible, are greatly to be desired.

R. floridum L'Her is reported from Noble to Jefferson, through the eastern counties of the State; it is not reported from western or southwestern counties. While no herbarium specimens have yet come to my notice, it is doubtless a member of our state flora. The latest stations are Montgomery County, near a swamp (single station E. W. Olive). Madison County (Walker).

R. rubrum L. var. *subglandulosum* Maxim. is reported from Clark County (B. and T.), and Jefferson (J. M. C.). No herbarium specimens have been examined. The manual range includes Indiana specifically, an addition in 6th ed., probably based upon this citation.

It is remarkable that of the sixteen species representing this family in Indiana (excluding two species of Philadelphus) *seven* are of extreme interest, either because of their rarity or because of their extending previous ranges.

They are:

Saxifraga Virginiensis, Michx. [Not authenticated.]
Sullivantia Ohionis, Torr. and Gray.
Tiarella cordifolia, L.
Heuchera villosa, Michx.
Heuchera hispida, Pursh.
Parnassia Caroliniana, Michx.
Ribes rubrum, L., var. *subglandulosum*, Maxim.

Careful search should be made for these exceptional forms in various localities, and in any case where they are noted prompt report, accompanied by verified specimens, should be made.

The Range of the Blue Ash, Fraxinus Quadrangulata. By W. P. Shannon.

In Gray's Manual of Botany, edition of 1857, we have given as the range of the blue ash, Ohio and Michigan to Illinois and Kentucky. This is nearly equivalent to saying that Indiana is the center of the blue ash region. Let us look farther. In the 1868 edition of Gray's Manual we find the range given as Ohio to Wisconsin, Illinois and Kentucky. Again, in the edition of 1887, it is, Ohio to Michigan and Minnesota, south to Tennessee. In Wood's Botany, 1868, we find, Ohio to Tennessee and Iowa. In Sargent's Forest Trees of North America we find, Michigan and Wisconsin, south to northern Alabama. In Apgar's Trees of the Northern United States we find, Wisconsin to Ohio and Kentucky.

Putting together all of these definitions of the range of the blue ash we conclude that in going east from Indiana the tree disappears before we get through Ohio; in going north it disappears before we get through Michigan; in going northwest we find it beyond Illinois in Wisconsin, Minnesota and Iowa, and that it is very rare in Iowa and Minnesota; in going southwest it disappears somewhere in Illinois; in going south it becomes rare in Tennessee and disappears in northern Alabama. When we take into consideration the great prairies of Illinois, we see that Indiana is yet the center of the range of the blue ash. There is a northwestern extension around the prairie region through Michigan and Wisconsin to Minnesota and Iowa, and a southern extension through Kentucky and Tennessee to Alabama.

It would be difficult to work out the barriers that hold this tree close to Indiana. The purpose of this paper is this, to call attention to the fact that if any forest tree deserves to be called the "Indiana tree" it is the blue ash. Its range, when compared with that of other trees, is a small spot, and Indiana is the center of this spot. If this is an Indiana tree we would like to know its character when compared with other trees. It is always characterized as growing in rich soil. When a boy I heard my father say that he thought the blue ash the most beautiful tree of the forest. Frequently on looking at a large blue ash, I have thought of the truth of his judgment. From its light colored bark, with, sometimes, an imaginary blue tinge, and long straight stem, it contrasted strongly with other trees, so that the blue ash trees were bright streaks in the forest.

Among the pioneers of Indiana this tree was the choice stick for the rail fence, owing to its durability and its being easily split. A boy could make rails of the blue ash and a woman could split blue ash stove wood. Hence the blue ash soon disappeared as a large or even medium-sized forest tree. As members of the original forest, they are all gone but the scrubs. Unlike many other forest trees, the blue ash is making fair headway towards reëstablishing itself. It is an abundant fruiter, and we frequently find a young tree that has escaped the kind of civilization enforced by cattle and clean farmers.

Botanical Products of the United States Pharmacopœia, 1890. By John S. Wright.

[Abstract.]

A large number of the official organic drugs are plant products. The revisers of the United States Pharmacopœia, 1890 (published in 1894 and in effect until 1904), admit plant products, such as fruits, leaves, stems, underground portions, inspissated juices, resins, gummy exudations, products of distillation, and other materials of vegetable origin, representing 232 species, 186 genera, and 73 natural orders.

Since the pharmacopœia list of drugs is official, much care is exercised in making admissions to it. Long and general use is usually necessary to demonstrate the claim of a plant or any of its products to recognition in this work, which is the guide to druggists of the United States.

Only occasionally does an entire plant become an official drug, strictly speaking, that part only is official which is mentioned by the pharmacopœia; thus we have, under the title Capsicum: "The fruit of *Capsicum fastigiatum* Blume;" or as under Aloes, Socotrine: "The inspissated juice of the leaves of *Aloe Perryi* Baker." In the former case it is the fruit, and in the latter the inspissated juice, only, of the plant mentioned, which is official. In some cases several parts or products of a plant are extensively employed in medicine, and may even be generally recognized in dispensatories and kindred works, though only one of these may be official; for instance, the tubers and leaves of Aconite (*Aconitum Napellus* L.) are each recognized as medical agents, yet the tuber is alone official.

With this conservatism on the part of the revisers of the pharmacopœia, it is found that nearly every official drug is of positive value in medicine, and further, that the official list is very much smaller than any other general organic drug list. As before stated, the official list includes products representing 232 species of plants, while most others will approach 700 to 1,000, and one, especially, includes the products of 2,465 species.

The 232 species yielding official drugs, with seven exceptions, belong to orders of flowering plants, and most are plants which have been long known; in proof of this, we find that many have been named by the earlier botanists, Linné being the original author of the names of 132, over half of the entire number.

The seven species which do not belong to the flowering plants represent six genera and five families, as follows.

NATURAL ORDER.	GENUS AND SPECIES.	COMMON NAME.
FILICES	*Dryopteris Filix mas* (L.) Schott, *Dryopteris marginalis* (L.) A. Gray,	Aspidium.
GIGARTINEÆ	*Chondrus crispus*, Stackhouse, *Gigartina mamillosa*, J. Agardh,	Chondrus, Irish Moss.
LICHENES	*Cetraria islandica* (L.) Acharius,	Cetraria, Iceland Moss.
LYCOPODIACEÆ	*Lycopodium clavatum*, L.,	Lycopodium.
PYRENOMYCETES	*Claviceps purpurea* (Fries.) Tulasne.	Ergot.

Of the orders of plants represented by the official drugs, only the following five furnish ten or more species:

1. Leguminosæ . . . 17 species . . . . . 12 genera.
2. Compositæ . . . . 16 species . . . 14 genera.
3. Labiatæ . . . . . . 13 species . . . . . . 9 genera.
4. Liliacea . . . . 11 species . . 8 genera.
5. Rosaceæ . . 10 species . . 5 genera.

The other 165 species are very evenly distributed among the remaining 68 natural orders.

Of the 232 species of plants which yield official drugs, there are found in North America, either as indigenous, adventive, commonly cultivated or escaped from cultivation, 134 species belonging to 110 genera and 59 natural orders. Of this number there are in Indiana 75 species representing 68 genera and 47 natural orders.

The table and statistics below show the actual and relative numbers of plants, producing official drugs, found in North America and in Indiana:

	NATURAL ORDERS.	GENERA.	SPECIES.
Entire number	73	186	232
In America	59	110	134
In Indiana	47	68	75

Of total number of species Indiana has $\frac{75}{232}$, or about $\frac{1}{3}$.

Of total number of genera there are represented in Indiana $\frac{69}{186}$, or about $\frac{1}{3}$.

Of total number of natural orders there are represented in Indiana $\frac{47}{78}$, or about $\frac{3}{5}$.

Of American species (as defined above), Indiana has $\frac{75}{134}$, or about $\frac{5}{9}$.

Of American genera there are represented in Indiana $\frac{68}{110}$, or about $\frac{7}{11}$.

Of American families there are represented in Indiana $\frac{47}{59}$, or about $\frac{4}{5}$.

Below is given a list of plants found in Indiana which produce official drugs. The action and use of the drug also are given. For convenience, the plants are listed alphabetically under their natural orders, which also have an alphabetical arrangement.

LIST OF PLANTS WHICH PRODUCE OFFICIAL DRUGS.

NATURAL ORDER. Genus and Species.	DISTRIBUTION.	PART.	COMMON NAME.	PROPERTIES AND USES.
ANACARDIEÆ.				
Rhus glabra L.	Common	Fruit	R. glabra	Refrigerant, diuretic, astringent.
Rhus radicans L.	Common	Leaves	R. Toxicodendron	Irritant, rubefacient.
APOCYNACEÆ.				
Apocynum cannabinum L.	Common	Root	Apocynum	Emetic, cathartic, expectorant, diuretic aperient.
ARISTOLOCHIACEÆ.				
Aristolochia Serpentaria L.		Rhizome	Serpentaria	Stimulant, diaphoretic, tonic.
ASCLEPIADEÆ.				
Asclepias tuberosa L.	Common	Root	Asclepias	Sudorific, expectorant, carminative, anodyne.
BERBERIDACEÆ.				
Caulophyllum thalictroides (L.) Michx.	Common	Rhizome	Caulophyllum	Antispasmodic, diuretic, emmenagogue
Podophyllum peltatum L.	Common	Rhizome	Podophyllum	Alterative, cholagogue, cathartic.
BETULACEÆ.				
Betula lenta L.		Oil of Bark	Oil of Betula	Antiseptic, poisonous in over doses.

LIST OF PLANTS WHICH PRODUCE OFFICIAL DRUGS—Continued.

NATURAL ORDER. Genus and Species.	Distribution.	Part.	Common Name.	Properties and Uses.
CAPRIFOLIACEÆ				
Sambucus canadensis L.	Common	Flowers	Sambucus	Stimulant, carminative, diaphoretic.
Viburnum prunifolium L.	Common	Root Bark	Black Haw	Diuretic, tonic, nervine.
CELASTRINEÆ.				
Euonymus atropurpureus Jacq	Common	Root Bark	Euonymus	Tonic, diuretic, laxative, aperient.
CHENOPODIACEÆ.				
Chenopodium ambrosoides L., var. *anthelminticum* Gray	Common	Fruit	Chenopodium.	Anthelmintic.
COMPOSITÆ.				
Arctium Lappa L. and other Sp. of *Arctium*	Common	Root	Lappa	Diaphoretic, diuretic, alterative.
Artemisia Absinthium L.	Common	Leaves and inflorescence.	Absinthium	Stimulant, tonic, febrifuge anthelmintic.
Erigeron Canadense L.	Common	Herb	Oil of Erigeron	Hemostatic, irritant stimulant.
Eupatorium perfoliatum L.	Common	Leaves and inflorescence.	Eupatorium	Stimulant, tonic, diaphoretic, laxative, emetic.
Inula Helenium L.	Common	Root	Inula	Stimulant, diaphoretic, expectorant, rubefacient.
Tanacetum vulgare L.	Cultivated	Herb.	Tansy	Stimulant, tonic, anthelmintic, diuretic, emmenagogue.

Taraxacum officinale Weber	Common	Root	Taraxacum	Deobstruent, tonic in hepatic disorders.
CONIFERÆ.				
Juniperus communis L.	General, but not abundant.	Fruit	Oil of Juniper.	Stimulant, carminative, diuretic.
CRUCIFERÆ.				
Brassica alba (L.) Hooker f. et Thompson	Common near cult. ground.	Seed	White Mustard	Tonic, laxative, diuretic, sternutatory, epispastic, emetic, ext. rubefacient.
Brassica nigra (L.) Koch.	Common near cult. ground.	Seed	Black Mustard	Tonic, laxative, diuretic, sternutatory, epispastic, emetic, ext. rubefacient.
CUCURBITACEÆ.				
Cucurbita Pepo L.	Cultivated	Seed	Pumpkin Seed.	Tænifuge.
CUPULIFERÆ.				
Castanea dentata (Marshall) Sudworth	General, but not abundant.	Leaves	Castanea	Tonic, mild sedative.
Quercus alba L.	Common	Bark	White Oak	Astringent, chiefly used externally.
ERICACEÆ.				
Arctostaphylos Uva-ursi (L.) Sprengle	N. Indiana, on hills of southern part.	Leaves	Uva Ursi	Astringent, tonic, nephritic, diuretic.
Chimaphila umbellata L.	Common in rocky woods.	Leaves	Chimaphila.	Astringent, tonic, diuretic, nephritic.
Gaultheria procumbens L.	N. part of state	Oil of leaves	Oil of Gaultheria.	Stimulant, antiseptic, diuretic, poisonous in over doses.

LIST OF PLANTS WHICH PRODUCE OFFICIAL DRUGS—Continued.

NATURAL ORDER. Genus and Species.	DISTRIBUTION.	PART.	COMMON NAME.	PROPERTIES AND USES.
FILICES.				
Dryopteris marginalis (L.) Gray.	Common in cool, rocky woods.	Rhizome	Aspidium	Tænifuge.
GERANIACEÆ.				
Geranium maculatum L.	Common	Rhizome	Geranium	Tonic, astringent.
GRAMINEÆ.				
Agropyrum repens (L.) Beauv.	. . . . . .	Rhizome	Triticum	Diuretic, aperient.
Zea Mays L.	Cultivated	Starch from grain	Starch	Demulcent, nutritive.
Zea Mays L.	Cultivated	Stigmas and styles (silks)	Zea	Diuretic, lithontriptic.
HAMAMELACEÆ.				
Hamamelis virginiana L.	Common	Leaves	Witch hazel	Tonic, astringent, sedative.
IRIDEÆ.				
Iris versicolor L.	Common	Rhizome	Iris	Alterative, purgative, emetic.
JUGLANDACEÆ.				
Juglans cinerea L.	Common	Root bark	Juglans	Cathartic, tonic.

LABIATÆ.				
Hedeoma pulegioides (L.) Pers.	Common	Herb	Hedeoma	Carminative, stimulant, emetic.
Marrubium vulgare L.	Common	Herb	Melissa	Carminative, sternutatory, diaphoretic, emetic.
Mentha canadensis L. var. *glabrata* Benth.	Common along brooks	Stearopten from herb	Menthol	Stimulant, rubefacient, anodyne.
Mentha piperita Smith	Common, cultivated	Stearopten from herb	Menthol	Stimulant, rubefacient, anodyne.
Mentha viridis L.	General	Leaves and inflorescence	Spearmint	Carminative, stimulant, nervine.
Monarda punctata L.	Common	Herb	Thymol	Stimulant, antispasmodic.
Scutellaria lateriflora L.	Common	Herb	Scutellaria	Tonic, nervine, antispasmodic.
LAURINEÆ.				
Sassafras varifolium (Salisbury) O. Kuntze	Common	Part of root	Sassafras	Stimulant, diaphoretic, alterative, used as a flavor.
Sassafras varifolium (Salisbury) O. Kuntze	Common	Pith of stem	Sassafras pith	Demulcent.
LILIACEÆ.				
Veratrum viride Solander	General	Rhizome	Veratrum viride	Emetic, diaphoretic, sedative, irritant.
Convallaria majalis L.	Escaped from gardens	Rhizome	Convallaria	Heart tonic, poisonous.
LINEÆ.				
Linum usitatissimum L.	Escaped from cultivation	Seed	Linseed	Demulcent.
Linum usitatissimum L.	Escaped from cultivation	Oil of seed	Linseed oil	Demulcent, laxative.

LIST OF PLANTS WHICH PRODUCE OFFICIAL DRUGS—Continued.

NATURAL ORDER. Genus and Species.	DISTRIBUTION.	PART.	COMMON NAME.	PROPERTIES AND USES.
LOBELIACEÆ.				
Lobelia inflata L.	Common	Leaves and inflorescence	Lobelia.	Expectorant, nervine, purgative, emetic, narcotic.
LOGANIACEÆ.				
Spigelia Marylandica L.		Rhizome	Spigelia	Anthelmintic, toxic, dilates pupil.
MENISPERMACEÆ.				
Menispermum Canadense L.	Common	Rhizome	Menispermum.	Tonic, alterative, diuretic.
ORCHIDEÆ.				
Cypripedium parviflorum Salisbury		Rhizome	Cypripedium	Diaphoretic, stimulant, anti-spasmodic.
Cypripedium pubescens Swartz		Rhizome	Cypripedium	Diaphoretic, stimulant, anti-spasmodic.
PAPAVERACEÆ.				
Papaver somniferum L.	Escaped from cultivation	Concrete, milky exudation	Opium	Narcotic, sedative, anodyne, anti-spasmodic, hypnotic.
Sanguinaria Canadensis L.	Common in shady woods	Rhizome	Sanguinaria.	Alterative, tonic, stimulant, emetic, sternutatory.

PHYTOLACCACEÆ.				
Phytolacca decandra L.	Common	Root	Phytolacca root	Alterative, anodyne, resolvent, emetic.
Phytolacca decandra L.	Common	Fruit	Phytolacca fruit	Alterative, laxative, emetic.
POLYGALACEÆ.				
Polygala Senega L.	General	Root	Senega	Expectorant, emetic, diuretic.
POLYGONACEÆ.				
Rumex crispus L. and other species of *Rumex*	Common	Roots	Rumex	Astringent, tonic, alterative, laxative.
PYRENOMYCETES.				
Claviceps purpurea (Fries.) Tulasne	Common in rye fields	Sclerotium	Ergot	Emetic, ecbolic, parturient, hæmostatic, poisonous.
RANUNCULACEÆ.				
Cimicifuga racemosa (L.) Nuttall	Common	Rhizome	Cimicifuga	Alterative, emmenagogue, sedative.
Hydrastis Canadensis L.	General, more abundant in southern p't of State	Rhizome	Hydrastis	Tonic, deobstruent, alterative.
ROSACEÆ.				
Prunus serotina Ehr	General	Bark	Wild cherry	Tonic, sedative, pectoral.
Rubus Canadensis L	General	Root bark	Rubus	Astringent, tonic.
Rubus villosus Aiton	Common	Root bark	Rubus	Astringent, tonic.
Rubus idæus L.	Cultivated	Fruit	Raspberry	Refrigerant, mild laxative, dietetic.

LIST OF PLANTS WHICH PRODUCE OFFICIAL DRUGS—Continued.

NATURAL ORDER. Genus and Species.	DISTRIBUTION.	PART.	COMMON NAME.	PROPERTIES AND USES.
RUTACEÆ.				
Xanthoxylum Americanum Miller	Common . .	Bark	Xanthoxylum	Sialagogue, stimulant, alterative, emetic.
SCROPHULARINEÆ.				
Veronica Virginica L.	. . . .	Rhizome . . .	Leptandra . .	Alterative, cholagogue, cathartic.
SOLANACEÆ.				
Datura stramonium L.	Common . . .	Seed	Stramonium seed	Diuretic, dilates pupil, narcotic poison.
Datura stramonium L.	Common . . .	Leaves	Stramonium leaves . . .	Diuretic, dilates pupil, narcotic poison.
Nicotiana tabacum L.	Cultivated in southern p't of State . .	Leaves	Tobacco	Diuretic, sedative, diaphoretic, emetic, narcotic.
Solanum dulcamara L.	General . .	Young br'nch's	Dulcamara .	Deobstruent, resolvent, alterative, anodyne.
UMBELLIFERÆ.				
Conium maculatum L.	Common . . .	Fruit	Conium	Sedative, narcotic.

URTICACEÆ.				
Cannabis sativa L.	Escaped from cultivation	Female inflorescence	Indian cannabis	Anodyne, nervine, narcotic, sudorific.
Humulus lupulus L.	Escaped from cultivation	Glandular powder from strobiles	Lupulin	Stimulant, tonic, anodyne.
Humulus lupulus L.	Escaped from cultivation	Strobiles	Hops	Tonic, sedative, anodyne.
Ulmus fulva Michx.	Common	Inner bark	Elm	Demulcent emollient.
VITACEÆ.				
Vitis vinifera.	Cultivated	Fermented juice of fruit	Wine, white and red	Chiefly as a stimulant.

NOTEWORTHY PHANEROGAMS OF INDIANA. BY STANLEY COULTER.

METHODS OF INFILTRATING AND STAINING IN TOTO THE HEADS OF VERNONIA. By E. H. HEACOCK.

In beginning a study of the development of the embryo sac of Vernonia, two difficulties at once present themselves. The first is to properly stain the head in toto, and the second to infiltrate with paraffine so as to be able to section properly.

The form is an ordinary composite, having twenty or more flowers in each head. The ovary is surrounded by a thick, solid integument several layers of cells deep, and the difficulty lies in penetrating this coat.

Before staining or infiltrating, all parts of the head above the achenes were cut off, thus securing a smaller body and a more ready penetration. Heads dehydrated by 96 per cent. alcohol were washed out in distilled water, the water being frequently changed, until they sank to the bottom of the vial. They were then stained for seventy-two hours in alum cochineal (Czoker's Formulae). When sectioned they showed but a faint trace of stain. Heads dehydrated by absolute alcohol and stained for seventy-two hours in borax carmine, Kleinberg's and Delafield's haematoxylins gave no better results.

Heads which had been dehydrated by absolute alcohol, washed out in distilled water and stained for seven days in alum cochineal (Czoker's Formulae) gave good results. The general tone of the stain is dim, but under high power the differentiation is very fine. Heads dehydrated by absolute alcohol and stained for seven days in borax carmine gave very fair results. These results point to the fact that with long time treatment the heads may be successfully stained.

The second difficulty: infiltrating with paraffine. The first medium used was turpentine. Heads dehydrated by 96 per cent. alcohol were placed in turpentine for twenty-four hours, then into a mixture of one-half turpentine and one-half paraffine for twenty-four hours, thence into pure paraffine (48° C.) for twenty-four to forty-eight hours. On sectioning the sections were found to tear out in the center, thus proving that paraffine had not reached the center of the head. Heads dehydrated by absolute alcohol were given the same treatment. In this series the small heads showed an improvement, but still the normal sized heads were not properly infiltrated.

The next medium used was a mixture consisting of one-half cedar oil and one-half xylol. Heads dehydrated by absolute alcohol were placed in this medium for twenty-four hours, then into a mixture of one-half the medium and one-half paraffine for twenty-four hours, then into pure paraffine (48° C.) for twenty-four hours. On being sectioned this material showed but little, if any, improvement over the material treated with turpentine.

The next medium used was xylol. Heads dehydrated by absolute alcohol were placed in xylol for twenty-four hours, then into a mixture of one-half xylol and one-half paraffine for twenty-four hours, then into pure paraffine (48° C.) for twenty-four hours. When sectioned on a Heidelberg microtome the heads were found to be well infiltrated and made fine ribbons. A series of experiments was then begun on heads dehydrated by absolute alcohol, giving them shorter time periods. It was found that heads treated with xylol for three and one-half hours, then to a mixture of one-half xylol and one-half paraffine for two hours, then to pure paraffine (48° C.) for two and one-half hours, were infiltrated, and sectioned just as well as heads which had had the extended time treatment.

The conclusions to be drawn seem to be, first, that large heads of composites may be stained successfully in toto, but to insure success a long time is necessary. Incidentally it may be said that, so far as tests made have gone, alum cochineal gives decidedly the best differential stain.

Second, that successful infiltration can be made in a time as short as eight hours by the use of xylol, a longer treatment being unnecessary. That a treatment with turpentine and a mixture of cedar oil and xylol, as far as Vernonia is concerned, gives unsuccessful results with the normal sized heads. Cedar oil alone was not tried, nor are the experiments as to methods yet completed. They are given, however, in the hope that suggestions may be made that will extend their scope and lead to more definite conclusions.

Embryology of the Ranunculaceae. By D. W. Mottier.

Certain Chemical Features in the Seeds of Plantago Virginica and P. Patagonica. By Alida M. Cunningham.

In the study of the genus *Plantago*, to ascertain the value of seed characters in determining specific rank, the peculiarities hereinafter described were noticed as among the results of some of the experiments. These results, in themselves, are perhaps of little or no value in determining the question under investigation, yet, they are so closely connected with the experiments, and altogether so peculiar as to warrant a somewhat extended research.

In the study of the seed characters of the genus *Plantago*, particular attention was given to outline and to the structure of the seed-coat, and it was necessary to make cross-sections of the seeds of each species. Preliminary to this the seeds of each were placed in water for a few hours, in order that they might be more easily sectioned, when the peculiar development of a blue color in *P. Virginica* was noticed. It was thought, at first, this might be due to some substance contained in the water used, so the experiment was repeated, using distilled water with the same unvarying results.

An examination of literature showed that, in all probability, it was a glucoside allied to Indican. This was further rendered probable because such substances are found in widely separated families, as *Euphorbia tinctoria*, and *Polygonum tinctoria*.

The indigo plant is destitute of color until treated with water. The broken and bruised plants are placed in vats, covered with water and allowed to ferment, and the indigo separates from the plants and is precipitated. Indican is soluble in boiling ether, boiling alcohol, glacial acetic acid, carbolic acid, petroleum, chloroform and hydrochloric acid.

The seeds of *P. Virginica*, when dry, are golden yellow in color, and the cross section showed the cell contents to be colorless. Within three hours after being placed in water they had turned black on the surface, but an examination of a cross section showed the cell contents of the entire seed coat, except the outer row, the cell contents of the cotyledons and even the cell walls to be a bright blue color. Since this color was developed in a similar way to that by which Indican is produced, the tests for Indican were tried, giving the following results: After the color had been developed by water, thin sections were placed in 96 per cent. alcohol and boiled for ten minutes with no perceptible change. Sections were boiled for three minutes in ether without any change in color. Others were kept in glacial acetic acid for two hours with no change. Sections were kept in petroleum for twenty-four hours, and within that time the blue color was destroyed, leaving the cell contents colorless. The blue remained unchanged after a two hours' treatment with pure chloroform. Sections were kept in carbolic acid for two hours with no perceptible change. Hydrochloric acid destroyed the blue color within ten minutes, and left the cell contents colorless. After comparing these results with those of Indican, it was found that this blue substance in the seeds of *Virginica* resembles Indican in that it is developed in the same way and gives the same reactions with nitric and hydrochloric acids, sodic hydrate and petroleum. It differs from Indican, however, in being insoluble in boiling ether, boiling alcohol, glacial acetic acid, carbolic acid and chloroform.

In order to determine whether this substance was insoluble in presence of water, dry seeds were kept in cold alcohol for twenty-four hours, and during that time there was no change either in the color of the seeds or in the cell contents. The seeds were taken from the alcohol and placed in water, and within three hours they had turned black, and the blue was developed in the cells. Dry seeds were placed in glacial acetic acid, and within twenty-four hours they were turned a light yellow color and sections showed the cell contents to be colorless. These seeds were taken from the acid and kept in water for twelve hours, and during that time no further change took place. Dry seeds were placed in strong ammonia, and within twelve hours they had turned black on the surface and the cell contents were turned brown. After this treatment with ammonia, the seeds were kept in water for several hours, but no further change was perceptible. The dry seeds were kept in pure chloroform for three days, and during that time they retained their golden yellow color and the cell contents also remained colorless. Then they were taken from the chloroform and placed in water, and within three hours they had turned black, and the blue was developed in the cells.

After the color had been developed by water, sections were treated with nitric acid, and the blue color disappeared immediately, leaving the cell contents a yellowish brown color. The blue was turned green immediately upon being treated with sodic hydrate, but was changed to blue again within twelve hours after being placed in glycerine. On account of the small amount of material it was impossible to carry these experiments to a conclusion.

A blue substance is developed by water in the seeds of *P. Patagonica* also, but no chemical experiments were made upon these seeds.

P. Virginica and *P. Patagonica* were the only species examined in the genus *Plantago* which showed this peculiar development of color.

The test for this substance in the indigo plant itself was made upon an herbarium specimen and failed to produce it. The indigo plant must be taken at certain stages of its development in order to produce Indican, and such may be the case in *Plantago Virginica*.

Root System of Pogonia. By M. B. Thomas.

The genus Pogonia is a remarkably interesting group of orchids represented by five species in northeast North America out of a total of forty-three in the whole genus.

The species have a very wide distribution, being found throughout North America, Africa, eastern Asia, and, to a very limited extent, throughout Europe.

Notwithstanding the wide distribution, the species seem to have a remarkably similar habitat, and consequently the plants show a very striking resemblance in regard to their structure and adaptation to their rather peculiar surroundings. The plants of the genus are all found in low, damp places, with an extreme reached in *P. ophioglossoides*, which grows in sphagnum bogs throughout North America, Japan and Europe. With reference to the other North American species of Pogonia no marked variation from the regular terrestrial orchids has been observed which would indicate that the plants had undergone any special or irregular variations as a result of their peculiar environments.

In an examination of the roots of *P. ophioglossoides* it was found that a striking exception existed which might be a very suggestive one when considered from the standpoint of the adaptation of the plant in order to better fit it to withstand the peculiar difficulties of its surroundings.

The roots of all phanerogams are provided at the tip with a series of initial groups, from which differentiate the various parts of the root in the following order: From the calyptrogen comes the root cap, from the dermatogen the epidermis, from the periblem the cortex, and from the plerom the central cylinder. Sometimes one or more of these groups are combined and this is the condition ascribed by Trent to the orchidaceae, regarding which he holds that the calyptrogen is not present and the root cap and epidermis originate from a common initial group, the dermatogen. Janczewski holds that in these monocots we find a well marked calyptrogen, and in this he is supported by Flahault and others.

With reference to this arrangement, in the roots of *P. ophioglossoides*, was found what is believed to be a marked exception to all phanerogams, except possibly a few parasitic ones.

The roots of the plant are small, very long, much branched, and provided with a few root-hairs. At the tip we find an entire absence of a root-cap, and the cells of the dermatogen, with but slightly thickened walls, form the outside covering, which in the growing plant is quite green.

The cells of the dermatogen undergo a periclinal extension 2-8 mm. back from the tip, and at this point they quickly change into the more firm, brown epidermis which soon shows the differentiation of the root hairs. The dermatogen cells are very large, regular and with conspicuous nuclei showing great activity.

Another condition not seen in other roots is the very rapid development of the fibro-vascular bundles from the procambium which usually extends some distance back from the tip, and from it very gradually differentiate the elements of the fibro-vascular system, whereas in *Pogonia ophioglossoides*, the xylem shows reticulated tracheids often not more than ten cells back from the initial group of the plerom. The arrangement of the parts of the central cylinder shows the regular differentiation of the radial bundle of roots.

It might at first be supposed that *Pogonia ophioglossoides*, like many plants (*Azolla*, *Hydrocharis*, *Ranunculus*, *Ficaria*) having roots with a limited growth, throws off its root-cap, but such is not the case, since not even the rudiment of one is developed, and the secondary roots break through the cortex and epidermis without any covering to their tip. Neither is the absence of the root-cap in any way comparable to the condition found in some Aroids, *e. g.*, *Anthurium longifolium* (Bot. Zeitung, 1878, p. 645,), where the root-cap is torn away and the root, by the production of a bud at its tip, developes into a shoot, and in this way continues its growth.

Of the constancy of the peculiar condition in *Pogonia ophioglossoides*, there seems to be no doubt, since it is found to be true of plants collected in various parts of the United States, and growing under somewhat different circumstances. The condition is then something more than accidental. The structure of the root, so far as the apex is concerned, is then not unlike that of the stem of many water plants (*Hippuris vulgaris*), where a single layer of dermatogen covers the tip, and inside of this, 5-6 regular isodiametric cells of the periblem, which undergo periclinal division, give rise to the cortex. Inside of this, is a group of 4-5 initial cells of the same character giving rise to the fibro-vascular system.

The meaning of this variation and its value to the plant is not certain, but it is suggested that, since the plant grows in loose sphagnum and the roots are not in any immediate contact with the material from which they draw their food supply, the tip of the root pressing constantly against the decaying stems of the moss is a very important factor in the absorption of food. Protected, as it usually is in other plants, with a root-cap, the outer cells of which are not capable of becoming turgid, the efficiency of this part of the root is very seriously interfered with for the absorption of food. With most plants, where the whole length of the roots is in immediate contact with their source of food supply, the work done by the root hairs does not make necessary the use of the tip for absorptive purposes. Neither does *Pogonia ophioglossoides* have the advantages of a water plant, which, like *Pontederia crassipes* and many floating plants, take up their nourishment from the free water through the agency of the great mass of root hairs, often so strikingly developed. In *Pogonia ophioglossoides* only those parts of the root that are here and there in contact with the stems of the sphagnum are able to take up food. The necessity of a large absorptive surface to the root system is more apparent when we consider that, contrary to the general opinion, the bog soil is not rich in nitrogenous material.

Another and stronger proof that the tip of the root is so valuable an absorptive organ is the extraordinary development of the conductive tissue of the root to a proximity of the tip wholly unlike that found in other plants. This unusual development would indicate that the plant obtained through the vascular tissue from the tip a part of its food supply. Such a condition of unusual development of vessels at unexpected places is to be noted in various plants, and indicates the dependence on that part for supplies of moisture. This is true, for example, of those parts of pitcher plants that retain supplies of water, without which the plant would wilt. (King and Zimmerman, 1885.) On the other hand, aquatic and semi-aquatic plants often show poorly developed root-caps, or frequently the cap is attached only at the very tip, thus allowing the water free contact with the epidermis, but a few cells back from the initial group.

The need of the root cap as an organ of protection in *Pogonia ophioglossoides* can certainly not overbalance the increased efficiency of that part of the root due to its absence. The loose nature of the sphagnum does not offer any resistance to the growing root, while it at the same time affords an efficient protection. It is true that aërial and aquatic roots are not required to force their way through the medium in which they grow, but at the same time the air and water do not protect the roots as does the moss, and, further, in the case of aërial orchids the outer cells of the root cap do not drop away to any great extent, and the whole tip of the root may become turgid and capable of absorbing moisture, thereby accomplishing the same end in this respect as would be reached were the root cap not present. No doubt the increased activity of the tip would make it more sensitive, and, as the recent investigations of Pfeffer (Annals of Bot., Sept., 1894,) show the irritability of the root to be confined to that part, this would certainly be of great advantage to the plant.

It would seem, in view of what has been said, that the absence of this cap in *Pogonia ophioglossoides* is not the effect of degeneration, but rather the attainment of a greater stage of perfection, true to the principles of evolution, whereby a useless organ has degenerated and disappeared, and in so doing worked material advantage to the organism.

Salt-rising Bread. By Katherine E. Golden.

Notes on Florideæ. By Geo. W. Martin.

Of the two orders comprising *Rhodophyceæ*, *Florideæ* is the most noteworthy. The number of species composing it is large, all of which have the predominating red shade in their normal condition, though other colors are sometimes very conspicuous. Like other noted cases, the order seems to be a very natural one; in fact, the genera and species graduate into one another so finely that sharp distinctions can not be obtained. However, it must not be inferred that exceptions do not occur here as is common to the other natural divisions of the plant kingdom. With the exception of a few genera, such as *Batrachospermum*, *Lemanea*, *Bangia*, *Chantransia* and *Hildenbrandtia*, all are marine; their favorite place of growth is below low-water mark and in deeper water, but some forms are found in tide pools.

Both morphologically and physiologically, by many it is claimed that this *order* exhibits the highest characters known to algæ. The structure of the frond varies with the genera; in some the tissues are very simple; in others very delicate and complex. All plant bodies are multicellular, and present a variety of forms; some are *filamentous*, either monosiphonous, as in *Ceramium*, or polysiphonous, as in *Polysiphonia*; growth is by means of an apical cell; others are *membranaceous*, formed by branching filaments cohering and the filling up of mucilaginous substance between; in the latter, growth results from a division of marginal series of cells.

While considerable variety of forms and complicated structures obtain in the *Florideæ*, *the most noteworthy characters* to be brought out are the methods of reproduction; namely, *vegetative multiplication* and *spore reproduction*. Of the former, many methods are purely vegetative, among which, reproduction by multicellular gemmæ being the most rare, such as found in *Melobesia*. Non-motile cells from terminal cells of branches are thrown off, and to all appearances represent a kind of transition stage between the purely vegetative and the spore-reproductive. Of the latter, two divisions occur; namely, the *non-sexual* and the *sexual-spore* reproduction. The non-sexual spores are formed either *sexually* or *asexually*; the former are always reproduced by the *sporophyte*, and known as carpospores, while the latter are formed by the *gametophyte*, and known as gonidia, or ordinary spores. These are produced in unilocular sporangia, as in *Ceramium*, or in multilocular sporangia, as in *Dasya*.

These bright red, motionless spores are divided into three classes, viz., *tetraspores*, which may be cruciate, zonate or tripartite, *polyspores* and *sierospores*. The latter are common to species of *Ceramium* and *Callithamnion*, and consist of chains of oblong cells formed directly from the branches at their extremities. The arrangement of the sporangia on the fronds is various. In some cases, as in *Dasya elegans*, they are limited to particular portions of the frond, borne on modified, lateral pod-like branches, so-called stichidia, the terminal cells of which give rise to sporangia. In others, as in *Polysiphonia*, they are developed internally, within the superficial cells, and are either isolated or collected in wart-like masses, *nemathecia*. The latter method seems to prevail among the genera. The fronds bearing the tetraspores are, with few exceptions, distinct from those bearing sexual fruit or cystocarps. Occasionally both tetraspores and cystocarps are found on the same specimen, as in certain species of *Callithamnion* and *Spyridia*. The tetrasporic plants are decidedly more abundant than the cystocarpic. In certain genera, among which *Callithamnion*, it is not uncommon to find *antheridia*, *cystocarps* and *tetraspores* on the same individual, a thing rarely to be seen in the *Florideæ*. But the most puzzling part of the whole life history of the order is the complicated process of sexual reproduction. In many cases the full development of the cystocarp is unknown. Many details connected with the act of fertilization are as yet very obscure. To account for all stages from procarp to cystocarp is at present a problem of extreme interest among algologists.

The organs of sexual reproduction include the antheridium and the procarp, the latter comprising the *trichophore* and the *trichogyne*. As a rule, the sexual cells are terminal in position and more or less fixed, usually placed on the youngest lateral branches of the frond, and are either unicellular or multicellular, thus forming clusters.

A brief description of the simplest arrangement to effect fertilization is the following:

The terminal cells of two lateral branches become changed in form and structure; the one, tuft-like, the antherid, contains a simple non-motile, non-ciliated antherozoid; the other, a terminal cell, with two below forming the procarp, enlarges and elongates above to form a long, slender, hyaline hair, the *trichogyne*, whose basal portion is the *trichophore*. In the simplest forms, as in the *Bangiaceæ*, the antherozoids come in contact with the extremity of the receptive trichogyne where they adhere for a time. After the walls of both points in contact are absorbed, the fertilizing influence is propagated through the trichogyne to the trichophore, which enlarges by cell division. In this case the trichophore becomes the carpogenic cell, which subsequently divides, each *division* yielding a carpospore. Such a product of fertilization is a *cystocarp*, whose formation is direct. Other cases of direct formation occur, as in *Nemalion* and *Chantransia*, where the carpogenic cell gives rise to an outgrowth of oöblastema filaments whose cystocarps consist of clusters of sporangia. In by far the greater number of genera the cystocarps are not formed by direct, but by indirect, outgrowths from the trichophore. For example, in *Callithamnion*, the fertilizing substance passes from the trichogyne, if at all, through the *trichophore* and *sometimes several cells below*, before certain lateral cells are reached, which become spore bearing. In *Dudresnaya* the trichophore of one procarpic filament gives rise to several lateral tubes, itself becoming non-spore bearing, which convey the fertilizing impulse to certain cells of other procarpic filaments which have no trichogyne in other parts of the frond. Thus, cystocarps are formed at great distances from the trichogyne. In *Polyides* a similar arrangement obtains, but the cystocarps are not the auxiliary cells of the procarpic filaments; they are lateral expansions of the trichophoric tubes. In other genera, the evidences are ample to disprove the act of fertilization. In *Ptilota serrata*, as far as observations went, I found the antheridial plants very rare. Not a single antheridial plant or an antherozoid was found in contact with the trichogyne. A very peculiar phase in the development of the cystocarp was noted—a trichophore with five trichogyns; the antherozoids would have had to pass through two, in some cases three, cells to have fertilized the lateral carpogenic cells.

In *Batrachospermum*, the carpogonium develops cystocarps without any connection with the trichogyne—an entirely non-sexual process. A cellulose plug separates the trichogyne from the trichophore. In *three* species of this genus cellulose plugs were constant, and two nuclei in the trichogyne. Only about 10 per cent. of specimens examined showed evident fusion of antherzoids with the carpogonium. The oöblastema filaments are not outgrowths of the carpogonium, but from cells below, which is in opposition to Thuret and Bornet. Physiologically, then, two great types of reproduction seem to occur: one in which cystocarps develop from the carpogonium; the other in which cystocarps develop from the cell below.

To sum up the sex phase of Florideæ: Antherozoids very rare, non-motile and in some cases wanting. Only a very few cases of actual fertilization recorded by algologists. Not definitely known whether antherozoids fuse with carpogonia or whether apogamy is the rule. The commingling of the nucleus of the antherozoid with the nucleus of the trichogyne and the contents separated from the carpogonium by a cellulose plug—a hint, no doubt, toward an old hereditary act of ancestral forms.

Therefore, the strongest point in the investigation of the *Florideæ* is the separation of the trichogyne from the trichopore, and fertilization not accomplished.

Measurements of Strains Induced in Plant Curvatures. By D. T. MacDougal.

The Stomates of Cycas. By Edgar W. Olive.

The Buckeye Canoe of 1840. By W. P. Shannon.

One of the campaign devices of 1840, in this State, was a buckeye canoe on wheels. General Harrison, the Whig candidate, was a citizen of the Buckeye state and the hero of the battle of Tippecanoe. Hence, the Buckeye Canoe embodied the ideas that caught the selfish pride of two states. The purpose of this paper is to give some idea of the size of the tree from which this canoe was made.

The dimensions of the canoe and of the tree were given to me by Mr. Robert Cones, of Muncie, a man that I have known all my life, and his statements agree well with those that I have obtained from others. Mr. Cones was one of those who guarded the canoe of nights, while it was being made. It was fifty feet long, well dressed both outside and inside. On the inside, boards were placed crosswise for seats, and three persons could sit comfortably on one seat.

During the campaign it was hauled from place to place over the state, appearing at Indianapolis, at Richmond and the Battle Ground. The dimensions of the canoe show that the tree was immense. We have seen yellow poplar or tulip trees big enough for such a canoe, but it hardly seems credible that there ever existed such a buckeye ree.

The tree, standing, measured 27 feet 9 inches in circumference at two feet from the ground, and was 90 feet from the ground to the first limb. The foliage was reduced to a bunch at the summit of the stem, which caused some who saw the tree to compare it to the palmetto. The tree had no spur roots, it stood in the ground like a post, it was as straight as an arrow and held its thickness remarkably well. This tree grew in the southeast corner of Rush County, and was recognized as a sweet buckeye. If so, it was *Æsculus flava*. On account of its size and majesty it was known far and wide, and was visited as a great curiosity by men from different parts of the United States. Occasionally a man from a distant city, a merchant from Philadelphia, for instance, having business in Connersville, Brookville, or Rushville, would drive from 10 to 15 miles to see the "Big Buckeye."

I have never found *Æsculus flava* in Decatur County, a region where I have given some attention to the forest trees. It is not in Mr. Meyncke's published list of the Phænerogams of Franklin County. It does not appear in the catalogue of Indiana plants published in connection with the Botanical Gazette a few years ago, in 1882, I believe. But according to Dr. Collins it occurs in Dearborn County. Dr. Phinney places it among the forest trees of Delaware County. It has been reported, I know not by whom, from Jefferson County. Hence Rush County seems to be in the region inhabited by the Sweet Buckeye.

The comparative sizes of *Æsculus glabra* and *Æsculus flava*, as given by the authors, is good evidence that the tree in question was *Æsculus flava*, and not the common buckeye, *Æsculus glabra*. According to Gray, *glabra* is a large tree, and *flava* a large tree or shrub. According to Wood, *glabra* is a small, ill-scented tree, and *flava* a large tree, 30 to 70 feet high, common in the southern and western states. Then he adds by way of parenthesis: In Columbia County, Georgia, only 4 to 6 feet high. This seems to explain the shrub of Gray, and indicates that it is not only an extreme, but narrowly local variety. In Sargent's Forest Trees of North America, *glabra* is a small and medium-sized tree, and *flava* a tree sometimes 60 feet in height, with a trunk 2 to 3 feet in diameter. According to Apgar, *glabra* is a small to a large tree, sometimes only a shrub 6 to 7 feet high, and is found from Virginia to Indiana and southward.

If this big buckeye was *Æsculus flava*, and the evidence shows that it was, we have an example of a gigantic individual growing near the limits of the range of the species.

EMBRYO SAC OF JEFFERSONIA DIPHYLLA. BY FRANK M. ANDREWS.

SOME NOTES ON THE AMŒBA. BY A. J. BIGNEY.

Students and teachers in biology usually have considerable difficulty in finding an abundant supply of this interesting little animal. The directions generally given in our text-books will enable one to find plenty in the course of time, but the teacher does not have very much time to devote to this part of the work, and in many cases the animal must be omitted because it can not be found when it is needed.

I hope that no member of this Academy has ever had any difficulty in this line, but I fear my wish can not be realized. It may be that the method of finding them here presented is not new to this Academy, but I have not as yet met with it after examining almost scores of texts and talking with many of the leading biologists of this country. If it be old to some, it will be new to others.

While collecting for the biological department of the Johns Hopkins university, I put a small quantity of *Euglena* in a bottle and kept it on my desk. In a few days I examined it and found ameba in great numbers.

To those who are not acquainted with the *Euglena*, permit me to say that it is a small plant which passes its motile stage on the surface of ponds in most parts of this country. After remaining in this condition a few days the surface of the pond being quite green with them—they pass into the resting stage and disappear, the surface of the pond becoming clear, but in a few days more the pond will be green with the motile forms. This seems to be a remarkably favorable habitat for the ameba. They are near the surface so that they can secure plenty of oxygen, and the surroundings are such that the other conditions of life are exceedingly good.

When the above material was first examined they were multiplying very rapidly, but in a few weeks the conditions changed somewhat, so that there were more large ones.

This supply was secured in November, 1893, and was the source of supply for the university the remainder of the year. When I left, late in May, 1894, there were as many as ever and in good condition. They were so abundant that often two or three dozen could be found on a single slide.

On my return to Indiana, I found plenty of *Euglena*, and likewise a good supply of ameba. In September I furnished my class with this material, and they met with practically no difficulty in finding them, for they were so numerous.

A little later I collected some of the *Euglena* from a pond of strong manure water in a barnyard, and the usual numbers were found.

A few days ago, on examining the same material, I found them more abundant than ever before.

By this method I feel sure that teachers can always obtain ameba without any difficulty.

The Variations of Polyporus Lucidus. By L. M. Underwood.

(Abstract.)

The above species is common to both Europe and America, and as usually reported is a fungus that inhabits the dead portions of conifers, notably in our northern regions the hemlock. It is also in northern regions a stipitate species, having a lateral stem and is, moreover, annual. I find that in lower latitudes it departs from all these supposed characteristics. (1) It grows on the wood and at the roots of deciduous trees. (2) It is often sessile or has an irregular stem.

3. It is perennial and even stratose, *i. e.*, forms a succession of layers of pores. Specimens from South Carolina and Indiana exhibit the latter condition. The species has been regarded as the type of a distinct genus, *Ganoderma*. It is possible that the supposed variations represent incipient and, perhaps, distinct species, yet the group in which the species occurs thoroughly defies all exact classification, a single species often in its variations overreaching generic and even family limitations.

The Proposed New Systematic Botany of North America. By L. M. Underwood.

[Abstract.]

Announcement of a new flora of North America, to be the combined work of the leading botanists of the country. Each group is to be monographed by specialists. The work is to consist of seventeen volumes octavo, of about 500 pages each and to be issued in parts. Separate parts of the work will also be obtainable, but at an advanced price.

Cell Structure of Cyanophyceæ. By Geo. W. Martin.

Contributions on the *cell structure of algæ plants* have by no means reached a considerable degree either in point of number or in scientific results. Research in this line is comparatively an untried field; especially does it obtain in reference to the class of algae known as the *Cyanophyceæ*.

During the past summer the writer had an opportunity of studying *marine* as well as *terrestrial* forms of a number of species. Work was undertaken, chiefly, to discover, if possible, by use of various reagents, any method that might lead to the identification of constituent and structural parts composing the cell. The following is a brief *resumé* of the results obtained:

Chromatophore. It appears to consist of colored bodies, so-called "grana," embedded in a homogeneous, colorless, ground substance. The grana are bound together by a connecting substance into a moniliform, or necklace-like fibrillae. These are denser near the surface and run more or less spirally around the cell. Just here may be mentioned the fact that the fibrillar arrangement of the grana is denied by Palla.

In all cases observed, the chromatophore is *parietal and continuous*, and is separated from the wall by a delicate layer of protoplasm. In several instances it appeared to be vacuolate.

Central Body. On treatment with methylene blue a central body appears: it takes a living stain, is more or less rounded and central in the cell. According to the investigations of Palla it is homogeneous, but according to Hieronymus it is more or less differentiated into granules, having a fibrillar arrangement. The fibrillae, however, are not surrounded by a membrane, and may extend in any direction throughout the cell, even penetrating the chromatophore. The granules are strikingly significant of the cyanophycin grains of Hieronymus. Though the central body in its reaction towards stains, etc., yields results similar to those of nuclei, yet it does not appear to be a nucleus, or at any rate it does not show in detail the characteristics of a nucleus, *as found in the higher plants.*

Mucus Globules. In the parietal part of the cytoplasm of most species occur globular structures which are most numerous along the septa. In appearances they harmonize with the description of Schmitz's mucus-globules. But according to the investigations of Hieronymus they are identical with cyanophycin grains. There is no similarity in results, for mucus globules are insoluble in hydrochloric acid and stain with methylene blue, while cyanophycin grains are soluble in hydrochloric acid and do not stain with methylene blue.

Vacuoles. Irregularly distributed through the contents of the cell are usually a number of transparent spaces of cell sap or vacuoles. They vary in size and in number.

Oil. Drops of oil were observed in the germinating spores of *Glœotrichia.*

The Cell Wall. The structure of the cell wall presents, to a slight degree, a form of lamination. It is of comparative thickness, and more or less colorless. As to its chemical composition, the results obtained by the application of acids and stains were too fragmentary to draw any satisfactory conclusions. However, I found it highly resistant on treatment with acids, especially 33 per cent. chromic and concentrated sulphuric. With the anilines very decided stains were obtained. In short, of the five recognized kinds of cell walls, one type possesses properties intermediate between those of *fungus-cellulose* and *cutin.*

The Sheath. Peripheral to, and conjunctive with the cell wall is the delicate, membranous sheath. In some species the sheath is wanting, but in most cases it is present and marked by varying degrees of thickness, even at times giving a stratified appearance. Chemically, it differs considerably from the cell wall, but it is closely allied to cellulose. In many cases it turns blue on treatment with chloriodide zinc; is mostly soluble in sufficiently concentrated chromic and sulphuric acid, but is insoluble in cupra-ammonia. Agreeing with cellulose, it, too, possesses the property of cuticularization.

Preliminary Account of the Development of Etheostoma. By A. B. Ulrey.

Embryology of the Cupuliferæ. By D. W. Mottier.

Variation in Etheostoma. By W. J. Moenkhaus.

Blood Corpuscles of the Very Young Human Embryo. By D. W. Dennis.

Embryology of the Frog. By A. J. Bigney.

The embryology of the frog is an old subject, yet few of our smaller institutions and many of the larger colleges and even some universities often do but little work on the frog in this line. The material is so abundant that it seems that it ought to be studied some at least even in our high schools. One difficulty in the way, and perhaps the greatest, is a good method of manipulation. Many find this trouble and give up almost in despair.

It is the chief object of this paper to present what I consider the easiest and best method of manipulation. By this method even the inexperienced student or the amateur may soon be able to do fairly good work.

Eggs obtained very early in the morning may show the first process in maturation, viz.: the formation of the polar bodies. This can be observed better in the Amblystoma, or even more easily in the common pond snail, the *Dymnaeus* or *Physa*.

In order to preserve the eggs for permanent mounting or sectioning, they should be killed and partially hardened in alcoholic-picro-sulphuric acid. The alcohol used in this solution should be 30 per cent. The eggs should remain in this solution from six to twelve hours, depending upon the age of the egg. Before putting them in this solution, most of the gelatinous substance should be removed by a needle or similar instrument. Next wash a few minutes in 30 per cent. alcohol, then transfer to 50 per cent. for an hour, then to 70 per cent. for two to four days.

The 70 per cent. alcohol passes through the membrane covering the egg and pushes it a short distance from the egg proper, so that it can easily be clipped with a pair of sharp scissors, and the egg is readily removed. If the alcohol is much stronger than 70 per cent. it will not cause this swelling of the membrane. After this the eggs can be dealt with after the regular methods.

To study the segmentation the eggs may be kept in a watch-glass, and examined with a strong lens or low power of the microscope. The formation of the furrows can be studied up to the 32-celled stage with practically no difficulty, and with some care to the 128-celled stage. Eggs at the various stages may be killed, hardened and sectioned so as to show the internal changes, the formation of the cleavage cavity, the archenteron, notochord and other organs that appear from time to time. In the process of clearing the eggs it is best to use cedar oil rather than turpentine, for the latter tends to make them even more brittle than they are.

The general progress of this development is too well described in text-books to merit any further account here. I am indebted to Prof. Th. H. Morgan, of Bryn Mawr college, for most of the above points. I have carefully tested them, and can recommend them without restricting qualifications.

Another interesting field in the study of these eggs is to separate the segments in the early stages of segmentation and observe the result. It has been found that in the two-celled stage each segment will form a perfect animal, but only about half the normal size. This has been tested as far as the eight-celled stage, each segment continuing its development, but forming specimens much smaller than ordinarily, the effects of pressure upon the developing eggs causing them to segment in a different manner. Other points of interest might be suggested, but these are sufficient to call attention to this important subject.

Poisonous Influence of Various Species of Cypripedium. By D. T. MacDougal.

At the last December meeting of the Academy a short paper was presented by the writer detailing some observations tending to show that *C. spectabile* and *C. pubescens* have an irritant action on the human skin. This paper was printed in full in the "Minnesota Botanical Studies," Part 1, 32, 1894.

The interest in the matter shown by the comment of the scientific and daily press and by the large amount of correspondence received, was such that a series of tests were planned which would place the entire matter beyond all question or doubt.

It had been suggested by ingenious correspondents that the poisonous effects experienced by the writer in handling *C. spectabile* in a swampy location, may have been due to the action of some of the poisonous plants, such as *Rhus*, usually found in or near sphagnum swamps. When it was found by careful examination that no plants of the genus *Rhus* grow within one mile of the locality in which the test was made, one of my correspondents, with a most admirably developed "scientific imagination" suggested that the pollen of the *Rhus* may have been carried by the wind and caught by the secretions of the glandular hairs, in such quantity that the amount of toxicodendric acid contained would be sufficient to produce the irritant effect.

A number of root clumps of *C. spectabile*, *C. pubescens* and *C. parviflorum* were obtained from Pitcher and Manda, and placed in the plant house under such conditions that leafy stems were formed and the experiments could be carried on at intervals from February 1 to June 1, 1894. In the plant house were no other known plants of poisonous influence, and since during the greater part of this period the country around Minneapolis was covered with snow to the depth of two or three feet, all danger from distant *Rhus* clumps and sphagnum swamps was held to be fairly excluded.

Detailed tests with the leaves of *C. spectabile* rubbed lightly on the skin of the wrist, arm, face or ear, were made with nine persons; of these, six were "poisoned" in a degree corresponding to the manner of application, in a time varying from ten to twelve hours. By a canvas of the students of the department it was found that nearly the same percentage were usually poisoned by *Rhus*. In order to confirm these results the test was repeated with the same result. Still farther repetitions were made by some of the persons concerned, until no question as to the result remained. The unpleasant effects of these tests were a severe drain on the enthusiasm of the subjects, and the later tests on three persons made with *C. pubescens* were equally marked. Nor is it a matter of surprise that similar effects were shown by *C. parviflorum*. It was next in order to ascertain whether this effect was due to the mechanical injury resulting from piercing the skin by the pointed hairs or to the corrosive action of the secretion found on the outside of the globular tips of the glandular hairs. To this end separate tests were made by material from *C. spectabile*. The hairs of each kind were taken from the leaf by means of a pair of fine forceps and the tip pressed against the skin. Irritation resulted from the contact of the glandular hair only, and in the form of a red macule 1 to 2 millimeters in diameter.

It was found, further, that the irritant action of the plant increased with the development of the plant, and reached its maximum with the formation of the seed-pod, from which it seems entirely reasonable to infer that this is a device, and a very efficient one, for the protection of the reproductive bodies during the period from pollination to the maturity of the seeds.

Development of Sexual Organs in Cymatogaster. By C. H. Eigenmann.

[Abstract.]

Reproductive cells are segregated very early before any protovertebræ are formed, and the embryo is no more than .3 mm. in diameter. About a dozen cells are present at this early time. These migrate backward with the growth of the embryo, but do not share in the general development. When the larva has attained a length of 7 mm. the cells begin to divide, and by the time the larva has reached a length of 8 mm. all have undergone division, so that about 24 cells are present. These are arranged in a V shaped area. The arms are formed by the folds in the peritoneum in which the sex cells lie.

The sexes become differentiated when the larvæ have reached 10 mm. The differentiation becomes apparent in the general shape of the reproductive glands before any difference is noted in the reproductive cells.

At 20 mm. the grouping of the cells has become characteristic of the sexes.

Formation of Ovarian Cavity.—The reproductive cells never lose their identity, they are never transformed into other tissue, and no other cells are ever transformed into reproductive cells.

The Vegetation House as an Aid in Research. By J. C. Arthur.

[Abstract.]

The general construction and purpose of a vegetation house were described, and examples of work performed during the season of 1894 in the one at Purdue university were given in illustration of what may be accomplished when such facilities are available. A vegetation house is essentially a structure to protect growing plants from wind, rain, extremes of cold, and other accidents to which they are subject in the open field. The plants are grown in suitable pots or beds mounted upon trucks, which run on wooden or iron tracks. The plants are only run into the vegetation house when requiring protection, and at other times are left in the open. Although the house is a glass structure, it has no heating arrangements, and is chiefly used during the summer season.

Interesting results obtained by feeding oats and purslane with variable amounts of potash, were explained, and by growing potatoes with a greater or less supply of water, and some other experiments. Photographs accompanied the paper. Some possibilities in the study of the physiology of plants were outlined.

Mass and Molecular Motion. By M. N. Elrod.

THE UNIONIDÆ OF THE OHIO RIVER. BY R. ELLSWORTH CALL.

[ABSTRACT.]

There are now recognized in the freshwater molluscan fauna of North America more than one thousand representatives of the great family of Unionidæ, or fresh-water mussels. A few of these forms, which constitute a peculiarly well-marked division of the family, occur in Mexico and in Central America. Less than a score of species are found in Canada. The rest are peculiar to the United States and, for the greater part, are found east of the Rocky Mountains. More than ninety per cent. of all known forms are from the regions east of the Mississippi and south of the Ohio Rivers. The center of distribution for the described southern forms is the great central plateau region of Middle Kentucky and Tennessee, Western North and South Carolina, and Northern Georgia and Alabama. Within the area as above limited, occur nearly all the species that are known—outside of the great Unionidæ group known as the *complanatus* division. In all the larger streams, and in most of the smaller, throughout all this region, the members of the family flourish in both great numbers of individuals and species. About eighty per cent. of all described North American forms come from this area, and some thirty per cent. of all are from Tennessee, Alabama and Chattahoochee Rivers, and their tributaries.

This singular, but interesting fact, has never yet received the attention it deserves, for geographic distribution, abundance in individuals, and diversity of form are herein correlated clearly with certain geologic factors. For instance, the family is a very ancient one, and dates back to Devonian times at the latest. The region under consideration has constituted a unique land-mass since a very early period in the history of the continent. It has scarce been subjected to glaciation—at least has not since the geologic record exhibited in its country rock began. The very great diversity of form and the great abundance of these modern representatives of a very ancient type, appear plainly to be related in no small degree to these factors.

In investigating in this field, for some twelve years or more past, the species and distribution of these mollusks, attention was necessarily directed to that peculiar Unionine fauna which lies on the northern border of this area. This was rendered necessary, in the first place, by the fact that the Ohio River had itself furnished most of the earlier described types. The literature of the subject reveals some sixty species, distributed unequally among the three Unionine genera, *Unio*, *Anodonta* and *Margaritana*, and shows the forms distributed among these genera in an abundance which has the relation just given, viz.: *Unio* has the greater number of species and *Margaritana* the least.

It was further discovered that as the Ohio River forms of *Unio* are traced over the regions southwards and their geographic and geologic environment becomes changed, that a large number of them sensibly change their external particular characters and grade into forms to this time regarded as peculiar to the region. At once here was opened up the great question of synonymy, with all the consequences which are involved in a wholesale reduction of species.

This study, then, in its final form, will seek to investigate the synonymy—First, of the shells which have been described from the Ohio River. Second, it will select the most marked species of these river mussels and about them, as types, attempt a natural grouping of the Unionine fauna of the valley and the region south. Third, it will attempt to eliminate the synonyms which have been so multiplied by earlier students who were misled by inadequate data or by the older notions of what constituted a species. It will, further, explain in a measure the way in which the different forms assumed by the sexes came to be regarded as species—an unfortunate condition which the *dilettante* of the present day are making worse. It will, fifth, seek to collect, for convenient reference, all figures and descriptions, in the hope that in this way the historic importance of the earlier descriptions may become apparent. These will be arranged chronologically. The Ohio River constitutes historic conchologic ground; from it must begin, as began the old, the new study of the *Unionidæ*.

The Strepomatidæ of the Falls of the Ohio. By R. Ellsworth Call.

[Abstract.]

The *Strepomatid molluscan fauna* of the Falls of the Ohio is one that is very rich in numbers, but rather poor in species. Including some which will eventually pass into synonymic lists, the total number comprizes but ten species which are distributed among four genera, to wit: *Pleurocera* with three nominal species, *Lithasia* with one species, *Anculosa* with two species, and *Goniobasis* with four species.

The falls mark the line of junction of the Silurian and Devonian strata, which may here be differentiated with very great success and ease. For a distance of some five or six miles the bed of the river is very rocky, with numerous islets of rock, which are always exposed at low water. From one end to the other are innumerable pools in which flourishes a very rich *conferroid flora*, and which furnish a very variable but favorable station for these forms. In numerous places the changes in the current are so marked that at different seasons of the year the

Strepomatid fauna varies with it. For instance, in some places where muddy bottoms, and an abundant flora co-exist, the several members of the genus *Pleurocera* abound. At another, where the bottom is clean rock, or is rock with abundant confervoid vegetation, the genus *Anculosa* occurs in the greatest profusion. At the numerous small falls over the rocky flats, where the water is indifferently swift, and the bottom is either clean or with scanty vegetation, are found great numbers of the four species of *Goniobasis*. At another time in the year, when the stage of the water is changed, a rather different distribution, locally, may be noted. These relations exhibit a certain dependence on local conditions that vary, and, perhaps, serves to explain the very different character of the shell fauna at the same place, at different periods of the year.

The earliest forms that have been described from the Falls are now unknown. They were discovered and studied by the unfortunate Professor Rafinesque, and have long since been merged into synonymy by other students, who were unwilling to allow his claim to original discovery. The attempt lately has been made, with indifferent success, to fix these forms. What result more extensive study of the literature of conchology will finally justify must be left for another time and place. Here it is simply the purpose to place on record the forms which occur, their synonymy as now understood, and a study of those changes in form and habit which manifestly result from the environment of the various representatives of the family.

The species of *Pleurocera* are the following: *Pleurocera canaliculatum*, *P. moniliferum* and *P. elevatum*. There are many specimens which are so difficult of determination, when studied in large series, that one is inclined to the view that forms of extreme variation, but really specifically related, have been given species names which ought to have been not even recognized as varieties. A species monger could erect, by carefully selecting his examples, a dozen or more species from the simple variations in coloration alone, and, strange to relate, this has been done. Thus *Pleurocera canaliculatum* has occurred in abundance with one, two, three and even four revolving purple bands. Many specimens have been secured which are entirely purple, and with no semblance of distinctness in the banding. Hundreds of individuals have been taken that are bright, honey-yellow, and have no tendency to other coloration whatever. Many present the character of channeled whorls, on which the specific name is based, while as many more are found that have plain and well rounded whorls, without any indication of the so-called characteristic grooving. The form called *P. elevatum* itself is a beautiful illustration of the effects of different environment. It taken from swiftly flowing water, and found attached to rocks, the shells are short and stubby, whorls well thickened and with incrassate aperture. The same shells obtained from pools where the water does not flow at all, and where vegetation flourishes in great abundance, are elongate, thinner in texture, thinner about the aperture, have the lines of growth far apart and well marked. These are the points on which the supposed distinct species have been based, but are thus seen to be but a reflex of the conditions of environment.

The *Goniobases* present the same facts, but since they are often found attached to the faces of vertical rocks, from which they do not migrate very far, there is a very characteristic modification of the aperture which results, evidently, from the effects of gravitation. The final paper will present many facts which tend to this explanation of the different forms of aperture, which, as is well known, determines the real form of the shell.

A few important observations on the animals themselves have been made, but these regard chiefly minor anatomical details and possess little general interest. Enough has been learned, however, to determine that several species, at least, have been based upon the sexes. This difference is seen in the general outline of the female shell, which has always characteristically well-rounded whorls, a condition itself a result of the positions of certain organs within the body of the animal.

Several of the forms found at the Falls of the Ohio are of wide geographic distribution. These limits have been determined and a study made of the shells as expressive of differences in the conditions of the several stations.

The most abundant species of *Anculosa* found at the Falls ranges to the rivers of middle Alabama, and occurs over all the region of east Tennessee, in the larger streams. Coincident with this wide distribution there is a great diversity of form, and thus there has arisen a rather large synonymy, which it is the purpose of this study to establish. Not less than twenty times has *Anculosa praerosa* been described by as many different conchologists who published from scanty material and with the understanding that every stream had its own forms. My own studies in this connection are based upon extensive collecting over all this wide region and on very large quantities of the shells of the several species. The material from the Falls of the Ohio alone, which has passed under observation, comprises something over two bushels of shells. In the quantity one who does not recognize, as Lea did not recognize, the modern notions pertaining to species and the extent to which they respond to geographic factors, might erect forty species with as great propriety as one.

A word or two on the great profligacy of nature in this form of life. During the period of receding waters on the Falls, in the spring and summer, myriads of these mollusks are left in small pools and rills. Later in the season these pools entirely dry up, and the shells, of course, die. It is no exaggeration for me to say that a hundred wagon loads a year, for the past three years that these falls have been under observation, have perished in this way alone, and this has annually occurred for centuries. One is constrained to ask why it is that nature is so profligate of life, and to question whether, after all, the ordinary conception of its sacredness is not one which the facts of nature do not conserve. The fact needs explanation. Certain it is, however, that if these forms reached maturity, and in turn produced their kind in the enormous numbers that the Strepomatids do reproduce, very soon the waters of the river would be dammed by a living, moving mass of animals, which in some situations are so tenacious of life as to have completely occluded large water mains and led to enormous cost to effect their removal.

REPORT OF THE BOTANICAL DIVISION OF THE INDIANA STATE BIOLOGICAL SURVEY FOR 1894.

Lucien M. Underwood, Director.

In presenting my second annual report as Director of the Botanical Division of the Biological Survey, it is fair to state that the organization of the survey allows no appropriation for carrying on the work, and whatever has been done by the Director has been in addition to the cares of a laboratory and department of botany. In the present year the Director was necessarily absent from the state during the entire summer and was further prevented from doing as extensive field work during the latter part of the year as was planned, on account of the accumulation of work of other kinds during the summer. It is very desirable that certain explorations be made in some of the less visited portions of the state, and in order to do this some arrangement will have to be made to secure transportation to these regions.

During the spring and fall considerable collections were made in the immediate vicinity of the university (Putnam County) and quite a number of additions were made to the list of last year; the trip to Rochester during the spring meeting of the Academy resulted in several additions to the flora. A trip to Franklin County in November was only partially successful on account of heavy rains. Material has been collected also by Mr. E. W. Olive in Montgomery County, who has made a considerable number of additions to the list of parasitic fungi of the state. Some of my own students have made small collections, notably in Grant, Green and Orange Counties. With further determinations of previously collected materials, together with that collected during the present year, we can add some plants to the previously published list. These plants, with their data, are included in Appendix A to this report. Mr. J. B. Ellis has furnished descriptions of three new species of *Fungi Imperfecti*. A list of new host plants for fungi forms, Appendix B. Notes on the previous report are included in Appendix C.

It is desirable to obtain a complete list of the persons who are willing to collect data and otherwise serve as correspondents to the survey. We ought to have at least one in each county of the state from whom reliable data can be received in regard to the occurrence, relative abundance and present status, of certain plants. If possible, yearly reports as to the appearance of new plants, particularly weeds, should be received. The recent issue of a bulletin on this subject from the State Experiment Station well illustrates the need of a fuller list of correspondents, and as well the immensely practical value of such information when properly collated and brought into its proper bearings. The fact remains, however, that these correspondents are for the most part only able to render assistance on the higher plants. There are very few persons in the state who have the proper training or who are willing to make the effort to collect the lower plants. Here there is opportunity for those who have charge of courses of instruction in the colleges to render assistance. It would be of immense practical advantage to many of our botanical students to learn how to recognize the lower forms of plant life in the field, and their work in regions which have not yet been visited would add materially to our knowledge of the distribution of these plants in the state.

In order to facilitate the recognition of the lower plants, and in accordance with the preliminary announcement issued last year,* there has been prepared a series of exsiccatæ representing the flora of Indiana. The first fascicle consists of 100 species of parasitic fungi so selected as to illustrate as many as possible of the groups which prey upon the tissues of other plants. These sets are to be distributed as follows:

One set to each of the four colleges of the state in which a department of botany exists, and in which there is a permanent herbarium established.

Three sets to public institutions outside the state, where there are large collections of plants accessible to the botanical student. The herbaria thus selected are (1) the collection of the Missouri Botanic Garden, St. Louis; (2) the Department of Agriculture at Washington; and (3) the Herbarium of Columbia College, New York.

One set to the private herbarium of the Director.

Other sets will be reserved for distribution to other institutions of the state where there is a reasonable certainty that they will be properly preserved and made useful for reference to students; or they will be sent to individuals who contribute an equivalent amount of material representing the lower flora of their respective regions. Some sets have been used by the director for the purpose of exchange with persons outside the state, where this could be done in such a way as to increase his facilities for work.

There are five sets remaining that can be distributed within the state. It is the purpose of the director to issue further sets illustrating other groups if sufficient encouragement is given. The expense of the present issue, including postage, envelopes for the specimens, and labels, to say nothing of the labor of preparation, has been contributed by the director. If it is thought desirable to continue this distribution, it is recommended that the actual outlay of money

* Proc. Indiana Academy of Science, 1893: 16, 1894.

for the above named incidentals be regarded as legitimate expenses of the survey, and be paid for by the Academy. It is also desirable to have the labels in further issues printed in full. This will add greatly to the appearance of the series without any great additional expense.

A list of the plants distributed in this first fascicle is appended. (Appendix D).

The work on the higher flora, as stated in the report of last year, was placed in the hands of Professor Stanley Coulter, who makes a separate report on the progress of his work. A set of blank cards to be used as a working index in preparing the final catalogue was ordered from the Botanical Supply Company, of Cambridge, Mass., and this is the only expense that the Division has asked the Academy to meet during the year. Professor Coulter deserves the thanks of all the botanical workers of the state for the laborious work he has already done, and deserves the support of every man in the state who knows even the commonest plants, in order that the catalogue when published finally shall completely represent the distribution of our higher flora.

It is the intention of the Division to publish from year to year such additions as are made to the flora among the Archegoniates and Thallophytes in order to make a permanent record of their occurrence, for it will be many years before the lower plants of the state will be known with even approximate completeness. It must be remembered that many of the plants belonging to the lower orders are ephemeral in their character, and unless collected in their season disappear and leave no visible trace of their existence. Many of them appear in certain years when the conditions are favorable to their development, and perhaps may not reappear for a succession of years. The past few seasons have been particularly unfavorable for the development of the fleshy fungi, especially those that appear during the midsummer. The same is also true with regard to some that appear in the autumn. As an instance *Phallus Ravenelii* was very abundant in the vicinity of Greencastle during the latter part of 1891, but it has not been seen since. It will thus be seen that the care required in searching for the lower plants is of necessity much greater than in the case of the higher plants, which for the most part are perennial and of constant growth. It will also be seen that the opportunities for bringing to light rare plants is much greater among lower forms. There is scarcely a low, wet piece of woodland where fallen timber is abundant that will not yield a rich harvest of species not yet found in the State. There is scarcely a rocky ravine that will not yield additional bryophytes. There is scarcely a stagnant pond but that will yield an abundance of algae which have as yet been scarcely touched in this region.[1]

The great need is for students who have the patience, the perseverance and the fortitude to make a special study of some of these groups that are waiting for the enthusiastic collector.

In conclusion, it is desirable to extend thanks to those who have aided in the prosecution of the work of the survey. Especially would we mention Messrs. Ellis, Peck and Morgan, for the continuance of favors in determinations and for the communication of other material assistance in the work of the survey. To my assistant, Miss Mary E. Wright, for the very laborious work of preparing the labels for the exsiccatae. And finally to the management of the Vandalia and Big Four Railroads for favors extended to the survey, that have made more extensive field work possible.

APPENDIX A.

LIST OF ADDITIONS TO THE STATE FLORA.

MYXOMYCETES.

ARCYRIA MINOR Schw. Putnam, 5, 1894 (Paul Burlinganins).

HEMIARCYRIA FUNALIS Morgan. Putnam, 10, 1894.

PHYSARUM ATRUM Schw. Tippecanoe, 6, 1893 (Arthur).

PHYSARUM POLYMORPHUM Mont. Grant, 7, 1894 (Mary Wright).

ASCOMYCETES.

DISCOMYCETES.

DASYSCYPHA VIRGINEA (Batsch) Fckl. Putnam, 9, 1893.

MACROPODIA MACROPUS (P.) Fckl. (*Peziza macropus*, P.) Putnam, 5, 1894. Fred Howe.)

SPHÆRIACEÆ.

CARYOSPORA PUTAMINUM (S.) De Not.

On Peach Stones, Putnam, 5, 1893.

DIATRYPELLA CEPHALANTHI (S.) Sacc.

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[1] One of the great drawbacks in the study of the algae is the lack of proper references. The director is pleased to announce that he had secured a set of Rabenhorst's *Die Algen Europas*, including over 2,500 specimens of algae exsiccatae); and shall be glad to make them useful to students who wish to consult them. These, with the two series of American exsiccatae issued during the present year, sets of which are now in the herbarium of the director, give fairly good opportunity to compare our local forms.

On Cephalanthus occidentalis. Putnam, 12, 1892.

EUTYPELLA PLATANI (S.) Sacc.

On Sycamore. Putnam. 5, 1893.

HYPOXYLON PETERSII B. and C. Putnam, 11, 1894.

HYPOXYLON SASSAFRAS (S.) Berk.

On Lindera. Putnam. 12, 1894.

NUMMULARIA REPANDA Fr. Putnam, 7, 1893.

SPHAERELLA THALICTRI E. and E.

On Thalictrum dioicum, Montgomery, —, 1894 (Olive).

TREMATO PERTUSA (P.) Fckl. Owen, 5, 1893.

DOTHIDIACEÆ.

DOTHIDEA COLLECTA (Schw.) E. & E.

On Osage orange. Putnam, 5, 1892.

DOTHIDEA LINDERÆ Ger.

On Lindera Benzoin. Putnam, 10, 1893.

FUNGI IMPERFECTI.

SPHÆROPSIDEÆ.

CONIOTHYRIUM CONCENTRICUM Desm.

On Yucca (cult.) Montgomery, 5, 1891 (Olive).

PHYLLOSTICTA CHENOPODII West.

On Chenopodium album. Montgomery, 1894 (Olive).

PHYLLOSTICTA DESMODII E. & E.

On Desmodium rotundifolium. Montgomery, 1894 (Olive).

PHYLLOSTICTA LABRUSCÆ Thuem.

On Vitis labrusca. Montgomery, 1894 (Olive.)

PHYLLOSTICTA MACROSPORA E. & E.

On Liriodendron tulipifera. Wabash, 8, 1892 (Miller).

PHYLLOSTICTA PODOPHYLLI Wint.

On Podophyllum peltatum. Montgomery, 1894 (Olive).

PHYLLOSTICTA ROSÆ Desm.

On Rosa setigera. Montgomery 7, 1894 (Olive).

PHYLLOSTICTA SOLITARIS E. & E., n. sp.

On Pirus coronaria. Montgomery, 10, 1893.

PHYLLOSTICTA SMILACIS E. & M.

On Smilax rotundifolia. Montgomery, 9, 1893 (Olive).

SEPTORIA AGRIMONIÆ Roum.

On Agrimonia Eupatoria, Montgomery, 6, 1894 (Olive).

SEPTORIA CALYSTEGIÆ West.

On Convolvulus sepium, Putnam, 6, 1894.

SEPTORIA CERASTII Rob. and Desm.

On Cerastium sp., Putnam, 5, 1894.

SEPTORIA CONSOCIA Pk.

On Polygala senega, Montgomery, O., 1894 (Olive).

SEPTORIA CRYPTOTÆNIÆ E. and Rau.

On Cryptotænia Canadensis, Montgomery, 1894 (Olive).

SEPTORIA ERIGERONTIS Pk.

On Erigeron annuus, Montgomery, 1894 (Olive).

On Erigeron Philadelphicus, Montgomery, 1894 (Olive).

SEPTORIA HEUCHERÆ Pass.

On Heuchera Americana, Montgomery, 4, 1894 (Olive).

SEPTORIA PIRICOLA Desm.

On Pirus communis, Tippecanoe, 9, 1892 (Arthur); Putnam, 10, 1892; 7, 1893; Montgomery, 9, 1894 (Olive).

? SEPTORIA PHLOGIS Sacc. and Speg.

On Phlox divaricata, Montgomery, 1894 (Olive).

SEPTORIA PTELEÆ E. and E.

On Ptelea trifoliata, Montgomery, 9, 1894 (Olive).

SEPTORIA RECURVATA E. and Halst.

On Trillium erectum, Montgomery, 1894 (Olive).

SEPTORIA SAMBUCINA Pk.

On Sambucus Canadensis, Montgomery, 1894 (Olive).

SEPTORIA SCROPHULARIÆ Pk.

On Scrophularia nodosa, Putnam, 10, 1893; Montgomery, 1894 (Olive).

SEPTORIA STAPHYSAGRIÆ Wint.

On Delphinium tricorne, Vigo, 5, 1893.

SEPTORIA URTICÆ Desm.

On Laportea Canadensis, Montgomery, 1894 (Olive).

VERMICULARIA LILIACEARUM Ursd. Fulton, 10, 1893.

VERMICULARIA VIOLÆ E. and E., n. sp.*

On Viola cucullata, Montgomery, 1894 (Olive).

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* VERMICULARIA VIOLÆ, E. and E. On leaves of *Viola cucullata*, Canada (Dearness), Indiana (E. W. Olive). Epiphyllous or subglobose or irregularly shaped. White spots 2 to 3 mm. in diameter. Perithecia punctiform, clothed with straight, black, obscurely septate bristles 75-150x$3\frac{1}{2}$-4 μ. Sporules fusoid, hyaline, slightly curved, 15-20x3 μ.

Hyphomycetes.

Cercospora amphakodes E. and H.

On Phlox divaricata, Montgomery, 1894 (Olive).

Cercospora armoraciæ Sacc.

On Nasturtium armoracia, Montgomery, 9, 1893 (Olive).

Cercospora caulophylli Pk.

On Caulophyllum thalictroides, Montgomery, 1894 (Olive).

Cercospora cleomis Ell. & Halst.

On Polanisia graveolens, Montgomery, 9, 1894 (Olive).

Cercospora nasturtii Pass.

On Nasturtium officinale, Montgomery, 10, 1893 (Olive).

Cercospora polygonorum Cke.

On Polygonum hydropiper, Putnam, 10, 1893.

On P. Muhlenbergii, Montgomery, 1894 (Olive).

Cercospora sordida Sacc.

On Tecoma radicans, Putnam, 9, 1893, Montgomery, 10, 1893.

Didymaria fulva E. and E., n. sp.*

On Dioscorea villosa, Montgomery, 1894 (Olive).

Epicoccum neglectum Desm.

On Sanguinaria canadensis, Montgomery, 6, 1894 (Olive).

Monilia sitophila (Mont.) Sacc.

On corn cobs. Putnam, 4, 1895 (Melia Ellis).

Oidium megalosporum Berk. Vermillion 9, 1889 (Arthur).

Phoma glandicola Desm.

On acorns. Vigo, 5, 1893.

Ramularia variabilis Fckl.

On Verbascum thapsus. Montgomery, 1894 (Olive).

Septonema spilomeum Berk. Vermillion, 9, 1889 (Arthur).

Didymaria fulva E. and E. On leaves of *Dioscorea villosa*. Crawfordsville, Ind., July, 1894 (E. W. Olive). Hypophyllous forming small yellow patches, made up of closely crowded tufts of fusoid or narrow ovate, uniseptate, hyaline conidia 12–22 (mostly 15–20) x 3–5 μ., straight or slightly curved, and often constricted at the septum. Hyphae short, hardly distinguishable from the conidia. The shorter conidia are also the broader ones, and are mostly obtuse at one end, while the longer ones are generally acute at both ends. Differs from the usual type of *Didymaria* in its yellow color and short, almost obsolete basidia.

MELANCONIEÆ.

CYLINDROSPORIUM OFFICINALE E. & E., n. sp.*

On Saponaria officinalis. Montgomery, 5, 1894 (Olive).

BASIDIOMYCETES.

USTILAGINEÆ.

ENTYLOMA SANICULÆ Pk.

On Sanicula, Putnam, 5, 1893.

SCHIZONELLA MELANOGRAMMA (DC.) Schrt.

On Carex. sp., Fulton, 5, 1894.

UROCYSTIS CEPULÆ Frost.

On onions in market, Putnam, 12, 1893.

UREDINEÆ.

ÆCIDIUM COMPOSITARUM Mart.

On Eupatorium perfoliatum, Montgomery, 1894 (Olive).

On Lactuca Canadensis, Montgomery, 1894 (Olive).

ÆCIDIUM ERIGERONATUM Schw.

On Erigeron annuus, Montgomery, 6, 1894 (Olive).

ÆCIDIUM NAPÆÆ Arth. and Holw.

On Napaea dioica, Tippecanoe, 6, 1889 (Arthur).

ÆCIDIUM THALICTRI-FLAVI (DC).

On Anemonella thalictroides, Montgomery, 1894 (Olive).

PUCCINIA FUSCA (Relh.), Wint.

On Anemone nemorosa, Fulton, 5, 1894

PUCCINIA OBTECTA Pk.

On Scirpus sp., Marshall, 10, 1893.

On Scirpus lacustris, Montgomery, 9, 1893, (Olive).

PUCCINIA PHYSOSTEGIÆ Pk. and Clinton.

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*CYLINDROSPORIUM OFFICINALE E. & E.

On leaves of *Saponaria officinalis*. *Crawfordsville*, Ind., May, 1894 (E. W. Olive). Spots numerous. Small (1-$1\frac{1}{2}$ mm.), dark brown, with a purplish shaded border, sometimes confluent. Acervuli epiphyllous, numerous, subcircinate. Sporules filiform, slightly curved, continuous, 30—40x$1\frac{1}{4}$—$1\frac{1}{2}$ μ, issuing in white cirrhi.

Septoria Saponariæ is on subindefinite, yellowish spots, and has true perithecia with sporules 40—50x$3\frac{1}{2}$—$4\frac{1}{2}$ μ, and is a very different thing from this.

Cylindrosporium Saponariæ, Roum., is on large, grayish green spots, and has conidia 10—40x3—5 μ.

On Physostegia Virginiana, Marshall. 10, 1893.

Uromyces rudbeckii Arth. and Holw.

On Rudbeckia laciniata. Montgomery, 1894 (Olive).

Tremellineæ.

Guepinia elegans B. and C. Putnam, 12, 1894; Marion, 1, 1895 (Boatright).

HYMENOMYCETES.

Thelephoreæ.

Corticium ochroleucum spumeum B. and Rav. Putnam, 10, 1893.

Exobasidium vaccinii (Fckl.) Woron.

On Vaccinium sp., Brown, 5, 1893.

Hymenochæte cinerascens S. Putnam, 12, 1891.

Hymenochæte rubiginosa Schrad. Putnam, 10, 1891; 4, 1892; 10, 1893.

Stereum subpileatum B. and C. Montgomery, 4, 1892.

Hydnei.

Grandinia tuberculata B. and C. Putnam, 10, 1893.

Hydnum membranaceum Bull. Putnam, 11, 1894 (R. Norton).

Radulum orbiculare Fr. Putnam 10, 1893.

Polyporineæ.

Polyporus biformis Fr. Putnam, 10, 1892.

Polyporus brumalis Fr. Putnam, 12, 1894.

Polyporus chioneus Fr. Putnam, 10, 1893.

Polyporus cinereus S. Vigo, 10, 1893.

Polyporus epileucus Fr. Putnam, 7, 1894.

Polyporus ferruginosus Schrad. Vigo, 10, 1893.

Polyporus galactinus Berk. Putnam, 10, 1894.

Polyporus lucidus Fr. Putnam, 10, 1894; Vigo, 9, 1894 (Blatchley); Greene, 8, 1894 (Myrtle Hays).

Polyporus nidulans Fr. Putnam, 10, 1891; 10, 1893.

Polyporus purpureus Fr. Putnam, 10, 1893.

Polyporus reniformis Morgan. Putnam, 4, 1895.

Polyporus salicinus Fr. Putnam, 12, 1891; 12, 1894.

Polyporus salmonicolor B. and C. Putnam 12, 1894.

Polyporus subacidus Pk. Putnam, 4, 1893.

POLYPORUS SUPINUS Fr. Vermillion, 4, 1893 (Arthur).

POLYPORUS RAPORARIUS Pers. Putnam, 12, 1894.

POLYPORUS VULGARIS Fr. Putnam, 10, 1892; 4, 1893.

TRAMETES SEPIUM Berk. Putnam, 10, 1891; 10, 1893.

AGARICINEÆ.

CLAUDOPUS NIDULANS Pers. Putnam, 12, 1894.

CREPIDOTUS ILLFRENS Pk. Putnam, 6, 1893.

LEPIOTA FRIESII Lasch. Putnam, 10, 1893.

LEPIOTA RUBROTINCTA Pk. Putnam, 10, 1893.

PLEUROTUS APPLICATUS Batsch. Putnam, 12, 1891.

PLEUROTUS SAPIDUS Kalchbr. Putnam, 11, 1894

STROPHARIA STERCORARIA Fr. Putnam, 10, 1891.

LENTINUS TIGRINUS Bull. Vigo, 10, 1893.

LENTINUS VULPINUS Fr. Putnam, 12, 1894.

GASTROMYCETES.

LYCOPERDACEÆ.

GEASTER MINIMUS S. Monroe, 12, 1894 (R. Norton).

LYCOPERDON CURTISII Berk. Tippecanoe, 10, 1894 (Arthur).

LYCOPERDON ECHINATUM P. Vermillion, 8, 1889 (Arthur).

BRYOPHYTA.

RICCIACEÆ.

RICCIOCARPUS NATANS (L.) Corda. Montgomery, 3, 1895 (Olive).

MARCHANTIACEÆ.

LUNULARIA CRUCIATA (L.) Dumort. In green houses. Tippecanoe, 3, 1895.

APPENDIX B.

ADDITIONAL LIST OF HOST PLANTS OF FUNGI, 1894.

CACALIA RENIFORMIS (Septoria cacaliae). Montgomery, 1894 (Olive).

CARDAMINE RHOMBOIDEA (Albugo candidas). Montgomery, 1894 (Olive).

CRATAEGUS CRUS-GALLI (Roestelia lacerata). Montgomery, 1894 (Olive).

HELIANTHUS STRUMOSUS (Erysiphe cichoracearum). Montgomery, 1894 (Olive

LACTUCA SCARIOLA (Septoria lactucae). Montgomery, 1894 (Olive).

POLYGONUM HYDROPIPEROIDES (Septoria polygonorum). Montgomery, 1894 (Olive).

POLYGONUM MUHLENBERGII (Septoria polygonorum). Montgomery, 1894 (Olive).

RIBES FLORIDUM (Æcidium grossulariæ). Montgomery, 1894 (Olive).

SOLIDAGO ARGUTA (Æcidium asterum). Montgomery, 1894 (Olive).

TRIODIA CUPREA (Puccinia emaculata). Montgomery, 1894 (Olive).

VITIS RIPARIA (Uncinula necator). Montgomery, 1894 (Olive).

APPENDIX C.

NOTES ON THE SPECIES REPORTED PREVIOUSLY.

1. MUTINUS CANINUS (p. 63). The species reported under this name is *M. Ravenelii* B. & C. according to Mr. Morgan.
2. PUCCINIA INDUSIATA Dietel & Holway *ined* (p. 54). This species has since been described under the name of *P. nigrovelata* Ellis & Tracy (Bull. Torr. Bot. Club, 22:60, F. 1895), which latter name being the first published will have priority. This is one of the species distributed.
3. DOTHIDELLA ULMI (p. 42) should be *Dothidella ulmea* (Schw.) E. & E.
4. RHYTISMA PRINI (p. 33) is *R. Ilicis-Canadensis* S., according to Mr. Ellis. This is correctly named in the distribution.
5. The EXOASCUS (p. 34) reported on *Ostrya Virginica* is *Taphrina Virginica* Sadebeck & Seymour, according to Prof. Atkinson.

APPENDIX D.

LIST OF PARASITIC FUNGI DISTRIBUTED BY THE INDIANA BIOLOGICAL SURVEY. DECEMBER, 1894. SERIES 1. No. 1–100.

1. *Ustilago anomala* J. Kuntze.
2. *Ustilago avenæ* (P.) Jensen.
3. *Ustilago panici-glauci* (Wallr.) W.
4. *Ustilago tritici* (P.) Jensen.
5. *Ustilago Rabenhorstiana* Kuehn.
6. *Ustilago syntherismæ* (S.) Pk.
7. *Ustilago zeæ-mays* (DC.) Wint.
8. *Entyloma physalidis* (K. and C.) Wint.
9. *Tilletia striæformis* (Westd.) Wint.
10. *Schizonella melanogramma* (DC.) Schrt.
11. *Puccinia menthæ* P.

12. *Puccinia obtecta* Pk.
13. *Puccinia physostegiæ* P. and C.
14. *Puccinia graminis* P.
15. *Puccinia podophylli* S.
16. *Puccinia xanthii* S.
17. *Puccinia galii* (P.) Wint.
18. *Puccinia violæ* (Schum.) DC.
19. *Puccinia interstitialis* (Scht.) Tranzs.
20. *Puccinia lobeliæ* Ger.
21. *Puccinia convolvuli* (P.) Cast.
22. *Puccinia caricis* (Schum.) Reb.
23. *Puccinia maydis* Carr.
24. *Puccinia tanaceti* DC.
25. *Puccinia Dayi* Clinton.
26. *Puccinia polygoni-amphibii* P.
27. *Puccinia indusiata* Diet. and Hol.
28. *Puccinia circeæ* P.
29. *Puccinia emaculata* S.
30. *Puccinia vernoniæ* S.
31. *Puccinia luteripes* B. and Rav.
32. *Puccinia angustata* Pk.
33. *Puccinia andropogi* S.
34. *Uromyces terebinthi* (DC.) Wint.
35. *Uromyces hedysari-paniculati* (S) Farl.
36. *Uromyces Howei* Pk.
37. *Uromyces junci* Tul.
38. *Uromyces trifolii* (A. and S.) Wint.
39. *Uromyces lespedezæ* (S.) Pk.
40. *Uromyces appendiculata* (P.) Lev.
41. *Uromyces polygoni* (P.) Fckl.
42. *Uromyces hyperici* (S.) Curt.
43. *Uromyces euphorbiæ* C. and P.
44. *Uropyxis amorphæ* (Curt.) Schrt.
45. *Gymnosporangium globosum* Farl.
46. *Gymnosporangium macropus* Link.
47. *Phragmidium fragariæ* (DC.) Rossm.
48. *Phragmidium subcorticium* (Schr.) Wint.
49. *Melampsora salicina* Lev.
50. *Melampsora populina* (Jacq.) Lev.
51. *Cæoma agrimoniæ* S.
52. *Uredo iridis* DC.
53. *Uredo polypodii* (P.) DC.
54. *Coleosporium sonchi-arvensis* (P.) Lev.
55. *Æcidium ranunculi* S.
56. *Æcidium sambuci* S.
57. *Æcidium pustulatum* Curt.
58. *Æcidium grossulariæ* DC.
59. *Æcidium euphorbiæ* S.
60. *Rœstelia lacerata* (Sow.) Fr.
61. *Uncinula parvula* C. & P.
62. *Uncinula salicis* (DC.) Wint.
63. *Uncinula geniculata* Ger.
64. *Uncinula macrospora* Pk.
65. *Uncinula circinata* C. & P.
66. *Uncinula necator* (S.) Burr.
67. *Uncinula flexuosa* Pk.
68. *Uncinula Clintonii* Pk.
69. *Sphærotheca castagnei* Lev.
70. *Sphærotheca phytoptophila* K. & S.
71. *Sphærotheca humuli* (DC.) Burr.
72. *Erysiphe galeopsidis* DC.
73. *Erysiphe communis* (Wallr.) Fr.
74. *Erysiphe liriodendri* S.
75. *Podosphæra biuncinata* C. & P.
76. *Podosphæra oxyacanthæ* (DC.) By.
77. *Microsphæra grossulariæ* (Wallr.) Lev.
78. *Microsphæra erineophila* Pk.
79. *Microsphæra Ravenelii* Berk.
80. *Microsphæra symphoricarpi* Howe.

81. *Microsphaera Russellii* Clinton.
82. *Microsphaera quercina* (S.) Burr.
83. *Microsphaera elevata* Burr.
84. *Microsphaera semitosta* B. & C.
85. *Microsphaera alni* (DC.) Wint.
86. *Phyllactinia suffulta* (Reb.) Sacc.
87. *Leptostroma hypophyllum* B. & Rav.
88. *Rhytisma andromedæ* (P.) Fr.
89. *Rhytisma ilicis-Canadensis* S.
90. *Rhytisma acerinum* (P.) Fr.
91. *Cercospora effusa* (B. & C.) E. & E.
92. *Cercospora polygonorum* Cke.
93. *Septoria cacaliæ* E. & K.
94. *Septoria scrophulariæ* Pk.
95. *Septoria piricola* Desm.
96. *Phyllosticta asiminæ* E. & K.
97. *Phyllosticta paviæ* Desm.
98. *Albugo candidus* (P.) Kuntze.
99. *Albugo amaranti* (S.) Kuntze.
100. *Plasmopara geranii* (Pk.) B. & DeT.

GREENCASTLE, IND., December 25, 1894.

FLORA OF HAMILTON AND MARION COUNTIES, INDIANA.

BY GUY WILSON.

This list is only preliminary, several of the families, notably Gramineæ and Cyperaceæ, being very incomplete.

The Salicaceæ have not been very satisfactorily studied.

Plants which are not represented in my Herbarium but can be collected are marked thus: ½.

If doubtful if they can be collected, thus: *

All Fungi, Musci, Hepaticæ and Lichenes were collected in Hamilton County. Other names followed by Hamilton County or Marion County were found only in that county. Otherwise they are common to both counties.

GREENCASTLE, IND., May 23, 1895.

LICHENES.

Parmelia caperata (L.) Ach. Common.

saxatilis (L.) Fr. Rock. Common.

Ramalina calicaria (L.) Timber. Common.

Sticta amplissima (Scop.) Mass. Timber. Common.

pulmonaria (L.) Ach. Timber. Common.

Usnea barbata (L.) Fr. Timber. Common.

Fungi.

Claviceps purpurea (Fr.) Tul. On Rye. Common.

Xylaria polymorpha (Pers.) Grev. Rare.

Phyllachora graminis (Pers.) Fckl. On Cinna arundinacea. Common.

Ustilago Zea-mays (D. C.) Wint. On Zea mays. Common.

Puccinia indusita Deitl & Holway. On Cyperus strigosus. Common.

interstitialis (Schl.) Tranzschel. On all sp. of Rubus. Very common.

Dædalea confragosa Bolt. Rare.

Lenzites betulina (L.) Fr. Common.

Polyporus sulphureus (Bull.) Fr. Common.

applanatus Willd. Common.

Trametes cinnabarina (Jacq.) Fr. Common.

Hepaticæ.

Riccia fluitans L. Ponds. Rare.

Conocephalus conicus (L.) Durmort. Rare.

Marchantia polymorpha L. Rare.

Musci.

Anomodon rostratus (Hedw. Schrimp. Common.

Climacium Americanum Brid. Rare.

Drummondia clavellata Hook. Common.

Funaria hygrometrica (L.) Sibth. Common.

Hypnum cupressiforme L. Common.

serpens L. Common.

Mnium cuspidatum Hedw. Rare.

Physcomitrum turbinatum (Michx.) Brid. Common.

Polytrichium Ohioense Ren. and Cardot. Common.

Tetraphis pellucida Hedw. Common.

Ophioglossaceæ.

Botrychium ternatum Sw. Rare. Hamilton County.

Virginianum (L.) Sw. Rare. Hamilton County.

Filices.

Adiantum pedatum L. Common.

Pteris aquilina L. Very rare. Hamilton County.

Asplenium acrostichoides Sw. Common. Hamilton County.

angustifolium Michx. Common. Hamilton County.

Phegopteris hexagonoptera (Michx.) Fee. Common.

Dryopteris acrostichoides (Michx.) Kuntze. Common.

spinulosa intermedia (Muhl.) Underw. Common. Hamilton County.

Thelypteris (L.) A. Gray. Very common. Hamilton County.

Cystopteris bulbifera (L.) Bernh. Very rare. Marion County.

fragilis (L.) Bernh. Very common. H.

Onoclea sensibilis L. Very common.

Osmunda regalis L. Very rare. Hamilton County.

All plants of this and the preceding order are known as ferns.

EQUISETACEÆ.

Equisetum arvense L. Very common.

hyemale L. Common. Hamilton County.

CONIFERÆ.

Thuja occidentalis S. Very rare. Hamilton County.

Juniperus Virginiana L. Common.

TYPHACEÆ.

Typha latifolia L. Common.

SPARGANIACEÆ.

Sparganium eurycarpum Engelm. in A. Gray. Common. Hamilton Coınty.

ALISMACEÆ.

Alisma Plantago-aquatica L. Common.

Sagittaria latifolia Willd. Common.

latifolia pubescens (Muhl.) J. G. Smith. Common.

GRAMINEÆ.

Panicum capillare L. Common.

Crus-galli L. Common.

sanguinale L. Very common.

Chamæraphis glauca (L.) Kuntze. Very common.

viridis (L.) Porter. Common.

Phleum pratense L. Very common.

Alopecurus geniculatus fulvus (J. E. Smith) Scribn. Rare. Hamilton County.

Cinna arundinacea L. Common.

‡ *Agrostis alba vulgaris* (With.) Thurb. Rare.

Eragrostis Eragrostis (L.) Karst. Common.

Major Host.) Common.

Frankii (Steud. Common. Hamilton County.

Dactylis glomerata L. Common.

Poa Pratensis L. Very common.

Bromus secalinus L. Very common.

Hystrix Hystrix (L.) Millsp. Common.

Cyperaceæ.

Cyperus strigosus L. Common.

Eleocharis ovata (Roth.) Roem. and Schult. Common. Hamilton County.

Scirpus Americanus Pers. Rare. Hamilton County.

atrovirens Muhl. Common.

cyperinus (L.) Kunth. Common.

lacustris L. Common.

Carex platyphylla Carey. Common.

Araceæ.

‡ *Acorus Calamus* L. Rare.

Spathyema fœtida (L.) Raf. Common.

Arisæma Dracontium (L.) Schott. Common. Hamilton County.

tryphyllum (L.) Torr. Common.

Commelinaceæ.

Tradescantia Virginiana L.) Common.

Juncaceæ.

Juncus tenuis Willd. Very common.

Liliaceæ.

Veratrum Woodii Robbins. Very rare. Hamilton County.

Uvularia grandiflora J. E. Smith. Common.

‡ *Allium Canadense* L. Common. Hamilton County.

‡ *tricoccum* Ait. Rare. Hamilton County.

Lilium Philadelphicum L. Very rare. Hamilton County.

Erythronium albidum Nutt. Rare.

Americanum Ker. Common.

Camassia Fraseri (A. Gray) Torr. Common. Hamilton County.

‡ *Asparagus officinalis* L. Not common.

Vagnera racemosa (L.) Morong. Common.

stellata (L.) Morong. Very rare. Hamilton County.

Polygonatum biflorum (Walt.) Ell. Very common.

biflorum commutatum (R. & S.) Morong. Very common.

Trillium erectum L. Common. Hamilton County.

recurvatum Beck. Very common.

SMILACEÆ.

Smilax herbacea L. Common.

rotundifolia L. Very common.

DISCOREACEÆ.

Dioscorea villosa L. Common.

IRIDACEÆ.

Iris versicolor L. Common.

Sisyrinchium Bermudiana L. Common. Hamilton County.

ORCHIDACEÆ.

Cypripedium hirsutum Mill. Very rare. Hamilton County.

regina Walt. Very rare. Hamilton County.

Orchis spectabilis L. Very rare. Hamilton County.

Pogonia trianthophora (Sw.) B. S. P. Very rare. Hamilton County.

‡ *Aplectrum spicatum* (Walt.) B. S. P. Rare. Hamilton County.

SAURURACEÆ.

Saururus cernuus L. Common.

JUGLANDACEÆ.

Juglans cinerea L. Common.

nigra L. Common.

Hicoria alba (L.) Britton. Common.

glabra (Mill.) Britton. Rare.

microcarpa (Nutt.) Britton. Common.

minima (Marsh.) Britton. Common.

ovata (Mill.) Britton. Common.

Pecan (Marsh.) Britton. Very rare. Hamilton County.

Salicaceæ.

⚲ *Populus alba* L. Beginning to escape from cultivation.

monilifera Ait. Common.

tremuloides Michx. Common.

Salix nigra Marsh.? Specimen so named in J. E. McMullan's collection of Woods from Hamilton County.

discolor Muhl.? Common. Hamilton County.

discolor eriocephala (Michx.) Anders.? Rare. Hamilton County.

fragilis L.? Common.

humilis Marsh.? Common. Hamilton County.

lucida Muhl.? Rare. Hamilton County.

purpurea L.? Very rare. Hamilton County.

rostrata Richards.? Common. Hamilton County.

sericea Marsh.? Common. Hamilton County.

Betulaceæ.

Carpinus Caroliniana Walt. Common.

Ostrya Virginiana (Muhl.) Willd. Common.

Corylus Americana Walt. Common.

Fagaceæ.

Fagus atropunicea (Marsh.) Sudw. Common.

Quercus alba L. Common.

macrocarpa Michx.

macrocarpa oliva formis (Michx. f.) A. Gray. Very rare. Hamilton County.

Muhlenbergii Engelm. Common.

minor (Marsh.) Sarg. Rare. Hamilton County.

⚲ *Prinus* L. Very rare. Hamilton County.

rubra L. Common.

Ulmaceæ.

Ulmus Americana L. Common.

pubescens Walt. Common.

racemosa Thomas. Rare.? Hamilton County.

Celtis occidentalis L. Common.

Moraceae.

Morus rubra L. Common.
? *Toxylon pomiferum* Raf. Very rare. Hamilton County.
Humulus Lupulus L. Common. Hamilton County.
Cannabis sativa L. Common.

Urticaceae.

Urtica gracilis Ait. Very Common.
Urticastrum divaricatum (L.) Kuntze. Very common.
Adicea pumila (L.) Raf. Common. Hamilton County.
Bœhmeria cylindrica (L.) Willd. Common. Hamilton County.

Aristolochiaceae.

Asarum Canadense L. Very common.

Polygonaceae.

Rumex Acetosella L. Common.
    crispus L. Common.
    sanguineus L. Common.
    verticillatus L. Common.
Polygonum dumetorum L. Very common.
    emersum (Michx.) Britton. Very rare. Hamilton Co.
    Hydropiper L. Common.
    hydropiperoides Michx. Common.
    incarnatum Ell. Common.
    orientale L. Very rare. Hamilton County.
    punctatum Ell. Common.
    sagittatum L. Common.
    aviculare L. Common.
    erectum L. Common.
Fagopyrum Fagopyrum (L.) Gaertn. Scarce.

Chenopodiaceae.

Chenopodium album L. Very common.
    Botrys L. Rare.

AMARANTHACEAE.

Amaranthus blitoides S. Wats. Common.
hybridus L. Common.
retroflexus L. Common.
spinosus L. Rare.

PHYTOLACCACEAE.

Phytolacca decandra L. Common.

AIZOACEAE.

Mollugo verticillata L. Very common.

PORTULACACEAE.

Claytonia Virginica Michx. Common.
Portulaca oleracea L. Very common.

CARYOPHYLLACEAE.

? *Agrostemma Githago* L. Very common.
Silene alba Muhl. Rare.
? *antirrhina* L. Common.
stellata (L.) Ait. f. Common.
regia Sims. Very rare. Hamilton County.
Virginica L. Common.
Saponaria officinalis L. Common.
Alsine longifolia (Muhl.) Britton. Rare. Hamilton County.
media L. Common.
pubera (Michx.) Britton. Common.
Cerastium longipedunculatum Muhl. Common.
vulgatum L. Common.

NYMPHAEACEAE.

Nymphaea advena Soland. Rare. Hamilton County.

MAGNOLIACEAE.

Liriodendron Tulipifera L. Common.

ANONACEAE.

Asimina triloba (L.) Dunal. Common.

Ranunculaceæ.

Hydastris Canadensis L. Very rare. Hamilton County.
Caltha palustris L. Common. Hamilton County.
Isopyrum biternatum (Raf.) T. and G. Common.
Actæa alba (L.) Mill. Common.
Delphinium tricorne Michx. Rare. Hamilton County.
Anemone Canadensis L. Common. Hamilton County.
Hepatica acuta (Pursh.) Britton. Very common.
Syndesmon thalictrioides (L.) Hoffmg. Very common.
Clematis Viorna L. Rare. Hamilton County.
Virginiana L. Common.
Ranunculus abortivus L. Very common.
delphinifolius Torr. Rare. Hamilton County.
recurvatus Poir. in Lam. Common.
septentrionalis Poir. Common.
? *Batrachium divaricatum* (Schrank) Wimm. Common. Hamilton County.
Thalictrum dioicum L. Rare. Hamilton County.
polygamum Muhl. Common.

Berberidaceæ.

Podophyllum peltatum L. Very common.
Caulophyllum thalictroides (L.) Michx. Rare. Hamilton County.

Menispermaceæ.

Menispermum Canadense L. Common.

Lauraceæ.

Sassafras Sassafras (L.) Karst. Common.
Benzoin Benzoin (L.) Coulter. Common.

Papaveraceæ.

Sanguinaria Canadensis L. Common.
Stylophorum diphyllum (Michx.) Nutt. Common.
Bicuculla Canadensis (Goldie) Millsp. Common.
Cucullaria (L.) Millsp. Common.

CRUCIFERAE.

Lepidium Virginicum L. Very common.
Sisymbrium officinale (L.) Scop. Very common.
Sinapis alba L. Rare. Hamilton County.
Brassica nigra (L.) Koch. Very common.
Sinapistrum Boiss. Common. ?
Barbarea Barbarea (L.) MacM. Common. Hamilton County.
Iodanthus pinnatifidus (Michx.) Prantl. Common. Hamilton County.
½ *Roripa Armoracia* (L.) A. S. Hitchcock. Common.
Nasturtium (L.) Rusby. Rare.
palustris (L.) Bess. Common.
Cardamine bulbosa (Schreb.) B. S. P. Common.
Douglassii (Torr.) Britton. Common.
hirsuta L. Common. Hamilton County.
Dentaria laciniata Muhl. Common.
½ *Bursa Bursa-Pastoris* (L.) Weber. Very common.
Arabis dentata T. & G. Rare. Hamilton County.
laevigata (Muhl.) Poir. Common. Hamilton County.

CRASSULACEAE.

Sedum Telephium L. Escaped from cultivation. Rare. Hamilton County.
ternatum Michx. Common.
Penthorum sedoides L. Common. Hamilton County.

SAXIFRAGACEAE.

Saxifraga Pennsylvanica L. Common. Hamilton County.
Mitella diphylla L. Common.
Hydrangea arborescens L. Common.
Ribes Cynosbati L. Common.
floridum L. Her. Common.

PLATANACEAE.

Platanus occidentalis L. Common.

Rosaceæ.

Opulaster opulifolius (L.) Kuntze. Rare.
Pyrus coronaria L. Common.
Malus L. Common.
* *Amelanchier Canadensis* (L.) Medic. ? Very rare. Hamilton County.
Crataegus coccinea L. Common.
molis (T. and G.) Scheele. Rare. Hamilton County.
punctata Jacq. Common.
tomentosa L. Specimen so named in J. E. McMullan's collection of woods from Hamilton County.
‡ *Rubus Baileyanus* Britton. Common.
* *Canadensis* L. Rare.
occidentalis L. Common.
‡ *villosus* Ait. Common.
Fragaria vesca L. Common.
Potentilla Canadensis L. Common.
‡ *Geum Canadense* Jacq. Common.
radiatum Michx. Common.
vernum (Raf.) T. and G. Common.
Ulmaria rubra Hill. Very rare. Marion County.
Agrimonia parviflora Soland. Common.
striata Michx. Common.
Rosa Carolina L. Common.
‡ *lucida* Ehrh. Common.
rubiginosa L. Not common. Hamilton County.
Prunus Americana Marsh. Common.
serotina Ehrh. Common.

Leguminosæ.

Cercis Canadensis L. Common.
Cassia Chamaecrista L. Rare.
Marylandica L. Common.
Gleditschia triacanthos L. Common.
‡ *Gymnocladus dioicus* (L.) Koch. Common.
‡ *Melilotus alba* Lam. Common.
Trifolium hybridum L. Rare. Hamilton County.
pratense L. Very common.
repens L. Very common.

Meibomia canescens (L.) Kuntze. Common.
Dillenii (Darl.) Kuntze. Common.
grandiflora (Walt.) Kuntze. Very common.
Lathyrus palustris L. Very rare. Hamilton County.
Apios Apios (L.) MacM. Rare. Hamilton County.
Phaseolus helvolus L. Rare. Hamilton County.
polystachyus (L.) B. S. P. Common.

GERANACEÆ.

Geranium maculatum L. Common.

OXALIDACEÆ.

Oxalis stricta L. Common.

RUTACEÆ.

Zanthoxylum Americanum Mill. Common.
Ptelea trifoliata L. Common. Hamilton County.

SIMARUBACEÆ.

Alianthus glandulosa Desf. Very rare. Marion County.

EUPHORBIACEÆ.

Euphorbia corollata L. Rare. Hamilton County.
Cyparissias L. Common.

LIMNANTHACEÆ.

Flœrkea proserpinacoides Willd. Common. Hamilton County.
maculata L. Common.
marginata Pursh. Escaped to streets of Noblesville and Carmel. Rare.
nutans Lag. Common.
Acalypha Virginica L. Common.

ANACARDIACEÆ.

Rhus glabra L. Common.
radicans L. Common.
Vernix L. Common. Hamilton County.

AQUIFOLIACEÆ.

Ilex verticillata (L.) A. Gray. Common. Hamilton County.

Celastraceæ.

½ *Euonymus atropurpureus* Jacq. Common.

obovatus Nutt. Common.

Celastrus scandens L. Common.

Staphyleaceæ.

Staphylea trifolia L. Common.

Aceraceæ.

Acer Negundo L. Common.

½ *nigrum* Michx. f. Common.

rubrum L. Common.

saccharinum L. Common.

Saccharum Marsh. Common.

Hippocastanaceæ.

Æsculus glabra Willd. Common.

Balsaminaceæ.

Impatiens aurea Muhl. Common.

biflora Walt. Common.

Vitaceæ.

½ *Vitis cordifolia* Michx. Common.

½ *Labrusca* L. Common.

½ *vulpina* L. Common.

½ *Parthenocissus quinquefolia* (L.) Planch in D. C. Common.

Tiliaceæ.

Tilia Americana L. Common.

Malvaceæ.

Abutilon Abutilon (L.) Rusby. Very common.

Althæa-rosea Cav. Escaped from cultivation in some places.

Malva rotundifolia L. Very common.

Sida spinosa L. Very common.

½ *Hibiscus Trionum* L. Rare.

Hypericaceæ.

Hypericum ellipticum Hook. Common.

mutilum L. Common. Hamilton County.

VIOLACEÆ.

Viola obliqua Hill. Very common.

obliqua alba (Y. and N.). Very rare. Hamilton County.

½ *palmata* L. Common.

pubescens Ait. Common.

striata Ait.

Solea concolor (Forst.) Gingins. Very rare. Hamilton County.

THYMELEACEÆ.

* *Dirca palustris* L. Said to occur in the northern part of Hamilton County.

LYTHRACEÆ.

Lythrum alatum Pursh. Very rare. Hamilton County.

Decodon verticillatus (L.) Ell. Very rare. Hamilton County.

ONAGRACEÆ.

Epilobium palustre L. Common.

Onagra biennis (L.) Scop. Very common.

Gaura biennis L. Common.

Michauxii Spach. Common.

Circæa Lutetiana L. Rare. Petals sometimes red.

ARALIACEÆ.

Aralia racemosa L. Rare. Hamilton County.

* *Panax quinquefolium* L. Very rare. Hamilton County.

UMBELLIFERÆ.

Daucus Carota L. Very common.

Oxypolis rigidus (L.) Britton. Very common.

Heracleum lanatum Michx. Common. Hamilton County.

Pastinaca sativa L. Very common.

Thaspium trifoliatum (L.) Britton. Common.

trifoliatum aureum (Nutt.) Britton. Common. Hamilton County.

Sanicula Canadensis L. Common. Hamilton County.

Chærophyllum procumbens (L.) Crantz. Common. Hamilton County.

Osmorrhiza longistylis (Torr.) D. C. Common. Hamilton County.

Sium cicutæfolium J. F. Gmel. Common. Hamilton County.

Erigenia bulbosa (Michx.) Nutt. Common.

Cornaceæ.

Cornus alternifolia L. Common. Hamilton County.
‡ *candidissima* Marsh. Common.
circinata L. Her. Common.
florida L. Common.
* *stolonifera* Michx. Rare. Hamilton County.
Nyssa aquatica L. Rare.

Monotropaceæ.

Monotropa uniflora L. Rare. Hamilton County.
Hypopitys Hypopitys (L.) Small. Very rare. Hamilton County.

Primulaceæ.

Samolus floribundus H. B. K. Common. Hamilton County.
Steironema ciliatum (L.) Bando. Common. Hamilton County.
Naumburgia thyrsiflora (L.) Duby. Rare. Hamilton County.

Oleaceæ

Fraxinus Americana L. Common.
‡ *nigra* Marsh. Common.
‡ *quadrangulata* Michx. Common.

Gentianaceæ.

Gentiana Andrewsii Griseb. Rare. Hamilton County. ?

Apocynaceæ.

Vinca minor L. Becoming common.
Apocynum androsæmifolium L. Rare. Hamilton County.
‡ *cannabinum* L. Common.

Asclepidaceæ.

Asclepias exalta (L.) Muhl. Rare. Hamilton County.
incarnata L. Common.
‡ *Syriaca* L. Very common.
tuberosa L. Rare. Hamilton County.

Convolvulaceæ.

Ipomœa hederacea Jacq. Rare. Hamilton County.
lacunosa L. Common.
purpurea (L.) Roth. Very common.
Convolvulus repens L. Common.
Sepium L. Common.

Cuscutaceæ.

Cuscuta glomerata Choisy. Common.

Polemoniaceæ.

Phlox divaricata L. Very common.
maculata L. Rare. Hamilton County.
paniculata L. Common.
Polemonium reptans L. Common.

Hydrophyllaceæ.

Hydrophyllum appendiculatum Michx. Common.
macrophyllum Nutt. Common.
Phacelia bipinnatifida Michx. Common.
Purshii Buckl. Very rare. Hamilton County.

Boraginaceæ.

Cynoglossum officinale L. Common.
Lappula Lappula (L.) Karst. Very common.
Mertensia Virginica (L.) D. C. Rare. Hamilton County.
Lithospermum arvense L. Common.
Onosmodium Carolinianum (Lam.) A. D. C. Very rare. Hamilton County.

Verbenaceæ.

Verbena stricta Vent. Common.
urticæfolia L. Common.
Lippia lanceolata Michx. Common.
Phryma Leptostachya L. Common.

Labiatæ.

Collinsonia Canadensis L. Common.

Perilla frutescens Nankinensis (Lour.) Britton. Escaped from cultivation.

Mentha piperita L. Common.

Lycopus Europæus L. Common. Hamilton County.

Virginicus L. Common. Hamilton County.

Kœllia pilosa (Nutt.) Britton. Rare.

Virginiana (L.) Britton Rare. Hamilton County.

Hedeoma pulegioides (L.) Pers. Very common.

Monarda fistulosa L. Common.

Blephilia ciliata (L.) Raf.? Very rare. Hamilton County.

½ *Vleckia nepetoides* (L.) Raf. Common.

Nepeta Cataria L. Very common.

Glecoma hederacea L. Very common.

Scutellaria incana Muhl. Common.

lateriflora L. Common.

nervosa Pursh. Very rare. Marion County.

Prunella vulgaris L. Common.

Physostegia Virginiana (L.) Benth. Common.

Marrubium vulgare L. Rare.

Stachys aspera Michx. Common.

palustris L. Common.

Leonurus Cardiaca L. Very common.

Solanaceæ.

Physalodes physalodes (L.) Britton. Rare.

Physalis Philadelphica Lam. Common.

pubescens L. Common.

viscosa L. Common.

Solanum Carolinense L. Common.

nigrum L. Common.

rostratum Dunal. Very rare. Marion County.

Datura Stramonium L. Very common.

Tatula L. Very common.

SCROPHULARIACEÆ.

Verbascum Blattaria L. Rare. Hamilton County.
½ *Thapsus* L. Very common.
½ *Linaria Linaria* (L.) Karst. Common.
Collinsia verna Nutt. Rare. Hamilton County.
Scrophularia Marylandica L. Common.
Chelone glabra L. Common.
obliqua L. Very rare. Hamilton County.
Pentstemon Digitalis (Sweet.) Nutt. Common.
hirsutus (L.) Willd. Very rare. Hamilton County.
Mimulus alatus Soland in Ait. Common.
Gratiola Virginiana L. Common.
Veronica arvensis L. Very common.
officinalis L. Common. Hamilton County.
peregrina L. Very common.
serpyllifolia L. Very common.
Leptandra Virginica (L.) Nutt. Very rare. Hamilton County.
Afzelia macrophylla (Nutt.) Kuntze. Common. Hamilton County.
Gerardia Skinneriana Wood. Rare. Hamilton County.
Pedicularis lanceolata Michx. Very rare. Marion County.

OROBANCHACEÆ.

Conopholis Americana (L. f.) Wallr. Very rare. Hamilton County.
Epiphegus Virginiana (L.) Bart. Common.

BIGNONIACEÆ.

Tecoma radicans (L.) DC. Common.

ACANTHACEÆ.

Ruellia ciliosa Pursh. Common.
Dianthera Americana L. Very common.

PLANTAGINACEÆ.

Plantago lanceolata L. Rare.
major L. Very common.

RUBIACEÆ.

Houstonia purpurea L. Very rare. Marion County.
Cephalanthus occidentalis L. Common.
Gallium Aparine L. Common.
    asprellum Michx. Rare. Hamilton County.
    circæzans Michx. Common.
    trifidum L. Common.

CAPRIFOLIACEÆ.

Sambucus Canadensis L. Common.
Viburnum acerifolium L. Very rare. Hamilton County.
    prunifolium L. Common.
Triosteum perfoliatum L. Common. Hamilton County.

VALERIANACEÆ.

Valeriana pauciflora Michx. Common.
Valerianella chenopodiifolia (Pursh.) D C. Common.

DIPSACEÆ.

Dipsacus sylvestris Huds. Very common.

CUCURBITACEÆ.

Micrampelis lobata (Michx.) Greene. Common.
Sicyos angulatus L. Common.

CAMPANULACEÆ.

Campanula Americana L. Common.
Legouzia perfoliata (L.) Britton. Common.
Lobelia cardinalis L. Common.
    inflata L. Common.
    syphilitica L. Common.
    ? *puberula* Michx. Common.

Compositæ.

Vernonia fasciculata Michx. Very common.

Eupatorium ageratoides L. Common.

altissimum L. Very rare. Marion County.

Cœlestinum L. Common.

perfoliatum L. Common.

purpureum L. Common.

‡ *maculatum* L. Common.

Coleosanthus grandiflorus (Hook.) Kuntze. Very rare. Hamilton County.

‡ *Kuhnia eupatorioides.* Common.

Solidago cæsia L. Common.

flexicaulis L. Common.

Riddellii Frank. Very rare. Hamilton County.

rigida L. ? Common.

speciosa Nutt. ? Common.

Aster. Several species which are uncertain.

‡ *Erigeron annuus* (L.) Pers. Common.

Canadensis L. Very common.

ramosus (Walt.) B. S. P. Very common.

Antennaria margaritacea (L.) Hook. Common.

plantaginifolia (L.) Richards. Rare. Hamilton County.

Inula Helenium L. Common.

‡ *Silphium perfoliatum* L. Rare. Hamilton County.

terebinthaceum L. Rare. Hamilton County.

Ambrosia artemisiæfolia L. Very common.

trifida L. Very common.

trifida integrifolia (Muhl.) T. and G. Very rare. Hamilton County.

‡ *Xanthium Canadense* Mill. Very common.

strumarium L. Very common.

Rudbeckia hirta L. Very rare. Hamilton County.

laciniata L. Very rare. Hamilton County.

triloba L. Common.

Lepachys pinnata (Vent.) T. and G. Very rare. Hamilton County.

‡ *Helianthus annuus* L. Common.

strumosus L. Common.

tuberosus L. Common.

Coreopsis tripteris L. Common.

Bidens bipinnata L. Very common.

cernua L. Common.

connata (L.) Muhl. Very common.

frondosa L. Very common.

trichosperma (Michx.) Britton. Common.

Helenium autumnale L. Common.

Achillea Millefolium L. Common.

Anthemis Cotula L. Very common.

Chrysanthemum Leucanthemum L. Rare. Hamilton County.

½ *Tanacetum vulgare* L. Common.

Senecio aureus L. Common. Hamilton County.

Cacalia reniformis Muhl. Rare. Hamilton County.

Arctium Lappa L. Very common.

† *Carduus altissimus* L.? Not seen in flower. Common. Hamilton County.

arvensis (L.) Robs. Rare. Hamilton County.

lanceolatus L. Very common.

muticus (Michx.) Pers. Common.

Cichoriaceæ.

Adopogon Dandelion (L.) Kuntze. Very rare. Hamilton County.

Taraxacum Taraxacum (L.) Karst. Very common.

Lactuca Canadensis L. Very common.

Scariola L. Very common.

Sonchus asper (L.) All. Common

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