Proceedings of the

Indiana Academy of Science

1904

PROCEEDINGS

OF THE

Indiana Academy of Science

1904.

EDITOR, - - DONALDSON BODINE.

ASSOCIATE EDITORS:

AMOS BUTLER, W. S. BLATCHLEY,
C. H. EIGENMANN, P. N. EVANS,
LYNN B. MCMULLEN, THOMAS GRAY,
JOHN S. WRIGHT.

INDIANAPOLIS, IND.
1905.

INDIANAPOLIS:
WM. B. BURFORD, PRINTER.
1905.

THE STATE OF INDIANA,
EXECUTIVE DEPARTMENT,
February 15, 1905.

Received by the Governor, examined and referred to the Auditor of State for verification of the financial statement.

OFFICE OF AUDITOR OF STATE,
INDIANAPOLIS, February 15, 1905.

The within report, so far as the same relates to moneys drawn from the State Treasury, has been examined and found correct.

D. E. SHERRICK,
Auditor of State.

FEBRUARY 15, 1905.

Returned by the Auditor of State, with above certificate, and transmitted to Secretary of State for publication, upon the order of the Board of Commissioners of Public Printing and Binding.

UNION B. HUNT,
Private Secretary.

Filed in the office of the Secretary of State of the State of Indiana, February 15, 1905.

DANIEL E. STORMS,
Secretary of State.

Received the within report and delivered to the printer February 15, 1905.

THOS. J. CARTER,
Clerk Printing Bureau.

TABLE OF CONTENTS.

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

Number of printed Reports.

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.

Proviso.

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.

Disposition of Reports.

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.

AN ACT FOR THE PROTECTION OF BIRDS, THEIR NESTS AND EGGS.

[Approved March 5, 1891.]

SECTION 1. *Be it enacted by the General Assembly of the State of Indiana*, That it shall be unlawful for any person to kill any wild bird other than a game bird, or purchase, offer for sale any such wild bird after it has been killed, or to destroy the nests or the eggs of any wild bird.

Birds.

SEC. 2. For the purpose of this act the following shall be considered game birds: the Anatidæ, commonly called swans, geese, brant, and river and sea ducks; the Rallidæ, commonly known as rails, coots, mudhens, and gallinules; the Limicolæ, commonly known as shore birds, plovers, surf birds, snipe, woodcock and sandpipers, tattlers and curlews; the Gallinæ, commonly known as wild turkeys, grouse, prairie chickens, quail, and pheasants, all of which are not intended to be affected by this act.

Game Birds.

SEC. 3. Any person violating the provisions of Section 1 of this act shall, upon conviction, be fined in a sum not less than ten nor more than fifty dollars, to which may be added imprisonment for not less than five days nor more than thirty days.

Penalty.

SEC. 4. Sections 1 and 2 of this act shall not apply to any person holding a permit giving the right to take birds or their nests and eggs for scientific purposes, as provided in Section 5 of this act.

Permits.

SEC. 5. Permits may be granted by the Executive Board of the Indiana Academy of Science to any properly accredited person, permitting the holder thereof to collect birds, their nests or eggs for strictly scientific purposes. In order to obtain such permit the applicant for the same must present to said Board written testimonials from two well-known scientific men certifying to the good character and fitness of said applicant to be entrusted with such privilege, and pay to said Board one dollar to defray the necessary expenses attending the granting of such permit, and must file with said Board a properly executed bond in the sum of two hundred dollars, signed by at least two responsible citizens of the State as sureties. The bond shall be forfeited to the State and the permit become void upon proof that the holder of

Permits to Science.

Bond.

Bond forfeited.

such permit has killed any bird or taken the nests or eggs of any bird for any other purpose than that named in this section, and shall further be subject for each offense to the penalties provided in this act.

Two years.

SEC. 6. The permits authorized by this act shall be in force for two years only from the date of their issue, and shall not be transferable.

Birds of prey.

SEC. 7. The English or European House Sparrow (Passer domesticus), crows, hawks, and other birds of prey are not included among the birds protected by this act.

Acts repealed.

SEC. 8. All acts or parts of acts heretofore passed in conflict with the provisions of this act are hereby repealed.

Emergency.

SEC. 9. An emergency is declared to exist for the immediate taking effect of this act, therefore the same shall be in force and effect from and after its passage.

OFFICERS—1904–1905.

PRESIDENT,
JOHN S. WRIGHT.

VICE-PRESIDENT,
ROBERT HESSLER.

SECRETARY,
LYNN B. McMULLEN.

ASSISTANT SECRETARY,
J. H. RANSOM.

PRESS SECRETARY,
G. A. ABBOTT.

TREASURER,
WILLIAM A. McBETH.

EXECUTIVE COMMITTEE.

John S. Wright,
Robert Hessler,
Lynn B. McMullen,
J. H. Ransom,
G. A. Abbott,
William A. McBeth,
Carl L. Mees,
Willis S. Blatchley,
Harvey W. Wiley,
M. B. Thomas,
D. W. Dennis,
C. H. Eigenmann,
C. A. Waldo,
Thomas Gray,
Stanley Coulter,
Amos W. Butler,
W. A. Noyes,
J. C. Arthur,
J. L. Campbell,*
O. P. Hay,
T. C. Mendenhall,
John C. Branner,
J. P. D. John,
John M. Coulter,
David S. Jordan.

CURATORS.

BOTANY ..... J. C. Arthur.
ICHTHYOLOGY ..... C. H. Eigenmann.
HERPETOLOGY
MAMMALOGY } ..... Amos W. Butler.
ORNITHOLOGY
ENTOMOLOGY ..... W. S. Blatchley.

*Deceased.

COMMITTEES, 1904-1905.

PROGRAM.

Lynn B. McMullen, John S. Wright, A. L. Foley.

MEMBERSHIP.

J. H. Ransom, R. L. Lyons, W. A. McBeth.

NOMINATIONS.

J. C. Arthur, A. S. Hathaway, W. J. Moenkhaus.

AUDITING.

Thomas Gray, A. J. Bigney.

STATE LIBRARY.

John S. Wright, A. J. Bigney, O. L. Kelso.

LEGISLATION FOR THE RESTRICTION OF WEEDS.

M. B. Thomas, D. M. Mottier, C. C. Deam.

PROPAGATION AND PROTECTION OF GAME AND FISH.

C. H. Eigenmann, A. W. Butler, Glenn Culbertson.

EDITOR.

Donaldson Bodine, Wabash College, Crawfordsville.

DIRECTORS OF BIOLOGICAL SURVEY.

C. H. Eigenmann, Stanley Coulter, Charles R. Dryer, M. B. Thomas, J. C. Arthur.

RELATIONS OF THE ACADEMY TO THE STATE.

C. A. Waldo, William Watson Woollen, R. W. McBride, G. W. Benton.

GRANTING PERMITS FOR COLLECTING BIRDS AND FISHES.

A. W. Butler, D. W. Dennis, W. J. Moenkhaus.

DISTRIBUTION OF THE PROCEEDINGS.

Thomas Gray, L. J. Rettger, John S. Wright, Donaldson Bodine, H. L. Bruner.

OFFICERS OF THE INDIANA ACADEMY OF SCIENCE.

	President.	Secretary.	Asst. Secretary.	Press 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.
1895–6.....	Stanley Coulter...	John S. Wright...	A. J. Bigney.....	.....	W. P. Shannon.
1896–7.....	Thomas Gray.....	John S. Wright...	A. J. Bigney.....	.....	W. P. Shannon.
1897–8.....	C. A. Waldo.....	John S. Wright...	A. J. Bigney.....	Geo. W. Benton...	J. T. Scovell.
1898–9.....	C. H. Eigenmann.	John S. Wright...	E. A. Schultze.....	Geo. W. Benton...	J. T. Scovell.
1899–1900..	D. W. Dennis.....	John S. Wright...	E. A. Schultze.....	Geo. W. Benton...	J. T. Scovell.
1900–1901..	M. B. Thomas....	John S. Wright...	E. A. Schultze.....	Geo. W. Benton...	J. T. Scovell.
1901–1902..	Harvey W. Wiley	John S. Wright...	Donaldson Bodine.....	Geo. W. Benton...	J. T. Scovell.
1902–1903..	W. S. Blatchley..	John S. Wright...	Donaldson Bodine.....	G. A. Abbott.....	W. A. McBeth.
1903–1904..	C. L. Mees.....	John S. Wright...	J. H. Ransom.....	G. A. Abbott....	W. A. McBeth.
1904–1905..	John S. Wright...	Lynn B. M'Mullen	J. H. Ransom.....	G. A. Abbott.....	W. A. McBeth.

In Memoriam

John Lyle Campbell

Born, Salem, Indiana, October 13, 1827.

Died, Crawfordsville, Indiana, September 7, 1904.

President Indiana Academy Science, 1891–1892.

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, Press 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 programs 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 the attending members of at least one year's standing. No question of amendment shall be decided on the day of its presentation.

BY-LAWS.

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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 morning of one of the days of the meeting at the expiration of his term of office.

3. The Press Secretary shall attend to the securing of proper newspaper reports of the meetings and assist the Secretary.

4. 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.

5. No bill against the Academy shall be paid without an order signed by the President and countersigned by the Secretary.

6. 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.

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

MEMBERS.

FELLOWS.

R. J. Aley	*1898	Bloomington.
Frank M. Andrews	1904	Bloomington.
J. C. Arthur	1893	Lafayette.
George W. Benton	1896	Indianapolis.
A. J. Bigney	1897	Moore's Hill.
A. W. Bitting	1897	West Lafayette.
Donaldson Bodine	1899	Crawfordsville.
W. S. Blatchley	1893	Indianapolis.
H. L. Bruner	1899	Irvington.
Severance Burrage	1898	Lafayette.
A. W. Butler	1893	Indianapolis.
J. L. Campbell**	1893	Crawfordsville.
Mel. T. Cook	1902	Santiago, Cuba.
John M. Coulter	1893	Chicago, Ill.
Stanley Coulter	1893	Lafayette.
Glenn Culbertson	1899	Hanover.
D. W. Dennis	1895	Richmond.
C. R. Dryer	1897	Terre Haute.
C. H. Eigenmann	1893	Bloomington.
Percy Norton Evans	1901	West Lafayette.
A. L. Foley	1897	Bloomington.
Katherine E. Golden	1895	Lafayette.
M. J. Golden	1899	Lafayette.
W. F. M. Goss	1893	Lafayette.
Thomas Gray	1893	Terre Haute.
A. S. Hathaway	1895	Terre Haute.
W. K. Hatt	1902	Lafayette.
Robert Hessler	1899	Logansport.
H. A. Huston	1893	Lafayette.
Edwin S. Johannott	1904	Terre Haute.
Arthur Kendrick	1898	Terre Haute.
Robert E. Lyons	1896	Bloomington.
W. A. McBeth	1904	Terre Haute.

*Date of election.
**Deceased.

V. F. Marsters	1893	Bloomington.
C. L. Mees	1894	Terre Haute.
J. A. Miller	1904	Bloomington.
W. J. Moenkhaus	1901	Bloomington.
Joseph Moore	*1896	Richmond.
D. M. Mottier	1893	Bloomington.
J. P. Naylor	1903	Greencastle.
W. A. Noyes	1893	Washington, D. C.
J. H. Ransom	1902	Lafayette.
L. J. Rettger	1896	Terre Haute.
J. T. Scovell	1894	Terre Haute.
Alex Smith	1893	Chicago, Ill.
W. E. Stone	1893	Lafayette.
Joseph Swain	1898	Swarthmore, Pa.
M. B. Thomas	1893	Crawfordsville.
C. A. Waldo	1893	Lafayette.
F. M. Webster	1894	Champaign, Ill.
Jacob Westlund	1904	Lafayette.
H. W. Wiley	1895	Washington, D. C.
John S. Wright	1894	Indianapolis.

NON-RESIDENT MEMBERS.

George H. Ashley	Charleston, S. C.
M. A. Brannon	Grand Forks, N. D.
J. C. Branner	Stanford University, Cal.
D. H. Campbell	Stanford University, Cal.
A. Wilmer Duff	Worcester, Mass.
B. W. Everman	Washington, D. C.
Charles H. Gilbert	Stanford University, Cal.
C. W. Green	Stanford University, Cal.
C. W. Hargitt	Syracuse, N. Y.
O. P. Hay	New York City.
Edward Hughes	Stockton, Cal.
O. P. Jenkins	Stanford University, Cal.
D. S. Jordan	Stanford University, Cal.
J. S. Kingsley	Tufts College, Mass.

*Date of election.

D. T. MacDougal.....Bronx Park, New York City.
T. C. Mendenhall.....Worcester, Mass.
Alfred Springer.....Cincinnati, Ohio.
L. M. Underwood.....New York City.
Robert B. Warder.....Washington, D. C.
Ernest Walker.....Clemson College, S. C.

ACTIVE MEMBERS.

George Abbott.....Indianapolis.
George C. Ashman.....Frankfort.
Edward Ayres.....Lafayette.
Edward Hugh Bangs.....Indianapolis.
Walter D. Baker.....Indianapolis.
Arthur M. Banta.....Franklin.
J. W. Beede.....Bloomington.
William N. Blanchard.....Greencastle.
Edwin M. Blake.....Lafayette.
Lee F. Bennett.....Valparaiso.
Charles S. Bond.....Richmond.
Fred. J. Breeze.....Delphi.
E. M. Bruce.....Weston, Oregon.
Herman S. Chamberlain.....Indianapolis.
E. J. Chansler.....Bicknell.
Otto O. Clayton.....Geneva.
Howard W. Clark.....Chicago, Ill.
George Clements.....Crawfordsville.
Charles Clickener.....Silverwood, R. D. No. 1.
U. O. Cox.....Mankato, Minn.
William Clifford Cox.....Columbus.
J. A. Cragwall.....Crawfordsville.
Albert B. Crow.....Charleston, Ill.
M. E. Crowell.....Franklin.
Edward Roscoe Cumings.....Bloomington.
Alida M. Cunningham.....Alexandria.
Lorenzo E. Daniels.....Indianapolis.
H. J. Davidson.....Baltimore, Md.
Charles C. Deam.....Bluffton.

Martha Doan ..... Westfield.
J. P. Dolan ..... Syracuse.
Herman B. Dorner ..... Lafayette.
Hans Duden ..... Indianapolis.
Frank R. Eldred ..... Indianapolis.
M. N. Elrod ..... Columbus.
Samuel G. Evans ..... Evansville.
Carlton G. Ferris ..... Big Rapids, Mich.
E. M. Fisher ..... Urmeyville.
Wilbur A. Fiske ..... Richmond.
W. B. Fletcher ..... Indianapolis.
Austin Funk ..... New Albany.
John D. Gabel ..... Montpelier.
Charles W. Garrett ..... Logansport.
Robert G. Gillum ..... Terre Haute.
Vernon Gould ..... Rochester.
Walter L. Hahn ..... Bascom.
Victor Hendricks ..... Indianapolis.
Mary A. Hickman ..... Greencastle.
John E. Higdon ..... Indianapolis.
Frank R. Higgins ..... Terre Haute.
S. Bella Hilands ..... Madison.
John J. Hildebrandt ..... Logansport.
J. D. Hoffman ..... Lafayette.
Allen D. Hole ..... Richmond.
Lucius M. Hubbard ..... South Bend.
John N. Hurty ..... Indianapolis.
C. F. Jackson ..... Greencastle.
Alex. Johnson ..... Ft. Wayne.
Ernest E. Jones ..... Kokomo.
Wm. J. Jones, Jr ..... West Lafayette.
Chancey Juday ..... Boulder, Colo.
O. L. Kelso ..... Terre Haute.
Norton A. Kent ..... Crawfordsville.
Charles T. Knipp ..... Champaign, Ill.
Henry H. Lane ..... Lebanon.
William E. Lawrence ..... Richmond.
V. H. Lockwood ..... Indianapolis.

Robert Wesley McBride..... Indianapolis.
Roussean McClellan .....Indianapolis.
Richard C. McClaskey.....Terre Haute.
Lynn B. McMullen.....Indianapolis.
Edward G. Mahin.....West Lafayette.
James E. Manchester.....Vincennes.
Clark Mick .....Indianapolis.
W. G. Middleton.....Richmond.
H. T. Montgomery .....South Bend.
Walter P. Morgan.....Terre Haute.
Fred Mutchler .....Terre Haute.
Charles E. Newlin.....Irvington.
John Newlin .....West Lafayette.
John F. Newsom.....Stanford University, Cal.
R. W. Noble .....Chicago, Ill.
D. A. Owen .....Franklin.
Rollo J. Peirce.....Indianapolis.
Ralph B. Polk.....Greenwood.
James A. Price.....Ft. Wayne.
Frank A. Preston.....Indianapolis.
A. H. Purdue.....Fayetteville, Ark.
Rolla R. Ramsey.....Bloomington.
Ryland Ratliff .....Danville.
Albert B. Reagan ..... Marietta, Wash.
Allen J. Reynolds..... Peru.
Giles E. Ripley ..... Decorah, Iowa.
George L. Roberts.....Greensburg.
D. A. Rothrock.....Bloomington.
John F. Schnaible.....Lafayette.
E. A. Schultze..... Ft. Wayne.
John W. Shepherd .....Terre Haute.
Claude Siebenthal.....Indianapolis.
J. R. Slonaker.....Madison, Wis.
C. Piper Smith.....Leland Stanford, Cal.
Retta E. Spears .....Elkhart.
J. M. Stoddard.....Indianapolis.
Charles F. Stegmaier .....Greensburg.
William Stewart .....Burlington, Vt.

William B. Streeter.....Indianapolis.
Frank B. Taylor.....Ft. Wayne.
J. F. Thompson.....Richmond.
C. H. Underwood.....Indianapolis.
A. L. Treadwell.....Oxford, Ohio.
Daniel J. Troyer.....Goshen.
A. B. Ulrey.....North Manchester.
W. B. Van Gorder.....Worthington.
Arthur C. Veatch.....Rockport.
H. S. Voorhees.....Ft. Wayne.
J. H. Voris.....Huntington.
Frank B. Wade.....Indianapolis.
Daniel T. Weir.....Indianapolis.
B. C. Waldemaier.....West Lafayette.
Fred C. Whitcomb.....Delphi.
William M. Whitten.....South Bend.
Neil H. Williams.....Terre Haute.
William Watson Woollen.....Indianapolis.
J. F. Woolsey.....Indianapolis.
Lucy Youse.....Terre Haute.
Charles Zeleny.....Bloomington.

Fellows	53
Non-resident members	20
Active members	126
Total	199

LIST OF FOREIGN CORRESPONDENTS.

AFRICA.

Dr. J. Medley Wood, Natal Botanical Gardens, Berea Durban, South Africa.

South African Philosophical Society, Cape Town, South Africa.

ASIA.

China Branch Royal Asiatic Society, Shanghai, China.

Asiatic Society of Bengal, Calcutta, India.

Geological Survey of India, Calcutta, India.

Indian Museum of India, Calcutta, India.

India Survey Department of India, Calcutta, India.

Deutsche Gesellschaft, für Natur- und Völkerkunde Ostasiens, Tokio, Japan.

Imperial University, Tokio, Japan.

Koninklijke Naturkundige Vereeniging in Nederlandsch-Indie, Batavia, Java.

Hon. D. D. Baldwin, Honolulu, Hawaiian Islands.

EUROPE.

V. R. Tschusizu Schmidhoffen, Villa Tannenhof, Halle in Salzburg, Austria.

Herman von Vilas, Innsbruck, Austria.

Ethnologische Mittheilungen aus Ungarn, Budapest, Austro-Hungary.

Mathematische und Naturwissenschaftliche Berichte aus Ungarn, Budapest, Austro-Hungary.

K. K. Geologische Reichsanstalt, Vienna (Wien), Austro-Hungary.

K. U. Naturwissenschaftliche Gesellschaft, Budapest, Austro-Hungary.

Naturwissenschaftlich-Medizinischer Verein in Innsbruck (Tyrol), Austro-Hungary.

Editors "Termeszetrajzi Fuzetk," Hungarian National Museum, Budapest, Austro-Hungary.

Dr. Eugen Dadai, Adj. am. Nat. Mus., Budapest, Austro-Hungary.

Dr. Julius von Madarasz, Budapest, Austro-Hungary.
K. K. Naturhistorisches Hofmuseum, Vienna (Wien), Austro-Hungary.
Ornithological Society of Vienna (Wien), Austro-Hungary.
Zoölogische-Botanische Gesellschaft in Wien (Vienna), Austro-Hungary.
Dr. J. von Csato, Nagy Enyed, Austro-Hungary.
Botanic Garden, K. K. Universität, Wien (Vienna), Austro-Hungary.

Malacological Society of Belgium, Brussels, Belgium.
Royal Academy of Science, Letters and Fine Arts, Brussels, Belgium.
Royal Linnean Society, Brussels, Belgium.
Societé Belge de Geologie, de Paleontologié et Hydrologie, Brussels, Belgium.
Societé Royale de Botanique, Brussels, Belgium.
Societé Geologique de Belgique, Liège, Belgium.
Royal Botanical Gardens, Brussels, Belgium.

Bristol Naturalists' Society, Bristol, England.
Geological Society of London, London, England.
Dr. E. M. Holmes, British Pharm. Soc'y, Bloomsbury Sq., London, W. C., England.
Jenner Institute of Preventive Medicine, London, England.
The Librarian, Linnean Society, Burlington House, Piccadilly, London W., England.
Liverpool Geological Society, Liverpool, England.
Manchester Literary and Philosophical Society, Manchester, England.
"Nature," London, England.
Royal Botanical Society, London, England.
Royal Kew Gardens, London, England.
Royal Geological Society of Cornwall, Penzance, England.
Royal Microscopical Society, London, England.
Zoölogical Society, London, England.
Lieut.-Col. John Biddulph, 43 Charing Cross, London, England.
Dr. G. A. Boulenger, British Mus. (Nat. Hist.), London, England.
F. DuCane Godman, 10 Chandos St., Cavendish Sq., London, England.
Mr. Howard Saunders, 7 Radnor Place, Hyde Park, London W., England.
Phillip L. Sclater, 3 Hanover Sq., London W., England.
Dr. Richard Bowlder Sharpe, British Mus. (Nat. Hist.), London, England.
Prof. Alfred Russell Wallace, Corfe View, Parkstone, Dorset, England.

Botanical Society of France, Paris, France.
Ministérie de l'Agriculture, Paris, France.
Societé Entomologique de France, Paris, France.
L'Institut Grand Ducal de Luxembourg, Luxembourg, Lux., France.
Soc. de Horticulture et de Botan. de Marseille, Marseilles, France.
La Soc. Linneenne de Normandie, Caen, France.
Societé Linneenne de Bordeaux, Bordeaux, France.
Soc. des Naturelles, etc., Nantes, France.
Zoölogical Society of France, Paris, France.
Baron Louis d'Hamonville, Meurthe et Moselle, France.
Pasteur Institute, Lille, France.
Museum d'Histoire Naturelle, Paris, France.

Bontanischer Verein der Provinz Brandenburg, Berlin, Germany.
Deutsche Geologische Gesellschaft, Berlin, Germany.
Entomologischer Verein in Berlin, Berlin, Germany.
Journal für Ornithologie, Berlin, Germany.
Prof. Dr. Jean Cabanis, Alte Jacob Strasse, 103 A., Berlin, Germany.
Augsburger Naturhistorischer Verein, Augsburg, Germany.
Count Hans von Berlspen, Münden, Germany.
Braunschweiger Verein für Naturwissenschaft, Braunschweig, Germany.
Bremer Naturwissenschaftlicher Verein, Bremen, Germany.
Ornithologischer Verein München, Thierschstrasse, 37½, München, Germany.
Royal Botanical Gardens, Berlin W., Germany.
Kaiserliche Leopoldische-Carolinische Deutsche Akademie der Naturforscher, Halle a Saale, Wilhemstrasse 37, Germany.
Königlich-Sächsische Gesellschaft der Wissenschaften, Mathematisch-Physische Classe, Leipzig, Saxony, Germany.
Naturhistorische Gesellschaft zu Hanover, Hanover, Prussia, Germany.
Naturwissenschaftlicher Verein in Hamburg, Hamburg, Germany.
Verein für Erdkunde, Leipzig, Germany.
Verein für Naturkunde, Wiesbaden, Prussia.

Belfast Natural History and Philosophical Society, Belfast, Ireland.
Royal Dublin Society, Dublin.
Royal Botanic Gardens, Glasnevin, County Dublin, Ireland.

Societa Entomologica Italiana, Florence, Italy.
Prof. H. H. Giglioli, Museum Vertebrate Zoölogy, Florence, Italy.
Dr. Alberto Perngia, Museo Civico di Storia Naturale, Genoa, Italy.
Societa Italiana de Scienze Naturali, Milan, Italy.
Societa Africana d'Italia, Naples, Italy.
Dell' Academia Pontifico de Nuovi Lincei, Rome, Italy.
Minister of Agriculture, Industry and Commerce, Rome, Italy.
Rassegna della Scienze Geologiche in Italia, Rome, Italy.
R. Comitato Geologico d'Italia, Rome, Italy.
Prof. Count Tomasso Salvadori, Zoölog. Museum, Turin, Italy.

Royal Norwegian Society of Sciences, Throndhjem, Norway.
Dr. Robert Collett, Kongl. Frederiks Univ. Christiana, Norway.

Academia Real des Sciencias de Lisboa (Lisbon), Portugal.
Comité Geologique de Russie, St. Petersburg, Russia.
Imperial Academy of Sciences, St. Petersburg, Russia.
Imperial Society of Naturalists, Moscow, Russia.
Jardin Imperial de Botanique, St. Petersburg, Russia.
The Botanical Society of Edinburgh, Edinburgh, Scotland.
John J. Dalgleish, Brankston Grange, Bogside Sta., Sterling, Scotland.
Edinburgh Geological Society, Edinburgh, Scotland.
Geological Society of Glasgow, Scotland.
John A. Harvie-Brown, Duniplace House, Larbert, Stirlingshire, Scotland.
Natural History Society, Glasgow, Scotland.
Philosophical Society of Glasgow, Glasgow, Scotland.
Royal Society of Edinburgh, Edinburgh, Scotland.
Royal Physical Society, Edinburgh, Scotland.
Royal Botanic Garden, Edinburgh, Scotland.

Barcelona Academia de Ciencias y Artes, Barcelona, Spain.
Royal Academy of Sciences, Madrid, Spain.

Institut Royal Geologique de Suède, Stockholm, Sweden.
Societé Entomologique a Stockholm, Stockholm, Sweden.
Royal Swedish Academy of Science, Stockholm, Sweden.

Naturforschende Gesellschaft, Basel, Switzerland.
Naturforschende Gesellschaft in Berne, Berne, Switzerland.
La Societé Bontanique Suisse, Geneva, Switzerland.
Societé Helvetique de Sciences Naturelles, Geneva, Switzerland.
Societé de Physique et d'Historie Naturelle de Geneva, Geneva, Switzerland.
Concilium Bibliographicum, Zürich-Oberstrasse, Switzerland.
Naturforschende Gesellschaft, Zürich, Switzerland.
Schweizerische Botanische Gesellschaft, Zürich, Switzerland.
Prof. Herbert H. Field, Zürich, Switzerland.

AUSTRALIA.

Linnean Society of New South Wales, Sidney, New South Wales.
Royal Society of New South Wales, Sidney, New South Wales.
Prof. Liveridge, F. R. S., Sidney, New South Wales.
Hon. Minister of Mines, Sidney, New South Wales.
Mr. E. P. Ramsey, Sidney, New South Wales.
Royal Society of Queensland, Brisbane, Queensland.
Royal Society of South Australia, Adelaide, South Australia.
Victoria Pub. Library, Museum and Nat. Gallery, Melbourne, Victoria.
Prof. W. L. Buller, Wellington, New Zealand.

NORTH AMERICA.

Natural Hist. Society of British Columbia, Victoria, British Columbia.
Canadian Record of Science, Montreal, Canada.
McGill University, Montreal, Canada.
Natural Society, Montreal, Canada.
Natural History Society, St. Johns, New Brunswick.
Nova Scotia Institute of Science, Halifax, N. S.
Manitoba Historical and Scientific Society, Winnipeg, Manitoba.
Dr. T. McIlwraith, Cairnbrae, Hamilton, Ontaria.
The Royal Society of Canada, Ottawa, Ontario.
Natural History Society, Toronto, Ontario.
Hamilton Association Library, Hamilton, Ontario.
Canadian Entomologist, Ottawa, Ontario.
Department of Marine and Fisheries, Ottawa, Ontario.
Ontario Agricultural College, Guelph, Ontario.

Canadian Institute, Toronto.
Ottawa Field Naturalists' Club, Ottawa, Ontario.
University of Toronto, Toronto.
Geological Survey of Canada, Ottawa, Ontario.
La Naturaliste Canadian, Chicontini, Quebec.

La Naturale Za, City of Mexico.
Mexican Society of Natural History, City of Mexico.
Museo Nacional, City of Mexico.
Sociedad Cientifica Antonio Alzate, City of Mexico.
Sociedad Mexicana de Geographia y Estadistica de la Republica Mexicana, City of Mexico.

WEST INDIES.

Botanical Department, Port of Spain, Trinidad, British West Indies.
Victoria Institute, Trinidad, British West Indies.
Museo Nacional, San Jose, Costa Rica, Central America.
Dr. Anastasia Alfaro, Secy. National Museum, San Jose, Costa Rica.
Rafael Arango, Havana, Cuba.
Jamaica Institute, Kingston, Jamaica, West Indies.
The Hope Gardens, Kingston, Jamaica, West Indies.
Estacion Central Agronomica Departmento de Patologia, Santiago de las Vegas, Cuba.

SOUTH AMERICA.

Argentina Historia Natural Florentine Amegline, Buenos Ayres, Argentine Republic.
Musée de la Plata, Argentine Republic.
Nacional Academia des Ciencias, Cordoba, Argentine Republic.
Sociedad Cientifica Argentine, Buenos Ayres.
Museo Nacional, Rio de Janeiro, Brazil.
Sociedad de Geographia, Rio de Janeiro, Brazil.
Dr. Herman von Jhering, Dir. Zoöl. Sec. Con. Geog. e Geol. de Sao Paulo, Rio Grande do Sul, Brazil.

Deutscher Wissenschaftlicher Verein in Santiago, Santiago, Chili.
Societé Scientifique du Chili, Santiago, Chili.
Sociedad Guatemalteca de Ciencias, Guatemala, Guatemala.

PROGRAM

OF THE

TWENTIETH ANNUAL MEETING

OF THE

INDIANA ACADEMY OF SCIENCE,

SHORTRIDGE HIGH SCHOOL, INDIANAPOLIS,

November 25, 1904.

OFFICERS AND EX-OFFICIO EXECUTIVE COMMITTEE.

CARL L. MEES, President.
GLENN CULBERTSON, Vice-President.
JOHN S. WRIGHT, Secretary.
J. H. RANSOM, Assistant Secretary.
G. A. ABBOTT, Press Secretary.
W. A. McBETH, Treasurer.

W. S. BLATCHLEY,
H. W. WILEY,
M. B. THOMAS,
D. W. DENNIS,
C. H. EIGENMANN,
C. A. WALDO,
THOMAS GRAY,
STANLEY COULTER,
AMOS W. BUTLER,
W. A. NOYES,
J. C. ARTHUR,
J. L. CAMPBELL,
O. P. HAY,
T. C. MENDENHALL,
JOHN C. BRANNER,
J. P. D. JOHN,
JOHN M. COULTER,
DAVID S. JORDAN.

The sessions of the Academy will be held in the Shortridge High School. The President's address will be given in the auditorium of the Shortridge High School.

Headquarters will be at the English Hotel. A rate of $2.00 and up per day, American plan, will be made to all persons who make it known at the time of registering that they are members of the Academy.

Reduced railroad rates for the members can not be secured under the present ruling of the Traffic Association. Many of the colleges can secure special rates on the various roads.

PROGRAM COMMITTEE.

GEORGE W. BENTON, Indianapolis.
JOHN S. WRIGHT, Indianapolis.
KATHERINE E. GOLDEN, Lafayette.

GENERAL PROGRAM.

THURSDAY, NOVEMBER 24.

Meeting of Executive Committee at Hotel Headquarters..... 8:00 p. m.

FRIDAY, NOVEMBER 25.

General Session..... 9:00 a. m.
President's Address..... 11:00 a. m.
General Session, followed by Sectional Meetings..... 2:00 p. m.

LIST OF PAPERS TO BE READ.

ADDRESS BY THE RETIRING PRESIDENT,

CARL L. MEES,

At 11 o'clock Friday morning, at Shortridge High School.

Subject: "Electricity and Matter; Recent Developments."

The following papers will be read in the order in which they appear on the program, except that certain papers will be presented "*pari passu*" in sectional meetings. When a paper is called and the reader is not present, it will be dropped to the end of the list, unless by mutual agreement an exchange can be made with another whose time is approximately the same. Where no time was sent with the papers, they have been uniformly assigned ten minutes. Opportunity will be given after the reading of each paper for a brief discussion.

N. B.—By the order of the Academy, no paper can be read until an abstract of its contents or the written paper has been placed in the hands of the Secretary.

GENERAL.

1. City Dust--Cause and Effect, 15 m. ..... Robert Hessler
2. Old Water Power Mills of Carroll County, 10 m. ..... Fred J. Breeze
3. Photography for the Nature Student (illustrated by the stereopticon), 20 m. Benjamin W. Douglass

**4. The Rosebud Indian Celebration, 10 m. ..... Albert B. Reagan

PHYSICS, MATHEMATICS, ASTRONOMY AND PHYSIOGRAPHY.

5. A Device for Determining the Period of a Pendulum, 5 m. ..... Herman S. Chamberlain
6. Some Experiments with a Simple Jolly Balance, 10 m. ..... Lynn B. McMullen
7. "N"-Rays, 15 m. ..... Rolla R. Ramsey and W. P. Haseman
8. Electro-Magnetic Induction in Different Conductors, 10 m. Arthur L. Foley and C. A. Evans
9. Interference Fringes from the Path of an Electric Discharge, 5 m. Arthur L. Foley and J. H. Haseman
10. On the Deformation of Surfaces Referred to a Conjugate System of Lines, 10 m. Burke Smith
11. Warped Surfaces with two Distinct Rectilinear Directrices, 10 m. ..... C. A. Waldo
12. A New Form of Mathematical Models, 10 m. ..... C. A. Waldo
13. Measures of Some Neglected Pairs of Double Stars, 5 m. ..... John A. Miller
14. An Esker in Tippecanoe County, Indiana, 10 m. ..... W. A. McBeth
15. Notes on the Mississippi Delta, 15 m. ..... W. A. McBeth

15a. The Newtonian Idea of the Calculus, 20 m. ..... A. S. Hathaway

ETHNOLOGY.

*16. The Cliff Dwellers of Arizona, 10 m.....Albert B. Reagan
17. All Saints' Day at Jemez, New Mexico, 10 m.....Albert B. Reagan
18. The Penitenties, 10 m.....Albert B. Reagan
19. The Matachina Dance, 10 m.....Albert B. Reagan
20. The Moccasin Game, 10 m.....Albert B. Reagan
21. The Apache Medicine Game, 10 m.....Albert B. Reagan
22. The Apache Ceremonies Performed Over the Daughter of C 30, 10 m. Albert B. Reagan

BOTANY AND ZOÖLOGY.

**23. A Heronry near Rushville, Indiana, 5 m.....D. W. Dennis
*24. Notes from the Indiana State Forestry Reservation, 10 m.....Charles Piper Smith
*25. Notes Upon Some Little Known Members of the Indiana Flora, 10 m. Charles Piper Smith
**26. Pollination of Campanula Americana, 3 m.....Moses N. Elrod
27. Additions to the Indiana Flora, 5 m.....Charles C. Deam
28. Physiological Apparatus for Botany, 10 m.....Frank M. Andrews
29. On the Nomenclature of Fungi Having Many Fruit Forms, 15 m.....J. C. Arthur
30. Amphispores of the Grass and Sedge Rusts, 15 m.....J. C. Arthur
31. Preliminary Notes on the North American Species of the Genus Cuscuta (by abstract), 10 m.....Stanley Coulter
32. The Poisonous Plants of Indiana, 10 m.....Stanley Coulter
33. Birds and Fruits, 10 m.....A. W. Butler
34. The Sclerenchymatous Tyloses in Brosimum Aubletii, 10 m.....Katherine E. Golden
35. The Effect of Environment on the Action of Cytase, 10 m.....Katherine E. Golden
36. Additions to the Flora of Marion County, Indiana, 3 m.....Benjamin W. Douglass
**37. Additions to the List of Gall Producing Insects, common to Indiana (abstract), 5 m.....Mel T. Cook

*Not presented.
**By title.

EDITORIAL NOTICE.

All members of the Academy will doubtless be ready to assist in any efforts put forth having in view correct and early publications of the Proceedings. To this end the following conditions of publication are announced by the editor:

1. All papers to be included in the report of 1904 must be in the hands of the editor not later than December 10, 1904.
2. All papers should be typewritten as far as the nature of the subject will allow.
3. All tracings and maps should be drawn to correspond with the size of the page of the Proceedings, and must come within the following limits: $4\frac{1}{4}$x7 inches. If necessary it may be made to cover two pages, or measure $8\frac{1}{2}$x11 inches.
4. Authors are especially requested to carefully mark and number all illustrations, and to carefully indicate in the MSS. the exact location of such illustrations.
5. To insure proper representation of mathematical work, authors are particularly cautioned to send in carefully traced figures on separate paper.
6. The limits of the appropriation require that all illustrations shall be in one color, and either photographs or etchings. As a consequence, all illustrations must be in black and white.

THE TWENTIETH ANNUAL MEETING OF THE INDIANA ACADEMY OF SCIENCE.

The twentieth annual meeting of the Indiana Academy of Science was held in Indianapolis, Thursday and Friday, November 24 and 25, 1904.

Thursday at 8 p. m. the Executive Committee met in session at hotel headquarters.

President Carl L. Mees, at 9 a. m. Friday, called the Academy to order in general session in the assembly hall of the Shortridge High School. The transaction of routine and miscellaneous business occupied the attention of the Academy until 11 a. m., when the retiring President, Carl L. Mees, delivered an address upon: "Electricity and Matter; Recent Developments." Following this address came an adjournment until 2 p. m., when papers of general interest were presented before the Academy as a whole. From 3:30 to 5 p. m., the time for adjournment, sectional meetings were held.

THE SPRING MEETING OF 1904.

The spring meeting of 1904 was held at Indianapolis, Thursday and Friday, April 28 and 29.

On Thursday evening an informal meeting was arranged at the Commercial Club. The principal topic for discussion was the interference of the Academy's set date of meeting with the dates usually chosen by the American Association for the Advancement of Science. The point was finally settled by making the date of the 1904 winter meeting November 24 and 25.

Friday morning most of the members of the Academy attended the meetings of the Indiana Science Teachers' Association.

Friday noon the Indianapolis members were the hosts at a luncheon at the Commercial Club.

Later various excursions were enjoyed by various members, some visiting the Kingan packing plant, others the Central Hospital for the Insane, and still other enthusiasts tramped over the country north and northeast of Indianapolis, under the leadership of W. S. Blatchley, studying the geological and botanical features of that district.

City Dust—Cause and Effect.

Robert Hessler.

This paper is in line with one read a year ago on "Cold and Colds" and is really a continuation of the same subject. The influence of dust on the health of man is, however, such a vast one that in a brief paper like this only one or two phases can be taken up.

In a general way we can say that dust is a product and an accompaniment of civilization. There are of course special kinds of dust with whose production man has nothing to do, such as the dust of sandy deserts, volcanic dust, and the dust arising along the trails of animals going to salt licks, etc., but in a general way the terms dust and man go together. Dust is solid matter in a state of fine division, so fine that it can be wafted or blown about by the wind. Among primitive people there is little dust, their mode of life forbids its formation and their nomadic or out of door existence prevents its accumulation.

Paradoxical as it may seem, the amount of dust in a modern city is not an index of a high degree of civilization, no more than is the presence of dirt and filth or its accumulation in a house an index of a high social standing of a family.

In a general way it may be said that accumulation of dust in a city is the result of the ignorance of common sanitary laws, of apathy on the part of the citizens, and of bad politics in those having the management of municipal affairs. A housewife who allows dust to accumulate is said to be slovenly; a tidy housekeeper is one who gets rid of the dust as soon as possible and does not allow it to accumulate. We have not yet reached a point where we can make similar distinctions between cities—we simply speak of one place being less dirty than another.

Cosmopolitan travelers tell us how clean some people and their cities are and how the streets correspond with the interior of their houses. The Japanese and the Dutch seem to stand at the head of the list, but I have no doubt that in the course of time other nations will reach the same standard of cleanliness, and, I may add, of general health.

Kinds of Dust: Confining ourselves to the kinds of dust due to the activity of man and disregarding special or rare kinds, such as factory dust, for instance, we can in a general way distinguish two kinds.

1. Common country road dust, due to the attrition of solid matter—the hoofs of the horse and the wheels of the vehicle on the road material, the stone or gravel or merely the common dirt. This kind of dust is mixed with only a small amount of other, vegetable, matter, the droppings of horses chiefly. From a sanitary standpoint it is not very objectionable, although it may be so esthetically.

2. City dust, the dust of the sanitarian, the dust par excellence. City dust has a complex composition. Most of it comes from the droppings of horses and originally existed in the form of hay, oats and corn. The fineness of the particles depends on the length of time it remains on the street to be pulverized by traffic. The wear of the street paving material under the horse's hoof and of vehicles adds an appreciable amount; more is added by litter falling from passing wagons, or is brought in from the mud roads adhering to the wheels. Soot, due to the imperfect combustion of coal, lends character to the city dust and in our American cities there is much of it, especially during the cold season of the year. Man himself adds not a little directly: the wear and tear of clothing and the shedding of epidermal scales adds a minute quantity—and much comes from his mouth, in the form of tobacco juice, saliva, and the abnormal secretions due to an unhealthy condition of the mucous membranes. City dust acquires peculiar properties on this account and thus making it differ radically from all other forms of dust.

More might be said on the causation of dust, but much more can be said concerning its influence or effects, and to this I will now turn.

Effects of Dust: The most noticeable effect of city dust is that it makes a city, its houses and inhabitants, look dirty. The dust is blown all about and settles over everything, indoors and out, and the housewife is kept busy trying to keep things looking clean.

There is an old saying about an ill wind that blows nobody good. The laundryman flourishes in a dusty city, clean linen means frequent laundering. The doctor flourishes because dust means sickness and disease. "There is good money in that for me," a physician remarked, as a dense cloud of dust was seen coming down the street. But the individual, par excellence, benefited is the patent medicine man; he flourishes exceedingly in a dusty city and his nostrums are in great demand.

Now this brings up a phase of city life and of the city dust question that is rarely considered. The scientist who has no medical education and no practical experience with ailments and diseases can not

fully realize the importance of the subject, while, on the other hand, the average physician pays too little attention to the scientific but non-medical aspects of it. As a matter of fact most physicians are so disgusted with the subject, and patent medicines are in such bad repute with them, that they think it beneath their dignity to notice it—and so the patent medicine man flourishes unmolested.

But, it will be argued, if the patent medicine man flourishes that is evidence that his wares are in demand; if there were no demand he would not flourish. Of course. The law of demand and supply might be quoted. It might also be said that reading maketh a full man—but that hardly applies to the reader of the patent medicine advertisements in the newspapers.

Consulting the Literature: Every worker in science knows what it means to look up the literature of a subject. "Consulting the literature," is a common expression. Now when it comes to the kind of literature just referred to we need not look far nor long to find it. The very first newspaper or magazine you get hold of will be full of it. Did you ever examine, not to say study, such advertisements? Can it be said of the man who does not and can not read that he is keeping back the progress of his race in its attempts to solve the problems that are constantly arising as man gets farther and farther away from the condition of primitive man? The man who reads patent medicine literature for the purpose of getting valuable or useful information is certainly to be pitied.

In a general way patent medicines and the names of common ailments, not to say diseases, go together; the one presupposes the other. Ailments and diseases fall into groups, likewise do patent medicines and their advertisements. If it can be shown that in some of our dusty cities in which the spitting habit prevails three-fourths of the patent medicines are advertised for ailments directly due to the inhalation of city dust, we at once see the importance of the question of pure and impure air and we dimly realize the effects of the dust.

We all know that life depends on the oxidation of organic substances used as food, enabling us to keep up bodily activities. Oxidation means the use of air. Pure air is an important factor in determining health; very impure air can not sustain life and partially impure air may place the body at a disadvantage in the struggle with its surroundings.

Individually susceptibility to impure air differs widely. When impure air is badly borne and bodily functioning is not carried on normally, we speak of ill-health and disease. Disease may result from the use of bad air, and in a general way, bad air means air contaminated by dust, as already mentioned.

Ailments and diseases have a cause, just like all other phenomena in this world. Some diseases are due to parasites, the preying of one form of life upon another. Some forms of life flourish only at the expense of human beings and are constantly transferred from one person to another. Some diseases and their causes are always among us, such as consumption and malaria; others come and go, as cholera and yellow fever. Some diseases are transferred mainly through the drinking water, as typhoid fever and cholera; other diseases are propagated by the bite of the mosquito, as yellow fever and malaria. Some diseases are transmitted through the agency of dust, and hence we speak of air-borne diseases, like tuberculosis, pneumonia, bronchitis and the like.

Some diseases are well defined and can be readily diagnosed, such as those just mentioned; others are obscure and their causes ill-defined. In a general way it may be said that the names of diseases and ailments in common use are names of ill-defined application, that is, there is nothing definite about them, and they are not used in the best medical literature of today. The words "cold," "biliousness," "catarrh," "rheumatism," and the like, do not express anything definite.

Air-borne diseases like tuberculosis and pneumonia are known as specific diseases due to a definite cause; if the cause is absent then the effect, the disease, will also be absent. Ailments are minor affections and are not always due to some one definite cause: headache or a pain in the arm are ailments and may arise from a variety of causes.

It is scarcely necessary to make any specific reference to the science of bacteriology—which concerns itself with what are popularly known as "germs," or to the number of established facts which it embraces. Anyone arguing in opposition to bacteria as a cause of diseases will not even get a respectful hearing from a qualified bacteriologist—it seems to him a waste of time. A man might as well deny the theory of universal gravitation as to deny the germ theory of disease.

Ailments Due to Infected Dust: Inhaling city dust may bring on a variety of ailments, as well as definite diseases. City residents may complain of various pains and aches during or after the prevalence of a dust

storm or after having been confined to a room or hall with a dusty atmosphere, and country people may complain of not feeling well every time they come from a trip to the dusty city or take a ride on a dusty railway car. Although the effects of inhaling a bad atmosphere or dust differ somewhat in different individuals, yet by observing certain individuals for a long time, and observing a great many now and then, we may be able to draw some conclusions with a reasonable degree of accuracy.

In a general way it may be said that when the air is free from sputum or expectoration, certain ailments and diseases are also absent. The Japanese are remarkably free from ailments that are very common among us: The Japanese do not spit and they also have clean homes. North pole explorers and weather observers on high mountains are free from colds, catarrh, rheumatic aches and pains, bronchitis, and a host of other ailments and diseases—simply because the air is pure and the active causes are absent.

The inhalation of a sputum contaminated air has been found to produce a definite reaction in man. In some individuals a reaction occurs under even a slight exposure, others may require a severe exposure, some may escape entirely. We know that in some of the epidemic diseases there are always some individuals who escape. The reaction due to inhaling infected air or dust, may be characterized about as follows: There is an irritation of the mucous membranes; vague wandering pains or aches throughout the body, mostly referable to the muscles and ligaments, and at times more strongly localized at some point, as in the back or in an arm; there is a feeling of lassitude or discomfort, rising to severe headache, feverishness, loss of appetite and even vomiting. In some individuals there is cough on account of the unusual irritation of the respiratory mucous membranes; some complain mainly of the nervous symptoms and the inability of applying themselves to any task; in some the wandering or localized pains may predominate.

The above symptoms have been grouped together and the name Dust Disease has been applied to them. When, therefore, we say a man has dust disease, we at once have some definite idea of the nature of his ailment, and of its cause.

As a general rule an attack of dust disease declines and disappears of its own accord in the course of a day or a few days, but in a bad atmosphere it may continue for several weeks. Other diseases, like bron-

chitis, tonsilitis and pneumonia or tuberculosis may follow, and we can never be sure that an attack will pass off lightly.

Now if we study the advertisements of patent medicines in the newspapers we will find that they vary in amount, that is in number and size, being most common in the fall and spring and when the dust is at its maximum, and least common in the summer—when the streets are sprinkled and the sputum is sterilized by the hot rays of the sun. We will moreover find that three-fourths of the names of the ailments, not to speak of diseases, mentioned in the newspaper advertisements are simply synonyms of dust disease and are due to the inhalation of dust. I will give a list: cold, hoarseness, throat trouble, sickening breath, foul breath, catarrh, grip, sore throat, tonsilitis, pleurisy, a stitch in the side, backache, kidney complaint, kidney disease, lumbago, stiff back, lame back, rheumatism, muscular rheumatism, a touch of rheumatism, aching joints, headache, sick headache, nervous headache, neuralgia, nervous prostration, the blues, brain fag, neurasthenia, biliousness, bilious fever, a touch of malaria. All of these names should of course be in quotation marks. We find also the terms dizziness, faintness, irritability, restlessness and sleeplessness given as names of ailments, and faceache and car sickness are mentioned as diseases.

Now I do not mean to say that in every case of ill-health or of sickness, where the above names are applied, the cause is to be traced to the inhalation of infected dust, because something else may be at the bottom of it, but I believe that most cases of such self-diagnosed ailments (and where the afflicted individual calls for an advertised nostrum at the drug store) are simply cases of dust infection. Even stomach and bowel disturbances in many instances come under the same head, that is, caused by the dust—if not by inhalation, then by the dust which settles on food, as the cold victuals of a dusty restaurant or on fruits and vegetables exposed to the dust of the street. As a matter of fact there is a form of dust infection which manifests itself mainly by a disturbance of the gastric mucous membranes, with abundant secretion of mucus and often accompanied by severe vomiting.

Where one symptom, or its location in the body, dominates, it may give character to the ailment and thereby determine its popular name, or its patent medicine name. For instance, if the secretion of mucus or muco-pus is the chief symptom then we have "catarrh;" if the pain in

the back predominates, we hear the words "backache," or "lumbago" or "rheumatism," or even "disease of the kidneys."

One of the peculiarities of the human mind is that the moment a name is given to a thing, to a phenomenon or even a sensation, it is, by many men at least, regarded as a something definite, as an entity. This is especially true in the case of abnormal conditions of the human body. The average man does not regard an ailment simply as a warning from nature that something is wrong and that means should be taken to correct the condition—by removing the cause, but he regards it as an entity that should or must be overcome by an antagonist, an antidote, or in other words a "medicine." Hence a pain calls for a "pain killer" and a cough for a "cough cure." That chronic ill-health and disease may result from such a course is well known to medical men, and that is why they say the more patent medicines the people use the more work there is for the doctors.

With the active cause constantly present, that is infective dust, there are of course many cases of ill-health. Minor ailments make up the great mass of daily complaints of ill-health. There may be simple malaise or lassitude, or well defined aches and pains for which we are not able to account and take them as a matter of course. The relationship between a ride on a dusty street car on the way down town or the confinement to an illy-ventilated, dusty room or an exposure to clouds of street dust, to a subsequent attack of running nose or feverishness, wandering pains and aches or headache or biliousness or loss of appetite, is seldom considered. People have to have their attention called to these things and led to realize that a polluted atmosphere means ill-health and may lead to a well-defined disease.

The Patent Medicine Habit: When a man feels bad he of course wants something to make him feel good or well. Simple means, such as quiet, rest, fasting, good air, may be all that is needed for a day or two to enable nature to bring about a normal condition. But few persons pursue such a course: It is easier to stop in at the drug store and call for one of those widely advertised nostrums guaranteed to "kill the pain" or "stop the cough." Repeated and increased doses may be required, but that does not matter so long as relief follows, and no serious thought is given the matter until nature rebels and a serious disease is the result. Pain in nearly every case is simply a warning that something is wrong,

and a cough in most instances is simply an effort on nature's part to get rid of some irritating material. When we get a particle of food into the windpipe we cough until it comes up, but when the cough is due to the inhalation of a mass of irritating dust particles we (that is, some of us) use a "cough cure."

With the active cause, the infected dust, so plentifully present and with a frequent reaction or effect, that is the presence of an ailment, we have hence another effect: a large variety of nostrums or patent medicines—to counteract the reaction due to inhaling infected dust. In advertising these the long list of names given above is used. Usually some one name is given in large type, followed by several others in smaller type and from time to time there is a shifting, one of the synonyms in the small type will be advanced to head the list. There are several sets of these words or names, depending on the part of the body where the symptoms of the dust infection are mainly localized. If, for instance the pain is mainly in the back, the chief word and the minor ones will likely be: BACKACHE, lumbago, rheumatism, diseases of the kidneys; by changing we get DISEASE OF THE KIDNEYS, backache, lumbago, etc., each of the words being in turn used in large type. For the throat and chest we have: COLD, catarrh, grip, throat trouble, weak lungs, tonsilitis, etc. For the nervous conditions we have words like headache, neuralgia, biliousness, neurasthenia, etc. With a large list of words there can be considerable shifting about. All these points are brought out in the clippings which I will show. The relative amount of space occupied by patent medicine advertisements in the newspapers of different Indiana towns and cities will also be shown by clippings. An examination will show that a minimum of such advertisements in a city means a comparatively clean city, while, on the other hand, in a dirty and dusty city the newspapers are full of advertisements of patent medicines relating to ailments and diseases directly attributable to the inhalation of a dust polluted atmosphere. Nature exacts her dues. What the people save by neglecting to keep their cities clean, they are compelled to spend, or do spend, for patent medicines in the vain attempt to counteract the evil influence of the dust. A comparative study of patent medicine advertisements in the newspapers of different cities, states and nations, furnishes much food for thought. Civic pride and dust seem incompatible. To be able to point with pride to one's home city is quite

different from having to explain to your visiting friend why everything is dirty and dusty.

It would be interesting to know the financial aspects or statistics of this subject, the cost of keeping a city clean and the cost of time lost on account of ill-health and the cost of so-called remedies used in attempting to counteract the evil influence of the dust. There is of course a wide gap between a headache or a cold and pneumonia or tuberculosis, there are all stages of ill-health between such extremes and between the attendant loss of time and money.

Some of the nostrums are advertised for the cure of specific diseases like tuberculosis or consumption—a disease easily curable as a rule, in its early stages, but not by swallowing a lot of patent medicines. What is not claimed for patent medicines is not worth claiming. That reputable physicians do not prescribe patent medicines needs scarcely be mentioned.

It is of some interest to know that some of the most widely advertised nostrums can be made at a cost of one or two cents per gallon—the container and label of many costing more than the ingredients. There must of necessity be a large margin of profit or a "medicine" costing a few cents and selling for a dollar could not be advertised so extensively and so persistently.

In conclusion: As our country becomes more and more densely populated various sanitary problems arise and press for solution. This is especially true of our cities. Houses of brick and stone are displacing those built of wood and thus lessening the danger from fire. The open ditch has given place to the underground sewer; the mud road to the paved street. Shallow wells disappear before the advent of water works, and the latter themselves are getting a better supply by means of filtration.

Water-borne diseases have been reduced to a minimum in many cities and epidemics are prevented. The occurrence of many diseases, such as the plague, cholera, typhus, smallpox and the like, have been reduced to a minimum, if not entirely prevented, by proper precautions, based on a proper knowledge of their active cause and its diffusion.

What about preventing the ravages of ailments and diseases transmitted through the agency of the dust? What are we doing to reduce the amount of dust to a minimum? What efforts are we making to have pure air in our public halls, churches, street cars, and in the city generally?

What shall we do with the persistent floor and sidewalk spitter? Will education cause him to be displaced by a generation of non-spitters? What can we do for the poor, ignorant man, and his family, who keeps himself poor buying patent medicines—medicines which may give relief but which can not cure.

The chief charts used in illustrating the paper were as follows:

1. Chart showing the common names used in patent medicine advertisements. The names were arranged in three columns, the first giving names of ailments of a catarrhal nature or of the respiratory system, and marked in red; the second column, marked in blue, contained names of the rheumatic and aching type, thus::

"Catarrh"	"Rheumatism"
"Colds"	"Backache"
"Grip"	"Lame Back"
"Sore Throat"	"Kidney Disease"
"Pleurisy"	"Aching Joints"
Etc.	Etc.

In the third column were given the names used more especially in connection with the nervous and gastric manifestations of dust infection, such as nervousness, headache, neuralgia, gastritis, a touch of malaria, etc.

2. Chart showing the amount of space occupied by advertisements of patent medicines in the newspapers of different cities and towns. The total space occupied by medical ads of all kinds, and that means of nostrums and of quacks, varied from 2.5 to 14.2 per cent., while the ads of dust disease nostrums (as indicated on chart 1) varied from 1.1 per cent. in a comparatively clean city, up to 10 per cent. (and even more) in a dusty city.

(Are we justified in concluding that if the inhabitants of a clean city pay $1.10 per year, those of a dusty city are compelled at the same time to pay $10.00 for patent medicines?)

3. An exhibit of the total number of ads and the amount of space they occupy in newspapers of half a dozen different cities. Clippings all pasted on long rolls of paper. The contrast between a clean and a dusty city is thus shown in a striking manner.

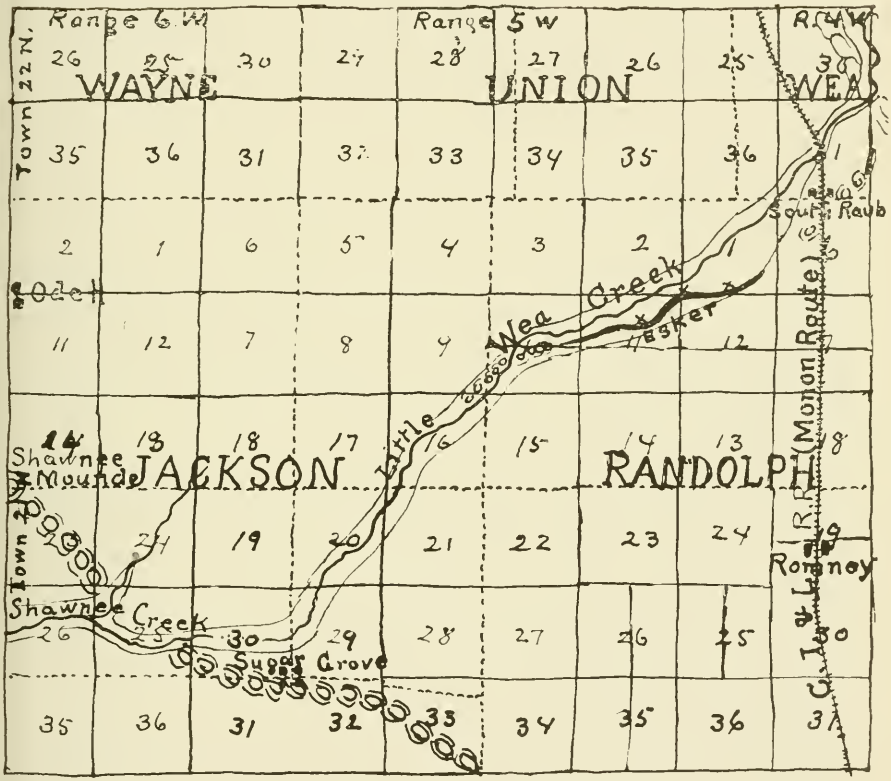
4. A selection of large ads, some occupying a full page. Most of these appeared at times when the dust was at its maximum, namely in the fall and again in the spring. The title of this sheet was: "Who Pays the Bill?"

5. Chart showing the seasonal prevalence of patent medicine ads. The fall and spring tides; low ebb in the summer. (In the summer the sputum on the sidewalks is sterilized by the hot rays of the sun, the streets are sprinkled and doors and windows are open.)

6. Clippings pasted on sheets showing the changes in names in the same advertisement at different times of the year, and from day to day or week to week. The words catarrh, colds, rheumatism, kidney disease, etc., being marked in red or blue—as indicated on chart No. 1.

An Esker in Tippecanoe County, Ind.

Wm. A. McBeth.



An Esker in Tippecanoe County, Indiana.

An esker or serpent kame is a serpentine ridge of sand and gravel evidently formed by a stream flowing in a tunnel at the bottom of a glacier or in a canyon through it.

An interesting example of this feature extends through sections 1, 2, 11, and 10, Town 21 north, Range 5 west, in Tippecanoe County, Indiana. Its northeast end is about one-half mile southwest of South Raub, a station on the C. I. & L. Ry. (Monon Route) nine miles south of Lafayette.

From the station and railway, it is visible and easily distinguished from the bordering prairie lands by its forested surface.

This ridge exceeds two miles in length and varies in height from a few feet at the ends to fifty or sixty feet along the main body. Its sides slope at angles of 20° to 35° away from the arching crest. Its height is quite uniform, but few irregularities occurring in the whole length. The base of the ridge is from twenty to thirty rods wide.

An interesting observation is that the outside or convex sides of bends have the steeper slopes, a fact bearing on the theory of stream origin.

The material is stream gravel assorted from the glacial drift arranged in layers which slope to the southwest. This arrangement of the material indicates stream action and shows the course of the stream that deposited the esker. Excavations to obtain gravel for road making occur at points x x x shown on the map and the characteristic structure is shown in each. Mounds of gravel occur in line with the general trend of the esker at each end. A chain of these elevations extends a mile from the southwest end.

The valley, a half mile wide, comprising the esker trough, extends from the vicinity of South Raub station to the Independence-Darlington moraine near Sugar Grove, where it crosses the divide and connects with the valley of Shawnee Creek, which flows west. The trough is now traversed by the Little Wea Creek, which flows northeast, just the reverse of direction followed by the stream which built the esker. This creek rises at the gap through the moraine at Sugar Grove and it leaves the trough by a deep narrow valley through another moraine at a little distance north of South Raub. Mounds of gravel near the station and further to the northeast may lie in the course of the stream that deposited the esker.

The problem of the slope of the esker trough opposite to the direction of the sub-glacial stream that originally corraded it suggests the explanation of hydrostatic pressure in the tunnel.

The cause of the deposit of gravel and sand as an esker may be related to the reverse slope of the esker trough causing the stream to grade up to a slope line in the opposite direction, which would carry it over the divide at Sugar Grove.

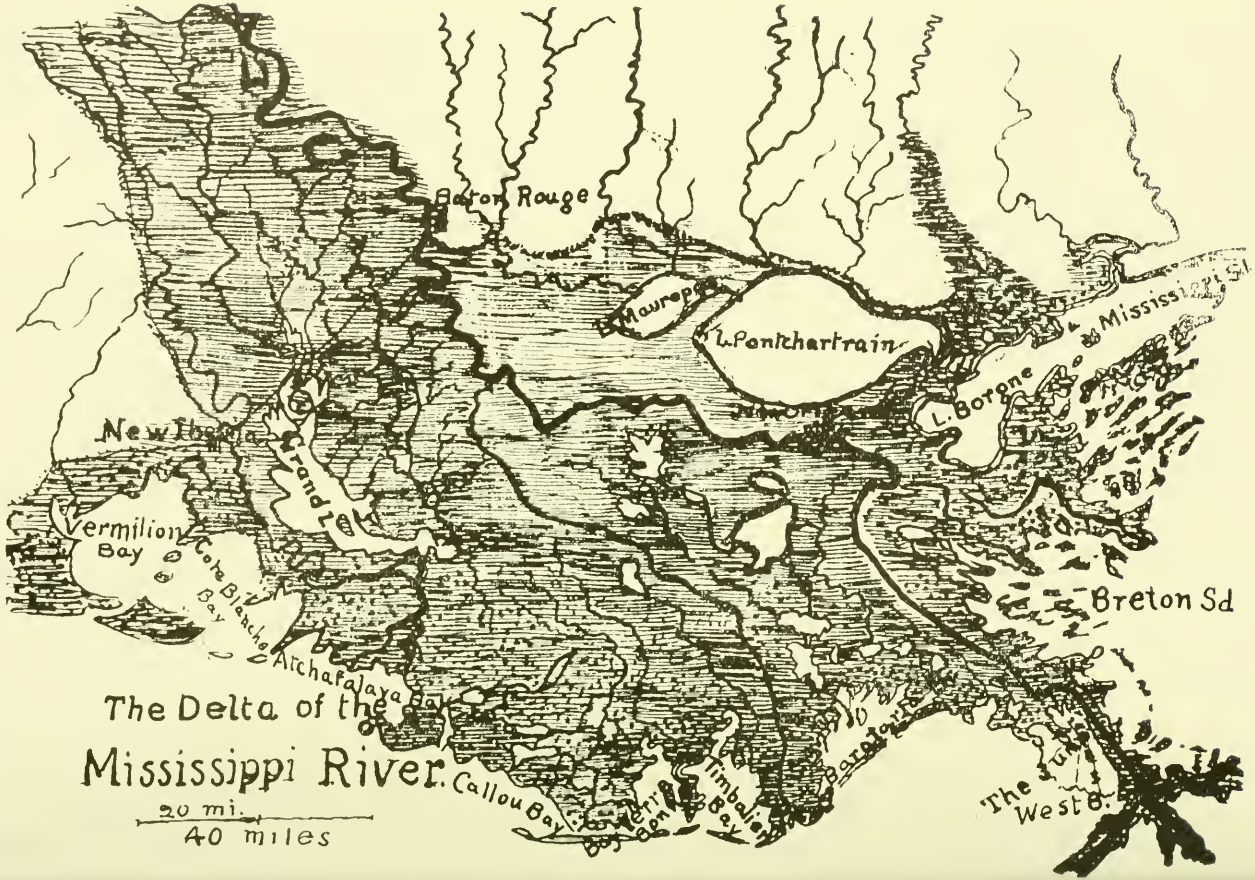
Notes on the Delta of the Mississippi River.

William A. McBeth.

The large scale map of the Alluvial Valley of the Lower Mississippi River published by the Mississippi River Commission, St. Louis, Mo., is a fine example of map making and a most valuable adjunct to geography study in the public high schools and colleges.

A study of this map reveals many interesting facts related to the growth of the delta that the stream has formed in the edge of the Gulf of Mexico. Various questions are suggested by this study. What land area has been added to the continent by the river? What facts or features observable on the map indicate delta area? What is the origin of such lakes as Pontchartrain, Maurepas and Grand? How do the lakes in the delta differ from those along the river above Baton Rouge? What do the bays along the seaward border of the delta indicate as to the manner of growth of the land area and of the origin of lakes in the delta? Why does the river become straighter toward the mouth? What is the cause of the abrupt bend just below New Orleans? Why does the river flow so persistently to the southeast through the delta?

It is generally stated that the delta extends from the mouth of Red River southward because here the distributary farthest upstream leaves the river. This statement seems somewhat arbitrarily derived from the earlier definition which describes a delta as the land included within the divided mouths of a river, rather than the land formed by a river about its mouth. A line extended from Baton Rouge to New Iberia connects the south edges of the uplands on the opposite sides of the river and seems a proper division between the filled valley above and the area of added land or delta proper. South of this line, the great fan of the delta projects, breaking the great curve of the north shore of the gulf. Below this line the shape and size of the lakes change abruptly from narrow, ox-bow lakes, formed by the river cutting across the necks of its bends, to large, broad, irregular shaped lakes, evidently formed by irregular deposit, leaving areas of the gulf unfilled. Lake Pontchartrain, for example, is a portion of the former gulf surface inclosed between the uplands to the north of it and the advancing delta on the south. Notice how near the south shore of this lake the river flows. Notice the stream from within the limits of New Orleans extending along the strip of land



The Delta of the Mississippi River.

between Lake Pontchartrain and Lake Borgne. This stream is evidently a former distributary of the main stream. The bays along the edge of the delta of which Barataria, Timbalier and Terre Bonne are examples, show how the advancing delta arms extend around areas of gulf and hem them in. Notice particularly Bay Marchand, at the mouth of Bayou la Fourche, and the separation of Timbalier and Terre Bonne bays by the long narrow delta of Bayou Terre Bonne.

This inclosing process is aided by the formation of barrier beaches from point to point by wave action. True delta area is further indicated by the straighter course of the river below Baton Rouge. The river is very meandering through the whole length of the alluvial valley on account of the gentle slope of the river bed, but below Baton Rouge it becomes increasingly straight, although in the distance of two hundred forty miles the fall is but five feet, or one-fourth inch per mile. As streams always acquire the meandering habit on gentle slopes, this apparent contradiction of the law of stream flow furnishes an interesting problem. I propose this explanation: The river flowing into the gulf produces a current some distance out from the shore along the sides of which the sediment is deposited more rapidly than in the swifter central line of flow. Finally the narrow mud banks appear above the surface along the course laid out by the current in the still waters of the gulf. The tendency to meander shown at the head of the delta indicates the inclination of the stream to conform to law. The stream is forming meanders. Below New Orleans an abrupt bend appears as an apparent refutation of the explanation of the straight lower course. This bend represents an accident in the direct forward movement of the delta. Observe the streams beginning near the eastern curve of this bend and the tract of land extending east and partially inclosing Lake Borgne and Mississippi Sound on the south. These streams and this strip of land indicate a former course of the river. A crevass across the narrow south bank caused the abandonment of the part below and the abrupt turn of the river. A crevass called "The Jump," twenty miles above the mouth of the river, indicates how a repetition of the above accident may occur. A submarine fan is approaching the surface outside of this gap. The southeast trend of the river through the delta and of the main area of the delta itself may be due to the eastward movement of the Gulf Stream off shore which deflected the incoming river current to the east.

The Poisonous Plants of Indiana.

Stanley Coulter.

It is the purpose in this paper to consider only those plants occurring within the limits of Indiana, which are said to be *contact poisons.* The list as assembled from various authorities is sufficiently extended to raise question as to the character of the facts upon which the forms were included among the contact poisons. The list, as I have been able to collate it, is as follows:

Alisma Plantago-aquatica L. Water plantain.

Arisaema triphyllum (L.) Torr. Jack in the Pulpit. Indian Turnip.

Arisaema Dracontium (L.) Schott. Green Dragon.

Spathyema fœtida (L.) Raf. Skunk Cabbage.

Veratrum viride Ait. Indian Poke. White Hellebore.

Cypripedium hirsutum Mill. Yellow Lady's Slipper.

Urtica gracilis Ait. Slender Nettle.

Urtica dioica L. Stinging Nettle.

Urticastrum divaricatum (L.) Kuntze. Wood Nettle.

Polygonum hydropiper L. Smartweed. Water Pepper.

Polygonum punctatum Ell. Water Smartweed.

Phytolacca decandra L. Pokeberry.

Actæa rubra (Ait.) Willd. Red Baneberry.

Delphinium consolida L. Field Larkspur.

Anemone quinquefolia L. Wind flower. Wild Anemone.

Clematis Virginiana L. Virgin's Bower. Wild Clematis.

Ranunculus sceleratus L. Ditch Crowfoot. Cursed Crowfoot.

Ranunculus acris L. Tall or Meadow Buttercup.

Ranunculus bulbosus L. Bulbous Buttercup.

Podophyllum peltatum L. May Apple. Mandrake.

Sanguinaria Canadensis L. Bloodroot.

Cruciferae: Various genera, including the mustards, pepper-grass and horseradish.

Drosera rotundifolia L. Round-leaved Sundew.

Ailanthus glandulosa Desf. Tree of Heaven.

Euphorbia: Not only all of the fourteen species reported from Indiana, but all of the hundred of more species occurring in the United States.

Rhus Vernix L. Poison Elder. Poison Ash. Poison Dogwood.

Rhus radicans L. Poison Ivy. Poison Oak.

Dirca palustris L. Leatherwood. Moose-wood.

Aralia spinosa L. Angelica Tree. Hercules Club.

Solanum Dulcamara L. Poison Nightshade.

Datura Stramonium L. Jamestown or Jimson-weed. Thorn Apple.

Datura Tatula L. Purple-stemmed Jimson.

Verbascum Thapsus L. Common Mullein.

Catalpa Catalpa (L.) Karst. Catalpa. Indian Bean.

Lobelia inflata L. Indian Tobacco.

Xanthium strumarium L. Cocklebur. Burthistle.

Solidago: All species to be regarded with suspicion by persons with sensitive skins. Solidago odora Ait., said to be particularly dangerous because of a "volatile oil that is an irritant and rubefacient."

Leptilon Canadense (L.) Britton. Horse-weed. Flea Bane.

Bidens frondosa L. Common Beggarticks. Spanish Needles.

Anthemis Cotula L. Common Dog-fennel.

Arctium Lappa L. Burdock.

To these may be added the commonly cultivated—

Tropæolum majus L. Nasturtium.

Nerium Oleander L. Oleander.

Primula obconica Hance. Primrose.

This is a rather startling array of dangerous plants, especially to the field botanist who has been handling most of them with perfect impunity for years. It occurred to me some years ago that it would be interesting to examine the list carefully and so far as possible to conduct a series of experiments confirming or disproving the correctness of the inclusion of the above forms in the list. This I have been able to do with the aid of a number of students who offered themselves as subjects for the experiments. In the last five years I have been able to secure twenty-two persons to aid me in the work.

The most cursory examination breaks the preceding list into two sharply separate groups. In the one the skin irritation is due to the action of some specific substance of the plant, as in the case of Rhus; in the

other the skin irritation is plainly due to mechanical causes, as in the case of Arctium and Xanthium. There seems to be no good reason why any plant with piercing surface outgrowths, such as Bur-grass (Cenchrus tribuloides L.), should not be included in the latter group and the list almost indefinitely extended. Very little was done experimentally with such plants, for though persistent and sometimes festering sores may result from handling them, the irritation is due to traumatic, not to toxic, causes.

In the first group of plants an additional separation may be made into those poisonous by mere handling and those whose poisonous properties seem to be liberated only as the result of dry trituration or grinding, the well known irritant effects of the dust arising from the dried roots of Podophyllum being a case in point.

It will thus be found that the number of plants which are really contact poisons, under ordinary handling is very much reduced and the long continued immunity of those of us who have collected widely is not after all as wonderful as it might at first seem. As a matter of fact it would seem that any plant, which in any way and under any conditions however extraordinary produced a skin irritation had been promptly placed among the contact poisons. There is also to be considered the personal idiosyncrasy. Some persons are peculiarly susceptible to plant poisons, either because of an especially sensitive skin or of some constitutional condition which makes them remarkably non-resistant to the sequelae of skin lesions of any sort. As a result of this consideration of the personal equation the list of plants poisonous by contact is still further reduced.

A rather careful experimental study of the plants in the above list has been made with the following results:

In all cases the procedure was simple but was deemed sufficient to demonstrate the poisonous or non-poisonous character of the plant. The plant was first handled freely in the way of collecting and making herbarium specimens. If after some days no results were apparent, the part of the plant said to contain the poisonous element was rubbed upon the back of the forearm until serum, and at times blood, exuded, the juice of the plant and the serum being allowed to dry upon the arm. If no results followed, it was considered safe to infer that the form was not a contact poison.

Water plantain (Alisma Plantago-aquatica L), common throughout the state in mud and shallow waters, is said by the National Dispensatory to

contain in the leaves "an acrid principle strong enough to irritate the skin." No one of the twenty-two subjects showed the slightest trace of skin irritation as the result of treatment as indicated in the preceding paragraph. The leaves were taken at different dates, but no results confirming the above statement were secured.

The Indian Turnip and Green Dragon (Arisæma triphyllum (L.) Torr., and A. Dracontium (L.) Schott) are said to be "violently acrid and almost caustic in every part, frequently producing intolerable itching and inflammation of the skin." None of the twenty-two subjects showed the slightest unpleasant results from the free handling of the above species. As a result of the more vigorous treatment five showed a vesicular inflammation lasting for three or four days. The inflammation was accompanied by considerable itching, which, however, was not so violent as to merit the term "intolerable." Of the five showing unpleasant effects, two were young ladies, who proved so susceptible to almost any type of skin lesions that they were unable to continue the work.

The Skunk Cabbage (Spathyema fœtida (L.) Raf.) is said to be "harmless as to the leaves, but with root so acrid as to produce intolerable itching and inflammation." No results were secured from frequent and rather rough handling of the roots. Later the juice was expressed by pressure and allowed to dry upon the arms, rubbed to extreme redness, of five subjects. Neither itching nor inflammation resulted. The latter test was repeated in April, May, June and September, four additional subjects being used, but in every case failing to confirm the reputation of the plant as a skin irritant.

Indian Poke (Veratrum viride Ait.), sparingly found in many localities, growing in swamps and wet woods, will, it is alleged, if "applied to the skin in moist condition cause redness and burning." The plant is so occasional in its occurrence that it need scarcely be taken into account. Two experiments upon myself gave absolutely no redness or burning. It is, however, fair to state that these experiments should not be regarded as determinative, since not even the poison ivy (Rhus radicans L.) produces any skin irritation, except when the skin has been rubbed to redness with the crushed leaves and the juice allowed to dry upon the surface.

Cypripedium hirsutum Mill., the Yellow Lady's Slipper or Moccasin flower, is said to be "irritating to the skin, in some cases poisoning as severely as Rhus." Eleven out of the twenty-two persons experimented

upon showed unpleasant effects from the mere handling of this species in collection and determination. Six others were poisoned as a result of the rubbing process, only five escaping entirely. In almost every class I have numerous cases of poisoning easily referable to this form. The poisonous property seems most active during the flowering season, the plant being practically innocuous after seed maturation. The effect shows first as a hyperæmia, later becoming vesicular and even pustular if untreated. It yields readily, however, to ordinary emollient treatment and can be fairly limited in its spread by frequently bathing the adjacent parts with alcohol. My attention was first called to the poisonous character of the plant by Dr. D. T. MacDougal and continued observation but serves to confirm the view that many cases of poisoning attributed to the poison ivy should be referred to this species. The attractiveness of the flower serves to lead many persons to collect it in large masses and if the results reported above are at all indicative, it is doubtless chargeable with many cases of poisoning occurring in the early spring.

The nettles including Urtica dioica L., Urtica gracilis Ait. and Urticastrum divaricatum (L.) Kuntze, poison through the action of acrid constituents, producing an intolerable burning. The inflammation, however, yields so readily to treatment by cooling lotions and is so ephemeral in its character if untreated, that the plants are to be considered as annoying rather than poisonous. None of twenty-two subjects escaped the intense burning following the handling of these forms. The inflamed condition never persisted over two or three hours even after a rather vigorous whipping of the skin with the plants.

Of the Smartweeds, two, Polygonum hydropiper L., and P. punctatum Ell., it is said "cause itching and burning of the skin." In the experiments tried this proved true if the expressed juice was applied to mucous membranes, especially those of the eye. In no case was any irritation observable where the application was to the skin. In this case also, the irritation was but temporary and yielded readily to bathing the affected parts in cold water.

That Pokeberry (Phytolacca decandra L.) contains a principle which is an internal poison is well known. The claim, however, that the "green plant and root irritate the skin, affecting chiefly mucous membranes," does not seem to be so well made out. Only eight subjects were treated with this species and in no instance were any inflammatory symptoms ob-

servable. Later the dried root was ground and a very annoying and somewhat persistent irritation of the mucous membranes of the eye resulted, yielding only to treatment by an oculist. It is fair inference that no part of the Pokeberry is a contact poison in the ordinary acceptance of the term, although the plant does possess a poisonous principle which under exceptional conditions may produce an inflammation of a somewhat obstinate and therefore serious character.

The Baneberry (Actæa rubra (Ait.) Willd.) is said to contain a "vesicating principle." Experimentation upon fifteen subjects failed to verify this statement. In this case, as in all others where negative results were obtained, the experiments were repeated several times at different stages of the development of the plant.

The Field Larkspur (Delphinium consolida L.) is also claimed to be a skin irritant. "A specific element in the seeds produces in tincture great burning and inflammation of the skin." The experiments upon this form were unsatisfactory because of the small amount of material available. The tincture applied to the skin produced some slight burning and inflammation, although the latter was no greater than would be expected from a similar treatment with pure alcohol. Evidently, however, the Field Larkspur is in no sense to be considered a plant dangerous to handle.

The Wild Anemone or Wind flower (Anemone quinquefolia L.), said to be "irritating to the skin, producing redness and itching," was found, so far as the experiments went, to be perfectly innocuous, not even those who were most susceptible to skin irritations showing the slightest sign of inflammatory symptoms.

The Virgin's Bower or Wild Clematis (Clematis Virginiana L.), said to contain an "acrid irritant producing blisters", affected nine out of seventeen subjects; four by the mere handling, the other five as a result of rubbing the skin with the leaves and flowers. A marked hyperæmia preceded the vesicular stage of the inflammation, which in no case was of more than three days duration.

Three of the Crowfoots or Buttercups (Ranunculus sceleratus L., R. acris L., and R. bulbosus L.), it is alleged, "cause inflammation and ulcers, the root being especially rich in poisonous substances." Of these R. sceleratus and R. bulbosus are sufficiently occasional in our area to be neglected. R. acris, also, as at present delimited by systematists, is of relatively scant occurrence in Indiana. Seven subjects were used. None

showed any ill effects from treatment with aerial parts. Two showed sharp inflammation from rubbing the skin with the root, but neither showed any indication of ulcers although the inflammation was left untreated. Inflammatory symptoms disappeared at the end of the sixth day, in both cases.

The familiar May Apple (Podophyllum peltatum L.) has been included in the lists of plants poisonous by contact from the earliest times. Both leaves and roots are said to be "poisonous and drastic" by some authors; others content themselves with the statement "rather poisonous"; still others attribute the "poisonous principle chiefly to the root, the powder of which affects the mucous membranes." Of the truth of the last statement there can be no doubt, as scores of careless or ignorant workers in the laboratories of manufacturing pharmacists can testify. Concerning the other two, there is at least room for reasonable doubt. No record has come to my notice of any case of poisoning from the mere handling, and I have in the past few years directed the work of classes in such a way as to secure the maximum amount of handling of every part of the plant. Twenty subjects submitted to the rubbing process, using aerial parts of the plant, and nineteen showed no signs of inflammation. One was a subject referred to in a previous paragraph as peculiarly susceptible to inflammation after skin lesions of any sort. In this case a rather persistent inflammation followed the experiment, requiring between two and three weeks' treatment before it was completely reduced. Five submitted to the rubbing process with fresh roots with no untoward results. The irritating effect of the dry powder of the root upon mucous membranes was considered too well established to need verification. It is a safe inference that any part of the May Apple may be handled with safety, even the dry root being apparently harmless, and only irritating when in the form of a finely comminuted powder.

The common Bloodroot (Sanguinaria Canadensis L.) is another plant regarded with suspicion by some authors. It is said that the "dust of the dried root is irritating and that frequently the handling of the root poisons." No experiments were made as to the effect of the dust produced by the grinding of dried roots, but both dried and fresh roots were persistently handled without record of poisoning in a single case out of seventeen. Seven showed no ill effects from rubbing the arm with the fresh root.

The Cruciferæ named are such well known irritants as to need no special discussion, although in none of the forms did any irritation arise from a free and rather rough handling of the plants.

The round leaved Sundew (Drosera rotundifolia L.) is classed as a skin irritant. It is so rare in our area that it scarcely deserves mention. Experiments were possible only with dried specimens. Of the five subjects selected none showed any signs of skin irritation as a result of either treatment. The material used was collected in August, the experiments were made the following February, the plants having been subjected to the usual drying.

The Tree of Heaven (Ailanthus glandulosa Desf.), it is said, "should be regarded with suspicion." No experiments were tried with this form and a somewhat extended examination fails to reveal any instance in which poisoning resulted from its handling. Personally I have handled it for years, and have rather encouraged classes to handle it but have failed utterly to find the form at all poisonous or even irritating.

Of the Spurges (Euphorbias) more than one hundred species occur in the United States. Loudon says of them, "Every one is so acrid as to corrode and ulcerate the body wherever applied." This somewhat vigorous arraignment of the genus does not seem fully justified by the behavior of the local forms. In the experiments upon ten subjects E. maculata L., E. humistrata Engelm., E. nutans Lag. and E. commutata Engelm., produced no ill effects from handling. Rubbing the arm vigorously with the crushed plants and allowing the latex to dry produced a marked irritation in five of the ten subjects and a light vesicular inflammation in another. The inflammation was somewhat obstinate, in two cases requiring the attention of a physician. In the case of the flowering Spurge (Euphorbia corollata L.) six out of ten subjects were distinctly poisoned by merely handling the plant in its flowering condition. In this case the plant was gathered in masses as for decorative purposes, thus attempting to imitate the manner in which this attractive form is usually handled. Allowing the latex to dy upon the arm caused evident poisoning in nine of the ten cases. The experience with the other species named above led to the prompt treatment of the inflammations, so that nothing can be said as to the persistence or ultimate character of the irritation. The inference may be drawn that the majority of our native spurges are not such virulent contact poisons that they can not be handled in the ordinary way without danger. Euphorbia corollata is, however, to be regarded as dangerous,

especially in the flowering period, and, as that extends from April to October, it is probably to be avoided at all times. Apart from the results of these experiments I have records of twenty-three cases of poisoning unmistakably chargeable to this form. In my opinion many cases of poisoning attributed to Rhus are to be referred to this species.

Of the Sumach, the poison ivy (Rhus radicans L.) is perhaps the most familiar, although the poison elder (Rhus Vernix L.) is by far the more poisonous. According to Robert Hessler, M. D.,[1] "Many persons proof against the common poison ivy readily succumb to this species." Fortunately the restricted range of the species, it being confined to the swamp regions of the northern part of the state, its favorite location being tamarack swamps, prevents it from being as dangerous as its virulence would indicate. The poison ivy, however, because of its almost universal distribution through the state is perhaps the most dangerous of the plants in the list. In the experiments, seventeen out of twenty-two poisoned by merely handling the plant. The remaining five responded vigoriously to the rubbing process. The character of the inflammation is too well known to need description in this connection. One of the subjects, a young man of about twenty-two, who was poisoned as the result of "rubbing," allowed himself to go without treatment for three weeks, in order that he might determine whether or not he would in the future be more susceptible to ivy-poisoning. His case of poisoning was quite severe, involving the whole arm and spreading to the neck, being perhaps more serious than ordinary cases. He wrote me last summer that he had not since the experiment escaped with less than two or three poison attacks a year. I have heard from two others that they also have poisoned since that time by the slightest contact with poison ivy. On the other hand, the other two members of the group of five do not seem to poison any more readily than before the experiment. In the poison ivy, also, the poisonous principle seems most active during the flowering season. The statement that Rhus poisoning occurs from the handling of dried herbarium specimens has not proven true in my experience. Determinative material placed in the hands of class after class, has never caused a single case of poisoning. It is fair to conclude that two out of three persons will be more or less affected by simply handling poison ivy, and perhaps nine out of ten if the plant is handled at all roughly. No other one of our indigenous plants is so generally poisonous.

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[1] Proc. Ind. Acad. Sci., 1896, p. 21.

It is said of the Leatherwood (Dirca palustris L.) that the "fresh bark applied to the skin causes redness and vesication and sores, which are very difficult to heal." Eight subjects were treated by binding pieces of freshly stripped bark upon their arms, allowing them to remain for periods ranging from two to twenty-four hours. Six showed no evil effects of any kind, while in the cases of the other two a somewhat painful hyperæmia resulted, easily reduced by an application of vaseline. Somewhat strangely, the two affected represented the extremes of time, two and twenty-four hours. Three other students chewed the fresh bark for a few minutes and in each case an extremely painful blistering of the mouth resulted. In my own case, tried subsequently, the mucous membranes of the mouth did not become normal for nearly a month. In the ordinary use of the term, the leatherwood is not a contact poison, although in exceptional cases it may prove such.

Aralia spinosa L., Angelica Tree or Hercules Club, was found without irritating principle in three cases, the small amount of material available precluding more extended experimentation. It is claimed that "green bark from roots or small shrubs acts as an irritant." As far as the results go the statement is without foundation.

It is the popular belief that Solanum Dulcamara L., poison or purple-leaved nightshade is one of the most virulent contact poisons. By some authorities it is claimed to be an even more virulent skin poison than poison ivy, the symptoms being similar, but the poison much more difficult to eradicate from the system. Tests made upon fifteen subjects failed utterly to justify the popular view. The plants were used in all stages and at all seasons, but in every case without the slightest irritation. I have tried many times to poison myself with this species, frequently taking plants selected by persons who claimed an absolute knowledge of the poisonous character of the form and always without untoward results. The result of these experiments makes it almost certain that the purple-leaved nightshade should not be considered as one of our poisonous plants.

The "Jimson" weeds (Datura Stramonium L. and D. Tatula L.) also have a bad reputation. Fourteen subjects were tested and in no case was there any sign of inflammation. No experiment was made to verify the statement that the forms "occasionally cause a swelling of the eyelids." It is probable that none of our native species of Solanaceae are as poisonous as the foliage of the potato and tomato, to which frequent cases of skin poisoning may be definitely referred.

The common Mullein (Verbascum Thapsus L.) is irritating to the skin because of its wooly hairs, the leaves being often applied to the throat for the rubefacient effect. Its action is so evidently mechanical that no experiments were tried.

The flowers of the Catalpa (Catalpa Catalpa (L.) Karst.) are said to be irritant to many persons, causing "reddening of the skin." In experiments tried and often repeated upon twenty subjects, no such results were obtained, although in some cases the flowers were rubbed upon the cheeks vigorously, the juice being allowed to remain for several hours. I have also been unable to find any definite record confirming the statement.

Indian Tobacco (Lobelia inflata L.), "when applied to the skin is capable of producing irritation." Experiments upon fifteen persons failed to confirm this alleged fact.

The Cockleburs (Xanthium) are irritant on account of dust and hairs with which they are covered and not because of a toxic principle. No experiments were made with this form.

Of the Goldenrods (Solidago) the statement is made that the "whole family is to be regarded with suspicion by persons with sensitive skin. Solidago odora Ait. possesses a volatile oil that is an irritant and rubefacient." Twenty-two persons were subjected to tests with various species of goldenrod, but no results were obtained to indicate the presence of a toxic element in our native species. Solidago odora was used with five subjects without resulting inflammation. It is extremely doubtful whether any skin irritation is produced by species of this genus save through mechanical causes.

The common Fleabane (Leptilon Canadense (L.) Brit.) it is said "contains a volatile oil possessing irritating qualities to those handling." Eleven persons were used in experiments upon this form. Two had skin irritations following the free handling of this plant. Five others were poisoned by the "rubbing" process. Four were unaffected under either procedure. In this case also, the maximum point of the toxic principle seemed to be the flowering season.

Common Beggar Ticks or Spanish Needles (Bidens frondosa L.), it is alleged, "causes itching on handling." Out of fifteen persons this was found to be true in three cases, one of them being peculiarly susceptible to skin irritation, as mentioned in a preceding paragraph. Four others were affected by the "rubbing" process. The remaining eight reported no change in skin sensations.

Ordinary Dog-fennel (Anthemis Cotula L.) was found to affect seven out of twenty persons as the result of free handling. Seven others were poisoned following rubbing and six were unaffected. The statement that the "juice is sufficiently acrid to poison sensitive skins" seems borne out by the results.

Arctium Lappa L., or Burdock, is a skin irritant through mechanical action, the dry burs producing the most serious inflammations, although the leaves, because of their roughness, are also irritant. The resultant inflammations after handling were so evidently traumatic that no experiments were made.

It is claimed that the ordinary cultivated Nasturtium (Tropæolum majus L.) "in exceptional cases produces dermatitis." Repeated experiments with all parts of the plant upon twenty-two subjects failed to give any verification to this statement. After extended inquiry I have failed to find any person who knew of any case of poisoning due to this plant.

The Oleander (Nerium Oleander L.), so largely cultivated, is probably under certain conditions poisonous. "An acrid principle in the leaves affects some people as Rhus." Loudon contents himself with saying "it is poisonous." Figuier calls it a "formidable poison." Van Hasselt says it causes "an internal burning and itching when rubbed in the skin." Five persons were experimented upon in the manner indicated by Van Hasselt and all suffered a greater or less irritation accompanied by burning and itching. It is probable that the thick-walled epidermal cells prevent poisoning in the ordinary handling of the plant. The most painful case of skin poison I experienced was from the oleander. It was, however, of short duration and in none of the cases indicated the persistence or tendency to recurrence of Rhus.

Of the cultivated Primroses, one, Primula obconica Hance, is occasional irritant. The cause, however, is plainly enough traumatic. No experiments were undertaken, although I know of one case in which the handling of this species is invariably followed by an annoying skin irritation.

The results of these experiments may be summarized as follows:

1. The great majority of the plants included in the preceding list are harmless under ordinary handling.

2. Some of these may act as skin irritants as the result of prolonged application or unusually rough handling. Careful washing after handling any of the forms will reduce the danger to a minimum.

3. The following species are definitely contact poisons, arranged in order of their virulence.

Rhus Vernix L.

Rhus radicans.

Euphorbia corollata.

Cypripedium hirsutum.

Anthemis Cotula.

Leptilon Canadense.

Clematis Virginiana.

Bidens frondosa.

The nettles are not included in this list on account of the ephemeral character of the irritation they produce, nor are there included a number of forms which poison under unusual conditions, such as grinding or long continued applications.

4. Of the plants named, the two species of the genus Rhus are the only ones affecting all upon whom experiments were tried, if we except the nettles.

5. Sixteen plants included in the list proved absolutely harmless under the conditions of the experiments. Probably all in the list with the exception of the first three or four may be safely handled under ordinary conditions.

The data bearing upon conclusion 3 may be tabulated as follows:

	Number of Subjects in Experiment.	Affected by First Method.	Affected by Second Method, Additional.
Rhus Vernix	No	Experimen	ts.
Rhus radicans	22	17	5
Euphorbia corollata	10	6	3
Cypripedium hirsutum	22	11	6
Anthemis Cotula	20	7	7
Leptilon Canadense	11	2	5
Clematis Virginiana	17	4	5
Bidens frondosa	15	3	4

Amphispores of the Grass and Sedge Rusts.

J. C. Arthur.

(Abstract.)

The paper described and illustrated the uredospores and amphispores of five species of *Puccinia* from central United States, and one species of *Uromyces* from Northern India, all occurring upon various kinds of grasses; they were *P. vexans* Farl., *P. Tripsaci* D. & H., *P. Stipæ* Arth., *P. tosta* Arth., *P. Cryptandri* E. & B., and *U. Rottboelliæ* Arth. It also described and illustrated the amphispores, the uredospores not being known, of three species of *Puccinia* from the United States occurring upon different species of *Carex;* they were *P. Caricis-strictæ* Diet., *P. atrofusca* (D. & T.) Holw., and *P. Garrettii* Arth. These are all the species of rusts so far known to possess amphispores. This kind of spore is the resting or winter form of the uredospore. They are not uredospores, however, accurately speaking, because they show distinct structural differences, often very great, and are correspondingly modified physiologically.

Ecological Notes on the Birds Occurring Within A Radius of Five Miles of the Indiana University Campus.*

By Waldo Lee McAtee.

With Photographic Illustrations by Clarence Guy Littell.

At various times since 1883 students of Indiana University interested in birds have kept records of the migrations, breeding habits, etc., of the birds within a radius of several miles of Bloomington. Twenty sets of migration records, covering fourteen seasons, are on file in the archives of the Biological Survey at Washington, D. C.

Three lists of birds have been prepared by former students.

W. S. Blatchley in 1886 recorded the "Winter Birds of the Vicinity of Bloomington, Indiana," in the Hoosier Naturalist I, pp. 169-171.

B. W. Evermann published a list of "Birds of Monroe County, Indiana," in the Hoosier Naturalist II, pp. 137-145 and 164. He enumerates 179 species.

C. H. Bollman listed 192 species in an unpublished paper on file in the Biological Survey.

"The Hoosier Naturalist," in which Evermann's and Blatchley's lists were published has long been extinct and the two papers are not accessible.

Some of the above lists and part of the migration records were used by Amos W. Butler in his "Birds of Indiana" published in the 22d Annual Report of the Department of Geology and Natural Resources, Indianapolis, 1897.

Pertinent facts contained in the above sources have been brought together in the present paper. They have been confirmed or supplemented by the author's observations extending through the last four years. While the material presented is chiefly of local interest it contains additions to our knowledge of the birds of Indiana and the more general subject of bird migration. Wherever possible, the authority for any state-

*Contributions from the Zoölogical Laboratory of Indiana University, under the direction of C. H. Eigenmann. No. 60.

ment is indicated. When no authority is given the author is responsible for the data.

The following is a list of observers most quoted. Their initials are used to indicate their authority.

V. H. Barnett.
W. S. Blatchley.
C. H. Bollman.
C. H. Eigenmann.
B. W. Evermann.
W. L. Hahn.
P. J. Hartman.
C. H. Kennedy.
E. M. Kindle.
C. G. Littell.
W. L. McAtee.
N. B. Myers.
A. B. Ulrey.
G. G. Williamson.

When other authorities are quoted their names are given in full.

To make the facts contained in this paper more readily accessible to teachers and students they have been placed in tabular form and appear at the end of the paper. The table and the index were prepared by C. H. Frazee and Leonard Haseman.

The region over which observations have been made, embracing the territory within about five miles of Bloomington, is varied in its topography. On the east and north are many rocky ravines, some of them containing cascades. At Bloomington, to the south of it and some distance to the west the surface is gently rolling and has typical features of the oölitic limestone area of Indiana. To the west in the Mitchell limestone area the surface is pitted with various sinkholes beneath which are caves of considerable extent. Bloomington and the area about it are well drained by rock bound brooks running in part to the north through Rocky Branch, Griffy Creek and Bean Blossom, finally flowing into the North Fork of White River. Other brooks, the Jordan River and Clear Creek drain the southern part of Bloomington through Clear Creek into the East Fork of White River. The extreme eastern part of the area is drained into Salt Creek and thence into the East Fork of White River. The western part

is rich in springs and sinkholes filled with water, the general trend of the underground drainage of this area being southward. There are no large streams or other large bodies of water or swamp in the region under consideration. Two artificial ponds have been constructed in recent years, a smaller one which supplies the Monon R. R. yards with water and a larger one which is the storage reservoir of the Bloomington waterworks.

The region is fairly forested, largely by second growth timber, though in some parts of the Knobstone region the primeval forests remain.

The area is not well suited to aquatic birds but offers many favorable localities to terrestial migrants and residents.

The total number of species recorded is two hundred and twenty-five, and includes seventy per cent. of the birds recorded from the entire State. Of this number ninety-eight nest here and thirty-nine of the breeding birds are also permanent residents. Twenty-one are winter visitants. Ninety-six are migrants and are seen during a few days in spring and fall. Six are extinct, two are included on rather doubtful evidence, and one is a hypothetic species. The last three groups are included in the supplemental list. One hundred species have been observed on or over the University Campus.

Each species which has been observed on or over the campus of Indiana University is marked by an asterisk. In cases of species which are either winter or summer residents, the recorded extremes of their stay are given. In the case of transients the limits of their arrival and departure are given for both of the migratory seasons. Extinct and hypothetic species are referred to a supplemental list. The numbers in brackets and the nomeclature are those of the A. O. U. check-list.

I am under obligations to Prof. W. W. Cooke and Mr. A. W. Butler for permission to examine migration schedules.

1. [3] *Colymbus auritus* Linn. Horned Grebe.

Common migrant. April 11 to 24. This species is classed as a common migrant wholly upon evidence obtained in the spring of 1903. It had not heretofore been recorded from the county, but circumstances lead me to believe that it has merely been overlooked. The first specimen was obtained April 11, by Mr. J. J. Batchelor and Mr. James Simonton. Three others were seen that day. The following numbers were seen at the dates given:—7, April 12; 4, April 13; 2, April 17; 2, April 18; 2, April 19, and 2, April 24.

2 [6] *Podilymbus podiceps* (Linn.). Pied-billed Grebe.

Common migrant. March 5 to April 29 and October 7 to November 30. May be found in nearly any sink or quarry-hole during the migratory season.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.
Observer	C. H. B.	C. H. B.	G. G. W.	G. G. W.
First seen	4-3	.....	4-10	3-26
Next seen	4-4	.....	4 16	.....
Common	.....	.....	.....	.....
Last seen	.....	10-7	.....	.....
Abundance	Common.	Not common	.....	Not common

Year	1899.	1899.	1902.	1903.
Observer	N. B. M.	.....	W. L. H.	W. L. M.
First seen	4-19	.....	.....	3-8
Next seen	.....	.....	.....	4-19
Common	.....	.....	.....	4 27
Last seen	.....	11-30	4-29	4-29
Abundance	Rare.	.....	.....	Common.

3. [7] *Gavia imber* (Gunn.). Loon.

Common migrant. April 1 to May 11. Loons may be seen on the larger ponds any morning after a stormy night in April. Before the waterworks and railroad reservoirs were made these birds were not seen. Bollman and Evermann do not give the Loon in their lists of 1886 and 1887.

MIGRATION RECORD.

Year	1886.	1903.
Observer	B. W. E.	W. L. M.
First seen	4-1	4-13
Next seen	.....	4-15
Common	.....	4-15
Last seen	.....	5-11
Abundance	.....	Common.

4. [68] *Larus philadelphia* (Ord). Bonaparte's Gull.

Rare migrant. One record April 16, 1903. A flock of one hundred "gulls" of three sizes was reported in April, 1902, by J. J. Batchelor. From his descriptions I concluded that these were either Forster's or the common Tern, and Bonaparte's and the Herring Gull. When these birds appear so far from any large body of water it is always after a period of very high winds.

5. [69] *Sterna forsteri* Nutt. Forster's Tern.

Rare migrant. Four seen May 13, 1903.

6. [70] *Sterna hirundo* Linn. Common Tern.

Not common migrant (C. H. B. '86).

7. [120] *Phalacrocorax dilophus* (Swain). Double-crested Cormorant.

Rare transient (C. H. B. '86). May 3, 1885 (C. H. B.).

8. [129] *Merganser americanus* (Cass.). American Merganser.

Common migrant. In 1887 B. W. Evermann classed it as not common. In late years, however, the Fish Duck has become a common spring visitor to the reservoirs.

MIGRATION RECORD.

Year	1903.
Observer	W. L. M.
First seen	4-16
Next seen	4-19
Common	5-14
Last Seen	5-14
Abundance	Common.

9. [131] *Lophodytes cucullatus* (Linn.). Hooded Merganser.

Common transient (C. H. B. '86). March 4, 1885 (C. H. B.). Several specimens, without dates, are in the University collection.

10. [132] *Anas boschas* Linn. Mallard.*

Abundant migrant. February 10 to April 23. After the example of Prof. W. W. Cooke all records simply given as "ducks" are referred to this species.

MIGRATION RECORD.

Year	1886.	1892.	1903.
Observer	B. W. E.	E. M. K.	W. L. M.
First seen	3-1	.....	2-10
Next seen	3-4	.....	3-8
Common	.....	4-3	4-23
Last seen	.....	.....	4-23
Abundance	.....	.....	Common.

11. [139] *Nettion carolinensis* (Gmel.). Green-winged Teal.

Not common migrant (B. W. E. '87). March 4 to April 17.

MIGRATION RECORD.

Year	1886.	1903.
Observer	B. W. E.	W. L. M.
First seen	3-4	4-10
Next seen	3-5	.....
Common	.....	.....
Last seen	.....	4-17
Abundance	Not common	Not common

12. [142] *Spatula clypeata* (Linn.). Shoveller.

Common migrant. March 20 to May 8. The first migrants are males and are seen in small numbers; later in the season the flocks are mixed, but the females are then generally in the majority.

MIGRATION RECORD.

Year	1886.	1896.	1902.	1903.
Observer	B. W. E.	W. S. B.	W. L. M.	W. L. M.
First seen	.....	.....	.....	3-20
Next seen	.....	.....	.....	4-5
Common	.....	.....	.....	4-19
Last seen	5-8	5-8	4-13	4 21
Abundance	Not common	.....	.....	Common.

13. 143 *Dafila acuta* (Linn.). Pintail.

Rare migrant. Feb. 26 to March 4.

MIGRATION RECORD.

Year	1886.	1902.
Observer	B W. E.	W. L. M.
First seen	2-26	3-1
Next seen	3-4	.....

14. [144] *Aix sponsa* (Linn.). Wood Duck.*

Rare migrant. March 24 to May. Formerly a common summer resident (C. H. B. '86), and the most common duck, often seen near the campus (B. W. E. '87). Reported breeding in 1887 (G. G. W.), and in recent years (A. W. Butler, '97). At present this duck is extremely rare; the only one reported since 1897 was seen in May, 1902 (T. J. Headlee).

MIGRATION RECORD.

Year	1885.	1887.
Observer	C. H. B.	G. G. W.
First seen	3-31	3 34
Next seen	4-1	3-26

15. [146] *Aythya americana* (Eyt.). Redhead.

Although this bird is a common migrant in neighboring localities, there is but one record of its occurrence here. Four were taken March 20, 1903.

16. [147] *Aythya vallisneria* (Wils.). Canvas-back.

Common migrant (C. H. B. '86). Common April 23, 1903.

17. [148] *Aythya marila* (Linn.). American Scaup Duck.

One record. March 4, 1886 (B. W. E.).

18. [149] *Aythya affinis* (Eyt.). Lesser Scaup Duck.*

Common migrant. March 9 to May 8. The Little Blue-bill is the most common duck. As is the case with the Shoveller, the first migrants are males. The females, however, are present in larger numbers than the males in the flocks seen later in the season.

MIGRATION RECORD.

Year	1885.	1886.	1902.	1903.
Observer	C. H. B.	B. W. F.	W. L. M.	W. L. M.
First seen	3-30	.....	3-27	3-9
Next seen	.....	.....	4-5	1-5
Common	.....	.....	.....	4-21
Last seen	.....	5-8	4-19	4-26
Abundance	.....	.....	Common.	Common.

19. [151] *Clangula clangula americana* (Bonap.). American Golden-eye.

Rather common migrant. There are several records, but the only date at hand is March 1, 1902.

20. [153] *Charitonetta albeola* (Linn.). Buffle-head.

Very rare migrant (B. W. E. '87). March 5, 1886 (B. W. E.).

21. [166] *Oidemia perspicillata* (Linn.). Surf Scoter.

Rare: one seen in 1886, "a storm duck" (C. H. B.). Of very unusual occurrence away from large bodies of water in this latitude. The only other records for the State are for the year 1875.

22. [167] *Erismatura jamaicensis* (Gmel.). Ruddy Duck.

Not common migrant. April 24, 1903.

23. [169.1] *Chen caerulescens* (Linn.). Blue Goose.

Rare migrant (C. H. B. '86).

24. [172] *Branta canadensis* (Linn.). Canada Goose.*

Common migrant. February 17 to April 12. October 31 to November 24. On two occasions, 3—2, '02 and 2—17, '03, Wild Geese were seen flying south. On both of these dates there was a sudden drop in the temperature, in the latter case to six degrees below zero. Those seen 4—12, 1903, were flying through a driving rain. A Canada Goose remained about the campus of the University for about a week ending 3—27, '02. At nights it flew in all directions over the campus from pond to pond, and its loud calling provoked a still more vociferous demonstration from the watchdogs below.

MIGRATION RECORD.

Year	1885.	1885.	1900.	1902.	1902.	1903.
Observer	C. H. B.	C. H. B.	N. B M.	W. L. M.	W. L. M.	W. L. M.
First seen	3-11	.....	3-3	3-2	.....	2-17
Next seen	.....	.....	3-8	.....	.....	3-2
Common	.....	.....	.....	3-2	.....	.....
Last seen	.....	11-24	.....	.....	10-31	4-12
Abundance	Common.	Not common	.....	Common.	Common.	Common.

25. [190] *Botaurus lentiginosus* (Montag.). American Bittern.*

Rather rare migrant. April 5 to May 13, August 7 to October 22. Most often seen on the weedy margins of a pond but not rarely in the open glades of a forest, or in the pine groves where they flap heavily from treetop to treetop, making a tremendous clatter in rising and alighting.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1888.	1892
Observer	C. H. B.	C. H. B.	B. W. E.	.....	A. B. U.
First seen	.....	8-27	.....	4-27 ††	4-23
Next seen	.....	9-*	.....	.....	5-†
Common	.....	.....	.....	.....	.....
Last seen	5-13	10-22	5-5	.....	.....
Abundance	Rare.	Rare.	Not common	.....	.....

*Foster Hight. † E. M. K. †† Wylie and Mitchell.

Year	1900.	1901.	1902.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-17	4-25	.....	4-5
Next seen	.....	4-29	.....	4-21
Commmon	.....	.....	.....	.....
Last seen	.....	.....	5-4	4-22
Abundance	.....	.....	.....	Rath'r rare

26. [191] *Ardetta exilis* (Gmel.). Least Bittern.

Rare migrant. One was taken alive and kept in the laboratory for a week in May, 1902. It was fed small fishes, which it swallowed readily. Its appetite was amazing but was the cause of its death. A large mass of fish bones became stuck in its œsophagus and put an end to his gastronomic feats and to his career.

27. [194] *Ardea herodias* Linn. Great Blue Heron

Rather rare migrant. March 12 to April 30. August 25.

MIGRATION RECORD.

Year	1885.	1886.	1901.	1902.	1903.
Observer	C. H. B.	W. S. B.	W. L. M.	Bicknell.	W. L. M.
First seen	3-25	4-8	4-22	.....	3-12
Next seen	3-26	.....	.....	.....	.....
Common	.....	.....	.....	.....	.....
Last seen	.....	.....	.....	8-25	4-30
Abundance	Not common	.....	.....	.....	Rath'r rare

28. [196] *Herodias egretta* (Gmel.). American Egret.

Rare migrant, not observed since 1887. "The earliest record for Indiana is that given by Prof. Evermann from Bloomington, April 10, 1887" (A. W. Butler). Evermann also says a few were seen in August, 1886. C. H. Bollman called it a rare transient in 1886, but makes the remark that it might be added to the list of summer residents as he had taken it July 29, 1885. It has also been taken in this county by I. N. Corr and S. E. Meek.

29. [201] *Butorides virescens* Linn. Green Heron.* Figs. 1–5.

Common summer resident. April 10 to September 22. In 1901 C. E. Edmonson found a colony of ten or twelve nests in a small clump of cedars near the water-works reservoir. June 3, 1901, a nest was found in a small cedar, about 50 yards from a pond. It was 25 feet high in a dense thicket of small trees. The nest was poorly made of sticks and the eggs were visible from below. There were 5 eggs. On June 11 these were hatched, and on the 19th the young were well covered with down and were hopping around among the branches (W. L. H.). May 11, 1903, a Green Heron's nest with 6 eggs was found 13 feet up in an apple tree in an orchard. Five eggs were in the lower layer, the sixth on top. There was another nest about 20 feet up in an adjoining

tree, which contained four eggs. The eggs in the first nest were hatched May 29 (C. G. L.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1893.
Observer	C. H. B.	C. H. B.	C. H. B.	E. M. K.	E. M. K.
First seen	4-17	.....	4-24	4-22	4-17
Next seen	4-18	.....	4-29	.....	.....
Common	4-28	.....	.....	.....	.....
Last seen	.....	9-22	.....	.....	.....
Abundance	Abundant.	.....	Abundant.	Rare.	Rare.

Year	1899.	1900.	1902.	1903.
Observer	N. B. M.	N. B. M.	C. H. K.	W. L. M.
First seen	5-16	4-17	4-23	4-10
Next seen	.....	5-2	.....	4-14
Common	.....	5-12	.....	5-11
Last seen	.....	.....	.....	.....
Abundance	Common.	Common.	.....	Common.

30. [204] *Grus americana* (Linn.). Whooping Crane.

"Mr. Charles Dury, of Cincinnati, O., informs me that there is a specimen in the Cuvier Club in that city that was taken near Bloomington, Ind." (A. W. Butler.)

31. [214] *Porzana carolina* (Linn.). Sora.

Rare migrant. B. W. Evermann says it is not often seen and gives two dates—May 5, 1886, and April 15, 1887. C. H. Bollman, '86, records it as a transient. It was also seen May 8, 1900. (N. B. M.)

32 [215] *Porzana noveboracensis* (Gmel.). Yellow Rail.

Not common. (B. W. E. '87.) "Prof. Evermann met with it near Bloomington in August, 1885, where one specimen was taken alive in a marsh" (A. W. Butler).

33. [219] *Gallinula galeata* (Licht.). Florida Gallinule.

Rare migrant. Two specimens taken May 10, 1880, by H. S. Bates.

34. [221] *Fulica americana* Gmel. American Coot.

Rare migrant. April 12 and 26, 1903 (W. L. M.), and April 17, 1900 (N. B. M.).

35. [228] *Philohela minor* (Gmel.). American Woodcock.

Reckoned as a common summer resident in 1886, this bird can now be ranked only as a rare migrant.

MIGRATION RECORD.

Year	1885.	1902.	1903.
Observer	C. H. B.	W. L. M.	W. L. M.
First seen	3-29	3-4	4-19
Next seen	.....	.....	.....
Common	.....	.....	.....
Last seen	.....	.....	.....
Abundance	Common.	Rare.	Rare.

36. [230] *Gallinago delicata* (Ord.). Wilson's Snipe.*

Common migrant. March 6 to May 10. September 22 to October 28. Common along all small streams in March and April.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.
Observer	C. H. B.	C. H. B.	B. W. E.	G. G. W.
First seen	4-17	.....	3-15	3-25
Next seen	4-18	.....	3-18	4-2
Common	.....	.....	.....	.....
Last seen	4-22	9-22	3-25*	4-18*
Abundance	Abundant.	Not common	Common. *W. S. B.	Common. *B. W. E.

Year	1899.	1902.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	P. J. H.
First seen	4-28	.....	.....	3-6
Next seen	.....	.....	.....	.....
Common	.....	4-18	.....	4-17*
Last seen	5-10	.....	10-28	.....
Abundance	Common.	Common.	Common.	..... *W. L. M.

37. [239] *Actodromas maculata* (Vieill.). Pectoral Sandpiper.

Moderately common migrant. March 15 to May 9. This bird seems to have been quite common during the spring of 1885. The bulk of the species departed May 3.

MIGRATION RECORD.

Year	1885.	1886.	1887.	1903.
Observer	C. H. B.	B. W. E.	B. W. E.	W. L. M.
First seen	3-27	3-15	3-15	.....
Next seen	4-19	.....	3-18	.....
Common	4-22	.....	.....	.....
Last seen	5-9	5-5	.....	4-29
Abundance	Common.	.....	.....	Not common

38 [242] *Actodromas minutilla* (Vieill.). Least Sandpiper.

Rare migrant (B. W. E. '87).

39. [246] *Ereunetes pusillus* (Linn.). Semipalmated Sandpiper.

Rare migrant (B. W. E. '87). Twelve were seen April 26, 1903 (H. H. Lane), and one May 3, 1903.

40. [254] *Totanus melanoleucus* (Gmel.). Greater Yellow-legs.

Not observed until the spring of 1903 when it was seen in small numbers on April 26, 29 and 30 and May 1 (W. L. M.). A bird conspicuous by restless actions accompanied by continual and piercing cries.

41. [255] *Totanus flavipes* (Gmel.). Yellow-legs.

One record. Concerning the year 1895, which was remarkable for early arrivals of the Yellow-legs, Butler says: "The last report from southern Indiana that spring was from Bloomington, where it was noted April 26" (Juday).

42. [256] *Helodromas solitarius* (Wils.). Solitary Sandpiper.

Common migrant and perhaps rare summer resident. April 23 to June 9. October 6. This bird has been reported as early as March 20, but these dates should probably be referred to some other species, perhaps Wilson's Snipe. One observer records it as a summer resident while another gives a queried affirmation. The date, June 9, is an extremely late one if the Solitary Sandpiper is to be considered purely as a migrant. But it probably indicates summer residence, since in the Alaskan breeding grounds young have been found in the same month

(June 23, '03, Charlie Creek, Yukon River. W. H. Osgood). A common bird during the migratory season in all muddy places. Seen as early as September 20 in fall. Will probably be found in August.

MIGRATION RECORD.

Year	1886.	1887.	1892.	1899.	1900.	1903.	1903.
Observer	C. H. B.	G. G. W.	E. M. K.	N. B. M.	N. B. M.	W. L. M.	W. L. M.
First seen	5-3	4-28	5-7	4-29	5-3	4-23	.....
Next seen	5-5	4-30	.....	.....	5-4	4-30	.....
Common	.....	.....	.....	.....	5-12	5-3	.....
Last seen	5-7	.....	.....	5-16	5-12	6-9	10-6
Abundance	Rare.	.....	Rare.	.....	.....	Common	.....

43. [261] *Bartramia longicauda* (Bechst.). Bartramian Sandpiper.

Not common transient (C. H. B. '86.).

44. [263] *Actitis macularia* (Linn.). Spotted Sandpiper.

Common migrant and rare summer resident. April 12. There is one egg in the University collection from this locality. Found in the same places as the Solitary Sandpiper but in smaller numbers.

MIGRATION RECORD.

Year	1885.	1892.	1900.	1901.	1903.
Observer	C. H. B.	E. M. K.	N. B. M.	W. L. M.	W. L. M.
First seen	4-22	4-27	4-17	4-12	4-19
Next seen	5-2	5-7	4-28	.....	4-24
Common	5-3	.....	.....	.....	4-28
Last seen	.....	.....	.....	.....	.....
Abundance	Common.	Rare.	.....	.....	Common.

45. [273] *Oxyechus vocifera* (Linn.). Killdeer.* Fig. 6.

Abundant summer resident and rare winter resident. January 31 to Dec. 12. Nest and four eggs found April 12, 1903 (C. E. Edmondson). Another set found May 12, 1903, in a depression in the ground lined with dry grass (C. G. L.). During several dark and cloudy or rainy

nights (March 5 to 13, 1903), the well-known piercing notes of this bird were heard everywhere at all hours. On Nov. 29, '03, a Killdeer was seen on the snow when there was no open water. The few uncovered muddy spots were filled with tracks and probings.

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1886.
Observer	C. H. E.	C. H. E.	C. H. B.	B. W E.	B. W. E.
First seen	3-18	2-28	.....	3-7	.....
Next seen	.....	3-7	.....	3-14	.....
Common	.....	3-19	.....	3-25*	.....
Last seen	.....	.....	12-12	.....	11
Abundance	.....	Abundant.	Abundant.	Common. *W. S. B.	Common.

Year	1892.	1899.	1900.	1901.	1902.
Observer	A. B. U.	N. B. M.	N. B. M.	W. L. M.	W. L. M.
First seen	3-24	3-2	3-9	3-17	3-2
Next seen	4-2	5-3	4-20	3-19*	3-7
Common	.....	.....	.....	3-24	3-26
Last seen	.....	.....	.....	.....	.....
Abundance	Common.	Rare.	Not common	Abundant. *V. H. B.	Abundant.

46. [289] *Colinus virginianus* (Linn.). Bob-white.*

Bob-white is scarcely a common resident at present. In 1886 C. H. Bollmann considered it abundant. May 18, 1903, a nest and two eggs were found in a rather damp spot in a large dense woods and June 14, young ones were seen running about with their mother (C. G. L.). Coveys have been observed rather late; eight were seen April 13, 1902, and seven, May 16, 1903. The so-called "crazy" season was at its height October 11, 1902. A score of instances was noted of their flying in open doors and against windows. More often seen in the woods than in open fields.

47. [300] *Bonasa umbellus* (Linn.). Ruffed Grouse.

As late as 1886 the Ruffed Grouse was a common resident in Monroe County (C. H. B.), and in 1887 was frequently seen in the hills northeast of town (B. W. E.), and was rather common in deep woods (W. S. B.). These phrases are far from indicative of the occurrence of the Ruffed Grouse at present. In four years of continuous field-work but one bird has been observed each year. April 7, 1901, a splendid male was seen; March 23, 1902, one was found dead; Sept. 23, 1902, one flew through a window into a house, and March 14, 1903, one was seen in a dense, tangled and wild tract of woods which was swept by a hurricane several years ago (P. J. H.). It is in this place that the Ruffed Grouse will probably persist longest in this county, and it may be found there in sparing numbers for several years. Three were seen in this locality on April 9, 1904, and two more on April 16. In Brown, the adjoining county east, the Ruffed Grouse was classed as common as late as 1894 (E. M. K.).

48. [316] *Zenaidura macroura* (Linn.). Mourning Dove.* Figs. 7–10.

Common resident, less numerous in winter, though it is sometimes seen in bands of four to twelve in this season. They become common after the first week of March, and the dates are rather regular—March 8, '01, March 9, '02, March 8, '03. A bird of even distribution, equally liable to be met with in thickets or more open woods or in plowed lands or weedy fields. A most attractive creature of beautiful appearance and pleasing manner, in the mating season filling the air with the sonorous melody of his love.

The point of greatest interest in regard to the Mourning Dove is its early nesting. Mr. A. W. Butler says: "They begin cooing about the middle of March. * * * They mate early, and their nests, with complement of eggs are often found early in April—April 4, Franklin County." B. W. Evermann found a nest and set of eggs here April 17, 1886. In the last few years, however, nests and eggs have been found at much earlier dates. In 1901, the first nest was found March 17; no eggs were seen, however, until April 7 and April 10. Those found on the latter date were hatched April 14, therefore they must have been laid about on the first and second days of April. The nest was in a tangle of vines on a rail fence. In 1902 the record was as follows: Cooing March 7—nest complete March 27—one egg seen March 28. This

egg and nest were then destroyed by an unfortunate accident. Three other nests were found, however, on the 29th, each of which contained either one or two eggs. All of these nests were placed in small cedar trees. A Dove was heard cooing imperfectly November 9. Doves began cooing in 1903 on March 5. The first nest was found in a cedar, March 22; on April 8 it contained one egg and one young dove just hatched. Reckoning the period of incubation as two weeks, this nest must have had a full set of eggs on March 25 or 26. Another nest was in a pine tree and had young two and one-half inches long on April 11. These were at least a week old, probably more. Then this nest must have contained a full complement of eggs on March 21. On April 24 a nest containing two eggs was found flat on the ground under a mandrake.

49. [325] *Cathartes aura* (Linn.). Turkey Vulture.*

With one exception all the records show that the Buzzard is a resident only a little over nine months in the year, January 31 to November 21. In 1892 E. M. Kindle said that a few were permanent residents. They are quite abundant in this county, and it is not an uncommon thing to see them in companies of ten to sixty gliding about in circling paths in the upper air.

B. W. Evermann found a full set of eggs April 17, 1886. This is earlier than any other date reported from the State. C. G. Littell found young just hatched in a nest in a hollow log in a large, dense and damp woods, May 19, '03. According to the owner of the place Buzzards had roosted at this spot for three years before.

MIGRATION RECORD.

Year.	1885.	1885.	1886.	1892.	1893.	1899.
Observer	C. H. B.	C. H. B.	W. S. B.	E. M. K.	E. M. K.	N. B. M.
First seen	2-7	.....	2-22	2-6	2-22	2-26
Next seen	2-8	.....	2-23*	2-13	2-25	4-1
Common	3-3	.....	.....	2-13*	3-2	4-2
Last seen	.....	11-13	.....	.....	.....	.....
Abundance	Very common.	Abundant.	Common. *B. W. E.	Common. A. B. U.	Common.	Common.

Year.	1900.	1901.	1902.	1902.	1903.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.	.....
First seen	4-5	2-17	2-26	.....	1-31	.....
Next seen	4-18	3-3	3-14	.....	2-10	.....
Common	4-18	3-17	3-20	.....	3-8	.....
Last seen	.....	.....	.....	11-8	.....	11-21
Abundance	Common.	Abundant.	Abundant	Abundant.	Abundant.	Abundant.

50. [326] *Catharista urubu* (Vieill.). Black Vulture.

Rare spring and summer visitant. "It was noted in Monroe County, 1890" (A. W. Butler). One was seen May 16, 1903.

51. [327] *Elanoides forficatus* (Linn.). Swallow-tailed Kite.

Rare summer visitant. All that have been reported from this county were seen in August, 1885. One was taken on the 4th (C. H. B.), and two were seen of which one was taken on the eighteenth (B. W. E.).

52. [331] *Circus hudsonius* (Linn.). Marsh Hawk.

Rare migrant. The earliest and latest dates of arrival for a series of years are February 28, '85 (C. H. B.), and April 19, '02. It is seen nearly every year, and it was probably common March 14, 1903, when several were seen in a densely wooded creek bottom (P. J. H.).

53. [332] *Accipiter velox* (Wils.). Sharp-shinned Hawk.*

An uncommon resident; common in winter and during the migrations, especially in March and October. W. S. Blatchley reports it as breeding.

54. [333] *Accipiter cooperii* (Bonap.). Cooper's Hawk.*

Resident; not common; breeds. Most numerous in January, February and March.

55. [334] *Accipiter atricapillus* (Wils.). American Goshawk.

Rare winter visitor; one taken November 22, 1885 (G. G. W.).

56. [337] *Buteo borealis* (Gmel.). Red tailed Hawk.*

Common resident; breeds. Nest and eggs April 19, 1903.

57. [339] *Buteo lineatus* (Gmel.). Red-shouldered Hawk.*

Common resident; breeds. This and the last species are somewhat confined to the wilder parts of the country, but are occasionally seen flying over the city.

58. [343] *Buteo platypterus* (Vieill.). Broad-winged Hawk.*

Rather rare resident. Not reported from this county before 1892. More often seen in recent years. Commonest in April and October.

59. [347a] *Archibuteo lagopus sancti-johannis* (Gmel.). American Rough-legged Hawk.

Rare winter visitor; February 21, 1885 (C. H. B.).

60. [349] *Aquila chrysaëtos* (Linn.). Golden Eagle.

Rare winter visitor; a few seen every winter. Has been observed as late as May 15, 1903 (W. L. M.) in Brown County, where it is as likely to remain to breed as in any part of Indiana. Last date for Monroe County, November 28, 1903.

61. [352] *Haliæetus leucocephalus* Linn.). Bald Eagle.

Rare winter visitor. Considered less rare than the last by W. S. Blatchley and B. W. Evermann. But in recent years the Bald Eagle has not been observed at all, while Golden Eagles have been seen and captured every year. The last date is July 29, 1885 (S. E. Meek). This date suggests a possibility of summer residence of this bird also.

62. [357] *Falco columbarius* Linn. Pigeon Hawk.

Rare migrant, taken several times during 1885-1887, but not observed in recent years. March 12, 1887 (W. S. B.). April 28, 1885 (C. H. B.). November 7, 1885 (G. G. W.)

63. [360] *Falco sparverius* Linn. American Sparrow Hawk.*

Common resident, less numerous in winter; in fact, they are entirely absent some winters as they were during those of 1900-1901, 1902-1903 and 1884-1885. They become common in March—March 15, 1902, March 19, 1903, March 26, 1885 (C. H. B.). They have been observed mating March 17, '03 (W. L. M.), and repairing a nest on the University campus, which has been used for years, on April 11, 1901 and 1903. In years when they do not winter it is seen that the females are the first migrants, as for example, in 1885. The first and second dates for females were March 17 and 20, while males were not seen until March 23 and 24.

64. [364] *Pandion haliaëtus carolinensis* (Gmel.). American Osprey.

Rather rare migrant. March 12 to April 29. November. C. H. Bollmann saw but one in four years, March 12, 1885. B. W. Evermann said it was occasional on the White River ('87), and E. M. Kindle reported it during November, 1892. Of late it has been seen frequently

in the central part of the county; the record for 1903 is as follows: First seen April 13, next April 17, and last April 29.

65. [366] *Asio wilsonianus* (Less.). American Long-eared Owl.

Rare winter visitor. Fall 1886 (B. W. E.); Jan. 30, 1883 (W. S. B.); March 19, 1885 (C. H. B.), are the only dates at hand.

66. [367] *Asio accipitrinus*. (Pall.). Short-eared Owl.

"Very rare; two seen in the fall of 1886" (B. W. E.).

67. [368] *Syrnium varium* (Barton). Barred Owl.*

Considered a common resident by C. H. Bollmann, B. W. Evermann and W. S. Blatchley. The last is authority for a breeding record. I know but little concerning the occurrence of owls in Monroe County. In fact owls are more rare here at present than in any place where I have ever made observations. The only record of a Barred Owl in three years is March 24, 1902, when one was heard. That this condition is only a temporary one is shown by the fact that in the fall of 1900 Screech Owls were abundant and Great Horned and Barred Owls were often heard and seen.

68. [372] *Cryptoglaux acadica* (Gmel.). Saw-whet Owl.*

Rare resident. August 20, 1884. One was taken in the University power plant November 27, 1886 (C. H. B.).

69. [373] *Megascops asio* (Linn.). Screech Owl.*

Common resident. Breeds. The red phase prevails. With the exception of the fall of 1900 this has been a rare bird here in the last few years.

This is the fellow who can best explain the meaning of the series of fan-like scratches which we see after a fresh fall of snow on either side of two parallel rows of tiny dots which end in a little carmine punctuated pit—the shambles of a Peromyscus. A Screech Owl which had the sad affliction of a cataract on one eye was placed in a roomy cage with two whitefooted mice with which to satisfy his appetite. Morning dawned on the scene of an unexpected tragedy. Two mice, with golden coats and pretty white stockings, were nestled in a warm bed of bright rufous feathers, sleeping away the effects of a banquet of owl.

70. [375] *Bubo virginianus* (Gmel.). Great Horned Owl.

Common resident (C. H. B. and B. W. E.). Breeds (W. S. B.). As in the case of the other *Striges*, rare since 1900. The only recent date is March 22, 1903 (P. J. H.).

The following epitaph is of interest: "'Old Bubo,' the college pet. Caught in a steel trap in September, 1885, and kept in the basement of Owen Hall until January, 1886, when he died."

71. [376] *Nyctea nyctea* (Linn.). Snowy Owl.

Rare winter visitor (C. H. B. '86.). Last date, January 25, 1903 (P. J. H.).

72. [387] *Coccyzus americanus* (Linn.). Yellow-billed Cuckoo.*

Common summer resident. April 13 to Sept. 24. Breeds. A nest of the Yellow-billed Cuckoo was found May 30, 1901. It contained one egg on that day and two on the next. It was in a spice-bush three feet above the ground and was built of sticks and partly lined with leaves (W. L. H.). May 25, 1903, a nest and two eggs were found about seven feet up in a grapevine (C. G. L.). In 1885 a nest with fresh eggs was found as late as June 30, by B. W. Evermann (Butler). "The usual nest is a mere pretense, a flimsy structure of a few sticks, with a few blossoms, generally of the oak, upon which to lay the eggs. Occasionally a very substantial nest is built—one such was found at Bloomington, Ind., by my friend, Mr. O. M. Meyncke" (Butler).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1893.
Observer	C. H. B.	C. H. B.	G. G. W.	E. M. K.	E. M. K.
First seen	5-17	.....	4-13	5-7	5-15
Next seen	5-19	.....	5-5*	5-13	5-21
Common	5-24	.....	.....	.....	.....
Last seen	.....	9-24	.....	.....	.....
Abundance	Very common.	Very common.	Common. *B. W. E.	Common.	Common.

Year	1899.	1900.	1902.	1902.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-28	5-15	5-5	.....	5-5
Next seen	4-29	5-16	.....	.....	5-10
Common	5-4	5-17	5-10	.....	5-13
Last seen	.....	.....	.....	9-21	.....
Abundance	Common.	Common.	Common.	Common.	Common.

73. [388] *Coccyzus erythrophthalmus* (Wils.). Black-billed Cuckoo.* Fig. 11.

Common summer resident. May 12 to Sept. 22. Breeds. May 20, 1903, C. G. Littell found a nest and three eggs about eight feet up in a cedar. The nest was a mere platform.

In 1887 B. W. Evermann said that this species was apparently more common than the last. If there is any difference in numbers at present the Black-billed Cuckoo is the more rare of the two species. All records since 1892 show the same state of affairs. In 1894, E. M. Kindle considered this bird rare and the last common in Brown County. At this place the present species is a much more regular migrant than the Yellow-billed Cuckoo. Records of five springs show that it arrived either on the 12th or 13th of May. May 12, 1893, Mr. E. M. Kindle heard them calling as they passed over, and on April 13, 1886, Mr. G. G. Williamson heard the calling of Cuckoos, "Yellow or Black-billed or both." This is much the earliest date that has been recorded for either species within the State. In all probability the birds heard were Yellow-billed Cuckoos, as they are much more irregular than the Black-billed in the time of their arrival and are always observed earlier.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1893.	1902	1903.
Observer	C. H. B.	C. H. B.	B. W. E.	E. M. K.	E. M. K.	W. L. M.	W. L. M.
First seen	5-12	.....	5-13	5-13	5-12	.....	5-12
Next seen	5-16	.....	.....	.....	.....	.....	5-13
Common	5-19	.....	.....	.....	.....	.....	.....
Last seen	.....	9-22	.....	.....	.....	9-21	.....
Abundance	Abund.	Abund.	Very com.	Com.	.....	Com.	Com.

74. [390] *Ceryle alcyon* (Linn.). Belted Kingfisher.

Common summer resident; rare winter resident. March 5 to November 9. Jan. 4, 1893 (E. M. K.). Breeds. The females become numerous in spring before the males.

MIGRATION RECORD.

Yea	1885.	1885.	1886.	1887.	1892.	1892-3.
Observer	C. H. B.	C. H. B.	B. W. E.	G. G. W.	E. M. K.	E. M. K.
First seen	3-31	.....	3-22	3-26	3-27	.....
Next seen	4-3	.....	3-25	.....	4-27	.....
Common	.....	.....	.....	.....	4-27	.....
Last seen	.....	11-5	.....	.....	.....	1-4, '93
Abundance	Common.	Very common.	Rare.	.....	Common.	.....

Year.	1893.	1900.	1902.	1902.	1903.	1903.
Observer	E. M. K.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	3-12	4-18	4-9	.....	3-5	.....
Next seen	4-26	4-28	4-19	.....	3-6	.....
Common	.....	.....	.....	.....	4-7	.....
Last seen	.....	.....	.....	11 9	.....	11-7
Abundance	Common.	Not very common.	Scarce.	Common.	Common.	Common.

75. [393] *Dryobates villosus* (Linn.). Hairy Woodpecker.*

Common resident; breeds. A less familiar bird than the next, but it is occasionally seen in the city. But his contact with civilization generally gives him a dingy color and a ruffled coat.

76. [394] *Dryobates pubescens* (Linn.). Southern Downy Woodpecker.* Fig. 12.

Common resident; breeds. Possibly more common than the last; apparently so because of its more confiding attitude towards man. Nest and one egg in a rail April 23, 1903 (C. G. L.). But the nest has been found with only two eggs in it as late as May 15, 1901.

77. [402] *Sphyrapicus varius* (Linn.). Yellow-bellied Sapsucker.*

Regularly a very common migrant; occasionally a common winter resident. Eight were seen January 21, 1903, in a group of cedars and pines less than an acre in area. It did not winter in 1901-1902. B. W. Evermann gives it as a rare resident, and W. S. Blatchley says it breeds. There are no later dates in spring, however, than May 1, 1903 (W. L. M.), and May 5, 1885 (C. H. B.). It was observed mating April 8, 1903 (W.

L. M.), but it would be an unusual occurrence for it to breed this far south. According to C. H. Bollmann's schedule for 1885 the males arrive and depart earlier than the females.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.	1887.
Observer	C. H. B.	C. H. B.	C. H. B.	G. G. W.	G. G. W.
First seen	♂ 3-27	♀ 4-2	9-15	3-15	3-31
Next seen	3-31	4-3	9-24	3-25*	4-1
Common	4-4	4-4	9-25	.....	.....
Last seen	4-19	5-3	12-29*	.....	.....
Abundance	Common.	Common.	Very common	Rare. *W. S. B.	.....

Year	1892.	1900.	1901.	1902.	1903
Observer	E. M. K.	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4 4	4-7	1-27	3-14	.....
Next seen	4-17	4-10	2-2	3-22	.....
Common	.....	4-10	4-7	3-27	4-12
Last seen	.....	.....	.....	4-23	5-1
Abundance	Common	Common.	..... *V. H. B.	Common.	Tolerably Common.

78. [405a] *Ceophlœus pileatus abieticola* Bangs. Northern Pileated Woodpecker.

Quite rare resident; very probably breeds. Although it is now restricted to the wildest and least visited parts of the county and is present there in but small numbers, it must have been tolerably common as late as 1885. Seven specimens were taken that year—March 21, March 22, a male; March 29, a male and a female (C. H. B.); two specimens were taken along Bean Blossom Creek in August (B. W. E.), and one

was seen December 24, by W. S. Blatchley. It has been seen or taken several times since; all the dates follow: November 3, 1887, J. Graham; February 13, 1892, two seen, one of which, a female, was taken, A. B. Ulrey; one seen in 1898 and one about February 7, 1901, V. H. Barnett; two seen and one, a male, taken January 20, 1903, by Mr. Whitaker. The last specimen was winged and brought in alive. It hammered to pieces the pine box used for a cage and escaped into the streets. After several adventures it was with difficulty recaptured and placed in a wire cage at the University. He tried to shatter this, too, but of course was unsuccessful. His accuracy was shown by his repeatedly pecking a wire, not more than one-sixteenth of an inch in diameter, which he hit squarely every time. He lived about three days in captivity. Two of these noble birds were also seen on May 17, 1904. In a steady majestic flight they winged their way across some fields and a highway that lay between two dense forests, their favorite retreats.

79. [406] *Melanerpes erythrocephalus* (Linn.). Red-headed Woodpecker.*

Abundant summer resident; not uncommon winter resident. All of the Redheads sometimes migrate in the fall, and leave us no winter residents. Such was the case in the years 1892 and 1903. The autumn of the latter year was noticeable for the very scanty production of beechnuts and acorns. In 1893 after their winter's absence they were first seen April 19 and became abundant April 28 and 29 (E. M. K.). For three years prior to 1903 the Redhead was a very common winter resident, in fact, the most common and most equally distributed winter bird. It became common each year from the middle of February to the 1st of March.

The mating call was heard as early as February 15, 1903. The nest and five eggs were found May 29, 1903 (C. G. L.).

Redheaded Woodpeckers are very quarrelsome, and are continually driving other birds from their favorite trees. Their attentions seem especially directed against their little cousin, the Downy, although Juncos, Tufted Titmice and Nuthatches are not slighted. They have been observed to come to the ground to attack a Tufted Titmouse. They are capable of making as large an animal as the Fox Squirrel beat a hasty retreat. Sparrow Hawks, too, are put to flight, but the Redheaded tyrant often finds his master in the English Sparrow.

There is nothing in the Redhead to suggest the flycatcher, but he really is an expert in that line. A flash of color often attracts your eye to a nearby treetop, and you see that it is the Redhead, who is diminishing the insect population. In one or two or three swoops, as gracefully as Myiarchus himself, he obtains his luncheon.

80. [409] *Centurus carolinus* (Linn.). Red-bellied Woodpecker.*

Common summer resident; less common winter resident. An increase in number is noticeable about the middle of March. Common April 8, 1903.

A very garrulous bird; a single individual often fills the woods with a din of his varied cries; stimulation and excitement are not needed to provoke a demonstration but he seems to do it for the pure love of making a racket.

81. [412a] *Colaptes auratus luteus* Bangs. Northern Flicker.* Fig. 13.

Abundant summer resident and very common winter resident. Becomes abundant in March. Mating call heard as early as February 15, 1903, and as late as November 20, 1902. A nest and two eggs were found in an apple tree April 22, 1903 (C. G. L.).

82. [417] *Antrostomus vociferus* (Wils.). Whip-poor-will.*

Rather common summer resident, but on account of its peculiar habits not commonly observed.

MIGRATION RECORD.

Year	1885.	1886.	1892.	1893.	1899.	1903.
Observer	C. H. B.	W. S. B.	E. M. K.	E. M. K.	N. B. M.	W. L. M.
First seen	5-17	4-21	5-7	4-29	4-25	4-29
Next seen	5-22	4-23*	5-13	5-3	.....	4-30
Common	5-27	.....	.....	.....	.....	.....
Last seen	.....	.....	.....	.....	.....	.....
Abundance	Common.	Common. *C. H. B.	Not common	.....	.....	Common.

83. [420] *Chordeiles virginianus* (Gmel.). Night Hawk.*

Common summer resident. (C. H. B.) April 28 to Sept. 21. Abundant migrant, especially in fall.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1893.
Observer	C. H. B.	C. H. B.	G. G. W.	E. M. K.	E. M. K.
First seen	5-16	.....	5-6	5-6	5-10
Next seen	5-17	.....	.....	5-13	5-12
Common	5-22	.....	.....	5-13	.....
Last seen	.....	9-21	.....	.....	.....
Abundance	Abundant	Abundant	Abundant.	Common.	Common.

Year	1899.	1901.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-14	5-20	.....	4-28
Next seen	5-26	5-23	.....	.....
Common	.....	.....	.....	.....
Last seen	.....	.....	9-13	.....
Abundance	Common.	Common.	Abundant.	.....

84. [423] *Chætura pelagica* (Linn.). Chimney Swift.*

Abundant summer resident. April 4 to October 14. April 4, 1892 (E. M. K.) is as early as it has been reported from the State, while October 14, 1902, is the latest date for the State. On the latter date one was found clinging to a maple tree in the campus. It was quite numb and offered no resistance when picked up. It quickly recovered its vitality in a warm room, however, The outside temperature was 64°.

Nestbuilding April 27, 1903. Nest and five eggs found June 5, 1903 (C. G. L.) in a large chimney about six feet from the top.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1893.
Observer	C. H. B.	C. H. B.	B. W. E.	E. M. K.	E. M. K.
First seen	4-6	.....	4-11	4-4	4-7
Next seen	4-7	.....	4-14*	4-17	4-8
Common	4-17	.....	.....	.....	.....
Last seen	.....	10-13	.....	.....	.....
Abundance	Abundant.	Abundant.	Abundant. *G. G. W.	Common.	Common.

Year	1899.	1902.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-19	4-15	.....	4-8
Next seen	4-20	4-18	.....	4-9
Common	4-26	4-15	.....	4-10
Last seen	.....	.....	10-14	.....
Abundance	Common.	Abundant.	Abundant.	Abundant.

85. [428] *Trochilus colubris* Linn. Ruby-throated Hummingbird.*

Common summer resident. April 29 to September 26. The males migrate about a week ahead of the females. Nest and two eggs May 15, 1902.

MIGRATION RECORD.

Year	1882.	1885.	1885.	1885.	1886.	1892.
Observer	B. W. E.	C. H. B.	C. H. B.	C. H. B.	G. G. W.	E. M. K.
First seen	5-13	♂4-29	♀5-8	.....	4-29	4 29
Next seen	.....	4-30	5-9	.....	4-30*	.....
Common	.....	5-13	.....	.....	.....	.....
Last seen	.....	.....	.....	9-14	.....	.....
Abundance	Common.	Abundant.	Abundant.	Abundant.	..... *C. H. B.	Not very common.

Year	1900.	1901.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-5	5-4	5-5	.....
Next seen	5-8	5-7	5-6	.....
Common	5-10	5-15	.....	.....
Last seen	.....	.....	.....	9-26
Abundance	Common.	Common.	Moderately common.	Common.

86. [444] *Tyrannus tyrannus* (Linn.). Kingbird.* Fig. 14.

Common summer resident. April 13 to September 5. Mating April 29, 1903. Nest and four eggs on the topmost limb of an apple tree, May 28, 1903 (C. G. L.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	W. S. B.	G. G. W.	E. M. K.
First seen	4-17	.....	4-13	4-24	4-18
Next seen	4-20	.....	4-14*	.....	4-27
Common	4-23	.....	4-15†	.....	4-27
Last seen	.....	9-5	.....	.....	.....
Abundance	Abundant.	Abundant.	Common. *G. G. W. †C. H. B.	.....	Common.

Year	1893.	1900.	1901.	1903.
Observer	E. M. K.	N. B. M.	W. L. M.	W. L. M.
First seen	4-16	4-23	4-30	4-19
Next seen	4-26	4-28	5-4	4-29
Common	.....	.....	5-6	4-29
Last seen	.....	.....	.....	.....
Abundance	Common.	Common.	Common.	Common.

87. [452] *Myiarchus crinitus* (Linn.). Crested Flycatcher.*

Common summer resident. April 18 to September 7. Nestbuilding May 14, 1901; six eggs May 27. In 1902 a nest and 5 eggs were found May 21; the eggs were hatched June 2 and the young birds had flown June 11 (Gertrude Hitze). Another nest with six young about ready to leave was found June 12. It was in a hollow apple tree about 6½ feet up (C. G. L.).

Later in the season, in August and September, these birds may be seen trooping around with a brood of lusty youngsters almost as large as themselves. These little family groups are pleasing objects in the sultry brightness of an open grove or beside the dimly lighted paths of the forest. Myiarchus here, as at all places and all times, seems to fit into his surroundings perfectly. Everywhere he is full of unconscious dignity and is perfectly at home.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	G. H. B.	G. G. W.	E. M. K.	E. M. K.
First seen	4-21	.....	4-23	4-25	4-24	4-18
Next seen	4-22	.....	4-24	.....	4-27	.....
Common	4-25	.....	.....	.....	4-27	4-26
Last seen	.....	9-7	.....	.....	.....	.....
Abundance	Abundant.	Very common	Common	.....	Very common	Common.

Year	1899.	1900.	1901.	1902.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-22	5-6	5-6	4-27	4-28
Next seen	4-28	5-7	5-7	4-28	4-29
Common	5-3	5-8	5-9	4-27	4-29
Last seen	.....	.....	.....	.....	.....
Abundance	Common.	Common	Common.	Common.	Common.

88. [456] *Sayornis phœbe* (*Lath.*). Phœbe.* Fig. 15.

Common summer resident. March 1 to October 17. An early migrant and an early breeder. B. W. Evermann gives the date March

1, but does not give the year, although it is probably 1887. E. M. Kindle saw it March 2, 1893. They are found first at the nesting places: March 17, 1901, a pair was seen at a quarry; March 14, 1902, one was seen at a bridge near a pond and on the first date in 1903, March 12, they were common at the caves; eleven were seen about the mouths of three caves. Nestbuilding March 22, 1902. Nest complete April 2, 1903. April 12, 1903, a nest and five eggs were found under a bridge (C. G. L.). Well-grown young have been seen May 6, 1899 (N. B. M.), and May 7, 1901.

The Phœbe seems to be better pleased if a suitable nesting site can be found near the dwellings of man. There he lives out his quiet and beneficial career, an unobtrusive yet confiding bird.

MIGRATION RECORD.

Year	1884.	1885	1885.	1886.	1887.	1892.
Observer	C. H. E.	C. H. B.	C. H. B.	W. S. B.	G. G. W.	V. H. B.
First seen	3-18	3-21	.....	3-10	3-20	3-25
Next seen	.....	3-22	.....	3-14*	.....	3-26*
Common	.....	3-31	.....	3-16†	.....	3-29
Last seen	.....	.....	10-17	.....	.....	.....
Abundance	.....	Abundant.	Abundant.	Common. *B. W. E. †G. G. W.	.....	Common. *E. M. K.

Year	1893.	1899.	1901.	1902.	1902.	1903.
Observer	E. M. K.	N. B. M.	W. L M.	W. L. M.	W. L. M.	W. L. M.
First seen	3-2	4-13	3-17	3-14	.....	3-6
Next seen	3-10	5-14	3-24	3-16	.....	3-12
Common	3-10	.....	.....	3-27	.....	3-12
Last seen	.....	.....	.....	.....	10-12	.....
Abundance	Common	Common.	Common.	Common.	Common.	Common.

89. [459] *Nuttallornis borealis* (Swains.). Olive-sided Flycatcher.

Rare transient. April 30, 1885 (C. H. B.). The only other record for the southern part of the State is that of May 12, 1885, Wheatland, Knox County (Robert Ridgway). Do these dates indicate an accidental deviation from the ordinary migration route in that one year?

90. [461] *Contopus virens* (Linn.). Wood Pewee.*

Very common summer resident. April 26 to October 5. Has been reported much earlier, as for instance: April 15, 1899, and April 7, 1900 (N. B. M.), but these records are probably due to wrong identification. The most common Flycatcher.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1893.
Observer	C. H. B.	C. H. B.	C. H. B.	E. M. K.	E. M. K.
First seen	5-3	.....	4-26	5-18	5-6
Next seen	5-5	.....	4-27	.....	.....
Common	5-16	.....	4-28*	.....	.....
Last seen	.....	10-3	.....	.....	.....
Abundance	Abundant	Abundant.	Common. *B. W. E.	Common.	.....

Year	1900.	1902.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-2	4-27	.....	4-28
Next seen	5-8	.....	.....	5-10
Common	5-8	.....	.....	5-10
Last seen	.....	.....	10-5	.....
Abundance	Common.	Common.	.....	Common.

91. [463] *Empidonax flaviventris* Baird. Yellow-bellied Flycatcher.

Rather common migrant. April 17 to August 29. These dates represent the extremes of arrival and departure for the State as well as for the county.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1903.
Observer	C. H. B.	C. H. B.	W. S. B.	A. B. U.	W. L. M.
First seen	4-28	8-26	4-17	5-7	4-28
Next seen	5-1	8-27	.....	.....	4-29
Common	.....	.....	.....	.....	.....
Last seen	5-19	8-29	.....	.....	.....
Abundance	Common.	Common.	.....	.....	Not common

92. [465] *Empidonax virescens* (Vieill.). Green-crested Flycatcher.*

Common summer resident. April 15 to September 18. Considered abundant by C. H. Bollmann and B. W. Evermann in 1886 and 1887. There are four nests, two with eggs, in the University collection.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.
Observer	C. H. B.	C. H. B.	B. W. E.	B. W. E.
First seen	5-14	.....	4-27	4-15
Next seen	5-15	.....	5-1*	.....
Common	5-16	.....	5-4†	.....
Last seen	.....	9-18	.....	.....
Abundance	Abundant.	Abundant.	Abundant.	Abundant.
			*C. H. B. †W. S. B.	

Year	1892.	1900.	1903.
Observer	A. B. U.	N. B. M.	W. L. M.
First seen	5-7	5-2	.....
Next seen	.....	5-7	.....
Common	.....	5-8	6-9
Last seen	.....	.....	.....
Abundance	.....	Common.	Common.

93. [466] *Empidonax traillii* (Aud.). Traill's Flycatcher.

"In Monroe County, Prof. Evermann found it an uncommon summer resident" (Butler).

MIGRATION RECORD.

Year	1885.	1885.
Observer	C. H. B.	C. H. B.
First seen	5-14	.....
Next seen	5-15	.....
Common	.....	.....
Last seen	.....	8-27
Abundance	Not rare.	Not common

94. [467] *Empidonax minimus* Baird. Least Flycatcher.*

Common migrant. April 21 to May 19. September 12 to 18. It has been reported by two observers as a summer resident (B. W. E. and N. B. M.), but these records are probably wrong. The bulk of the species departed May 13, '85 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1892.	1899.	1901.	1903.
Observer	C. H. B.	C. H. B.	E. M. K.	N. B. M.	W. L. M.	W. L. M.
First seen	4-21	9-12	5-3	5-5	4-23	4-29
Next seen	4-23	9-13	5-7	.....	.....	4-30
Common	4-30	9-15	.....	.....	.....	.....
Last seen	5-19	9-18	.....	.....	.....	5-13
Abundance	Abundant	Common.	.....	.....	Common.	Common.
			*A. B. U.			

95. [474b] *Otocoris alpestris praticola* Hensh. Prairie Horned Lark.*

Common resident; more abundant in winter and during the migrations. They became common March 26, 1903. Many notes are given under the name *Otocoris alpestris*, but this is probably due to faulty nomenclature; all such notes were considered as referring to the subspecies, although it is not improbable that *O. alpestris* will be found here in winter.

March 25, 1902. The Horned Larks were singing continually, and one of them was observed in his aerial evolutions. About dusk one began: singing all the time, flitting upward a little way, then poised

on stretched and quivering wing, then up again and poising, until he was nearly out of sight. The climax was a straight, swift dive, with wings closed, toward the earth. He did not open his wings until he was within a few feet of the ground, when he settled lightly down and went quietly to feeding as if nothing had happened. Four young were seen just ready to leave the nest May 10, 1903. G. G. Williamson obtained an adult female and a young male May 29, 1886.

96. [477] *Cyanocitta cristata* (Linn.). Blue Jay.* Fig. 16.

Abundant resident; sometimes less numerous in winter.

Jays were nearly all mated March 8, 1903, and a pair was observed mating February 16, 1901. This pair began a nest but abandoned it when about one-fourth completed, February 22. N. B. Myers observed them nestbuilding March 3, 1899. More usual dates are: Nestbuilding, March 17, '03; March 22, '02, a half-completed nest was found; nest completed March 26, 1902, and 1903; three pairs nestbuilding April 1, '01; nests with three eggs were found April 15 and 17, 1903 (W. L. M.). The former was between two rafters in a corncrib and was built partly of mud (C. G. L.). A Blue Jay was seen sitting on unhatched eggs May 16, 1903.

"As spring approaches they become very vocal, uttering many calls, some very pretty notes, varying from loud to low. Evidently some of the latter are intended solely for one female to hear. * * * With us the season of song begins early in March * * * as early as March 8. * * * With it comes pairing time, which I have known them to continue until April 25" (A. W. Butler). As is above stated the Blue Jay has a great number of calls, many of which are principally used during the mating season. But the writer has never heard a Jay give a call during that season that has not been heard during every other month from September to June at some time during the past four years. Careful observations and a separate series of notes have been made with the above conclusion as a result.

On April 28 and 29, 1903, at a time of very abundant nocturnal migration, many Jays were seen migrating by day. They flew steadily and quite high (about 200 ft.), in a northeast direction. The flight of the 29th was exactly similar to that of the 28th; no Jays were even 200 yards from the path. Whether the flight kept up all night is a question. Following are a few groups observed on each day and the approximate time elapsing between their passage of a given point: April

28—12; immediately, 3; 1 minute, 8; 4 minutes, 8; 15 minutes, 11. April 29—3; 2 minutes, 9; 1 minute, 2; etc. The woods below were furnished with their usual numbers of noisy Jays; but neither migrants nor residents seemed to be influenced by the presence of the other.

97. [488] *Corvus brachyrhynchos* C. L. Brehm. Common Crow.*

The crow is quite common in Monroe County, but the numbers in which it occurs seem insignificant to one accustomed to enormous roosts. Crows are very rarely seen in flocks of as many as one hundred individuals. About 1886 there was quite an extensive roost in Turner's (Cedar) Grove (W. S. B.), but at the present time there is no roost of any size in the county.

The nest has been noted by B. W. Evermann as early as March 20. A half-finished nest was seen April 4, 1903 (C. G. L.). Two nests, one with eggs were found April 20, 1902 (W. L. M.), and a nest with 5 young was found about fifty feet from the ground in a beech, April 26, 1903 (C. G. L.).

98. [494] *Dolichonyx oryzivorus* (Linn.). Bobolink.*

Common migrant, usually appearing during the first week of May, although it has been observed on April 17, 1885 (C. H. B.) and 1893 (E. M. K.). It may be observed until a month later; May, 17 (C. H. B., '85). August 29 to September 1. The males arrive and depart earlier than the females; males were seen from April 17 to May 5 and females from May 2 to 17, 1885 (C. H. B.).

On a rainy morning in May (5-3-'03) a Bobolink was found in an apple tree in town, singing with all the vivacity of mid-June. This is the first time I have heard it sing during migration.

MIGRATION RECORD.

Year	1882.	1883.	1885.	1885.	1885.	1886.
Observer	B. W. E.	B. W. E.	C. H. B.	C. H. B.	C. H. B.	Bicknell.
First seen	5-6	5-6	♂ 4-17	♀ 5-2	8-29	5-3
Next seen	.....	.....	5-2	5-4	9-1	5-4*
Common	.....	5-6	.....	.....	.....	5-5†
Last seen	.....	.....	5-5	5-17	.....	.....
Abundance	Ratherrare	Common.	Common.	Common.	Common.	Common.
						C. H. B.
						†G. G. W.

Year	1887.	1888.	1893.	1901.	1902.	1903.
Observer	G. G. W.	Butler.	E. M. K.	W. L. M.	W. L. M.	W. L. M.
First seen	5-1	5-6	4-17	5-6	5-5	5-2
Next seen	5-4	.....	5-6	5-10	.....	5-3
Common	.....	.....	.....	5-13	5-10	5-14
Last seen	.....	.....	.....	5-13	.....	5-14
Abundance	Common.	.....	.....	Common.	Common.	Common.

99. [495] *Molothrus ater* (Bodd.). Cowbird.*

Abundant summer resident. March 7 to October 17. Eggs found as early as April 22 (86 B. W. E.). The Cardinal and Indigo Bunting seem to be the coerced foster-parents more often than other birds of this region.

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. E.	C. H. B.	C. H. B.	B. W. E.	G. G. W.	E. M. K.	E. M. K.
First seen	3-23	4-8	.....	3-7	3-23	3-25	3-11
Next seen	.....	4-9	.....	3-14	.....	4-9	3-19
Common	.....	4-12	.....	.....	.....	4-27	.....
Last seen	.....	.....	10-17	.....	.....	.....	.....
Abundance	.....	Abundant.	Abundant.	Common	.....	Common	Common

Year	1899.	1900.	1901.	1902.	1902.	1903.
Observer	N. B. M.	N. B. M.	V. H. B.	W. L. M.	W. L. M.	W. L. M.
First seen	4-15	4-7	3-23	3-14	.....	3-17
Next seen	4-17	4-12	3-25*	3-25	.....	3-21
Common	4-27	4-28	.....	4-9	.....	3-21
Last seen	.....	.....	.....	.....	9-1	.....
Abundance	Common.	Common.	Common. *W. L. M.	Abundant.	Abundant	Abundant.

100. [498] *Agelaius phœniceus* (Linn.). Red-winged Blackbird.*

Abundant migrant and common summer resident. March 4 to November 16. There are two nests each containing two eggs in the University collection taken by C. H. Bollman, 1885. A bird with striking dress and musical call, as often observed remote from as near bodies of water during the migrations.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	B. W. E.	G. G. W.	E. M. K.	E. M. K.
First seen	3-11	.....	3-4	4-2	3-26	4-26
Next seen	3-14	.....	3-7	.....	4-2*	.....
Common	3-16	.....	.....	.....	4-12	.....
Last seen	.....	11-16	.....	.....	.....	.....
Abundance	Abundant.	Abundant.	Not common	.....	Not common *A. B. U.	Not very common.

Year	1900.	1901.	1902.	1902.	1903.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	3-11	3-17	3-4	.....	3-5	.....
Next seen	3-22	3-24	3-9	.....	3-6	.....
Common	3-23	5-4	3-10	.....	3-7	.....
Last seen	.....	.....	.....	11-4	.....	11-7
Abundance	Not very common.	Abundant.	Abundant.	Abundant.	Abundant.	Abundant.

101. [501] *Sturnella magna* (Linn.). Meadowlark.* Fig. 17.

The Meadowlark is an abundant summer resident and not uncommon winter resident. It becomes abundant at some time from January to March: January 21, 1903 to March 16, 1899 (N. B. M.).

They have been observed gregarious and with no tendency to pairing March 31, and mated April 7 in the same year. The nest with full complement of eggs was found May 1, '03 (C. G. L.); May 7, '01; and four young and an egg were found May 10, '01. They seem to be careless sometimes in regard to the disposal of the eggs. A nest with four young was found May 27, '01 (W. L. H.); two days later the young

were all there, still covered with down, but when the nest was disturbed, two eggs rolled out of the feathers about the nest.

"I have known them in full song March 8. * * * After the harvest is over and the young are able to take care of themselves, most of the Meadowlarks seek choice spots, and but seldom are their songs heard" (Butler). Butler also mentions hearing their song in September and November. The writer has heard them singing every month in the year, nine of which are spent in this region. Following are some dates for Bloomington: 9-28; 10-12; 11-8; 12-18, '02; 1-24; 2-26; 3-2; 4-3; 5-1; 6-9, '03.

The Meadowlark is another bird which migrates considerably by day. The immense, noisy flocks of February and March are always on the move. Fifty of these birds were seen as early as January 21, 1903, flying over due north at a height which made it necessary to use a powerful field-glass to identify them.

This species, as well as most of the members of the family *Icteridae*, is noted for its gregarious habits. That the different species should show such habits *inter se*, as do the swallows, is a more remarkable thing. That this seems to be the case is the only logical conclusion to be drawn from a study of local migration schedules. For instance, for a few days previous to March 21, 1903, Meadowlarks and Grackles, both resident species were the only *Icteridæ* seen. On the 21st, however, these species became augumented in numbers while Rusty Grackles, Redwings and Cowbirds, not seen for several days before, again made their appearance in considerable numbers. This family migration is to be observed in the *Icteridæ* at the time the species become abundant and not at their first arrival. The Orioles move together in the same way and become numerous at about the same time.

102. [506] *Icterus spurius* (Linn.). Orchard Oriole.*

Common summer resident, abundant and conspicuous during the spring migration. April 17 to August 29. These dates are each one day earlier than the recorded limits of its stay in the State. Six years out of ten, this species arrived before the Baltimore Oriole. This is a somewhat different proportion than the two out of fifteen obtained by A. W. Butler. The difference may be explained by a change in habit, as the dates of arrival of the Orchard Oriole before that of its relative are all included in the last seven years in which observations have been made at this point. This change in date of arrival is probably correlated with the

steady increase in numbers in this species and decrease in the next (*vide* Butler, Birds of Ind., p. 899).

The first song was heard April 28, 1903, and males in the second year plumage were seen singing April 29 and May 10, 1903. The Orchard Oriole is an abundant breeder here; the nest and complement of eggs have been found May 17, 1901.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	C. H. B.	G. G. W.	G. G. W.	E. M. K.
First seen	4-21	.....	4-22	.....	4-24	4-26
Next seen	4-22	.....	4-23*	.....	4-27	.....
Common	4-28	.....	.....	.....	.....	.....
Last seen	.....	8-29	.....	8-14	.....	.....
Abundance	Abundant.	Abundant.	Common. *G. G. W.	.....	.....	.....

Year	1893.	1899.	1900.	1901.	1902.	1903.
Observer	E. M. K.	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-17	4-22	4-24	4-28	4-28	4-24
Next seen	.....	4-27	4-25	4-29	4-30	4-28
Common	.....	4-29	.....	5-3	5-4	4-28
Last seen	.....	.....	.....	.....	.....	.....
Abundance	.....	Common.	Common.	Common.	Abundant.	Abundant.

103. [507] *Icterus galbula* (Linn.). Baltimore Oriole.*

A rather abundant migrant and moderately common summer resident. April 18 to September 2. C. H. Bollman in 1886 and B. W. Evermann in 1887 indicated in their lists that this species was more abundant than the last. The reverse is the case now. A quite regular migrant but it has arrived on the average about a week later since 1890 than it did during the eighties. Not nearly so common a summer resident as the last. Song April 28, 1903. June 8, 1903 nest found hanging in an inaccessible position, on the end of an elm limb about 80 feet from the ground. The bird was incubating I believe (C. G. L.).

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1887.	1892.
Observer	B. W. E.	C. H. B.	C. H. B.	C. H. B.	B. W. E.	E. M. K.
First seen	4-20	4-20	.....	4-20	4-20	4-28
Next seen	.....	4-21	.....	4-22	4-27*	5-7
Common	.....	4-24	.....	4-24*	.....	.....
Last seen	.....	.....	9-2	.....	.....	.....
Abundance	Common.	Abundant.	Abundant.	Common. *B. W. E.	..... *G. G. W.	Rare.

Year.	1893.	1899.	1900.	1901.	1902.	1903.
Observer	E. M. K.	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-24	4-26	4-18	5-6	4-29	4-28
Next seen	4-25	4-27	4-19	5-7	5-3	4-29
Common	.....	4-28	4-21	5-15	.....	4-29
Last seen	.....	.....	.....	.....	.....	.....
Abundance	Rare.	Common.	Common.	Moder'tely Common.	Moder'tely Common.	Common.

104. [509] *Euphagus carolinus* (Müll.). Rusty Blackbird.*

Rather common migrant. March 8 to May 16. November 15 to 21.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1901.	1902.	1903.
Observer	C. H. B.	C. H. B.	B. W. E.	G.Hubbard	W. L. M.	W. L. M.
First seen	3-14	11-15	3-14	3-17	3-16	3-8
Next seen	3-17	11-16	.....	.....	3-25	3-17
Common	3-18	.....	.....	.....	.....	.....
Last seen	4-12	11-21	.....	.....	4-19	5-16
Abundance	Abundant.	Common.	Rare.	.....	Tolerably Common.	Tolerably Common.

105. [511b] *Quiscalus quiscula æneus* (Ridgw.). Bronzed Grackle.*

Abundant summer resident and uncommon winter resident. Following are the numbers seen at some winter dates: 2, 12-30-'84 (C. H. B.), 1-11-'85 (C. H. B.); 1 taken, 1-4-'86 (G. G. W.); and 24, 1-17-1903. Of the last flock, 15 were females, and 9 were males; there were also more females than males in a flock of 30 seen November 30, 1902. On the other hand the first migrants in spring are all great, splendid males in full song. Twenty-six seen February 20, 1903. For a period after the beginning of migration the females are absent. They were not seen until March 8, 1901; March 23, 1902. Grackles become abundant during the first week of March.

A half-finished nest was found April 4 and a nest with three young was found May 13, 1903, in a pine, about 50 feet from the ground (C. G. L.).

Grackles roost in great numbers in the shade-trees of Bloomington and in early spring and in fall many Robins roost in the same places. The calls of the Grackle, both the *chuck* and the metallic notes may be heard at intervals after dark. I have heard them as late as 11 p. m. and as early as 3 a. m. and would not be surprised to learn that they are continued throughout the night.

106. [514] *Hesperiphona vespertina* (Coop.). Evening Grosbeak*.

Very irregular and rare visitor. Seen only in January and April, 1887. Mr. C. H. Bollman took a male on the University campus, January 20, 1887. Mr. G. G. Williamson saw the following numbers during April: 4 on the 27th; 2 on the 29th; and 2 on the 30th.

107. [517] *Carpodacus purpureus* (Gmel.). Purple Finch.

Common migrant and irregular winter resident. B. W. Evermann classes it as a frequent winter visitor and W. S. Blatchley says it wintered in 1882-3. It probably wintered in 1885-6, as no last date is given in the fall migration schedule, nor any first date in that of the spring. The females remain later than the males in spring. I have heard its song at Marion, Ind., March 8, 1900. More often observed in sycamore than in other trees. Most of them departed April 14, 1885 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1901.	1902.	1903.
Observer	C. H. B.	C. H. B.	G. G. W.	W. L. M.	W. L. M.	W. L. M.
First seen	3-14	11-8	.....	3-17	.....	3-8
Next seen	3-27	12-20	.....	3-18	.....	3-18
Common	4-2	.....	.....	.....	.....	.....
Last seen	♂ 4-25 ♂ 5-15	.....	4-30	4-7*	4-19	5-4
Abundance	Abundant.	.....	.....	Common. *V. H. B.	Common.	Common.

108. [521] *Loxia curvirostra minor* (Brehm). American Crossbill.

An exceedingly irregular species; has been found often in winter and has been reported a summer resident.

The Red Crossbill was first reported from Monroe County, February 10, 1883, by B. W. Evermann who says it was common for some time after that date. The same authority also says that it was common during the winter of 1883-4. In both the spring and the fall of 1885 they were quite common. C. H. Bollman's record of its movements in the spring is as follows: 8 males and females seen March 2 and 3; the arrival of the bulk from the north took place March 8 and both sexes were then common; in a letter to J. M. Wheaton he reported them still present March 13; and the last male was seen May 10 and the last female May 12. The bulk of the species departed April 15. From uncatalogued specimens in the collection of Indiana University the following additional dates were obtained: March 10; a male May 14. During the year 1885 it was also reported to have bred at Bloomington. "Mr. Sam Hunter reports a pair to have nested in a pine here in 1885. He says the nest was made exclusively of pine burrs" (E. M. Kindle.).

In the fall of 1885, C. H. Bollman reported the Red Crossbill October 4 and November 5, but gives no date for the last one seen, indicating that it remained throughout the winter, and, indeed, W. S. Blatchley reports it in his list of winter birds as a scarce resident during the winter of 1885-6. In the latter year, the first Crossbills were reported January 18, and fifteen or twenty were seen February 6 (G. G. W.). Crossbills, probably of this species, but not exactly identified were reported February 23

and March 8, 1886. C. H. Bollman saw eleven in a fir tree in Bloomington June 24, and reported them also on July 10, 13 and 14 (B. W. E.).

After being reported quite often during this period of 4 years, Crossbills were not again recorded until 1892, when six were observed by E. M. Kindle and A. B. Ulrey on March 1. The last date recorded for this locality is March 3, 1893 (E. M. K.), when a crossbill probably of this species, was identified by note.

109. [522] *Loxia leucoptera* Gmel. White-winged Crossbill.

A very irregular visitor, much more rare than the last.

White-winged Crossbills were first observed here February 6, 1883. On that date B. W. Evermann took two males from a flock of fifteen in a yard on College Avenue, Bloomington. A female was taken February 10, and "two days later two more specimens were taken near the same place." (A. W. Butler, in "Papers Read at the World's Congress of Ornithology" in Chicago, 1893-6.)

Mr. Evermann also observed this bird February 23 (List of Birds of Carroll County, "Auk," 1889). C. H. Bollman gives a queried record of this species for December 12, 1885. About five were identified by note.

A. W. Butler says: "The only instance of its occurrence in summer in the Ohio valley is that given me by the late C. H. Bollman. He saw eleven in a fir tree in Bloomington, Ind., June 24, 1886." However, on C. H. Bollman's schedule for 1886, this date is attributed to the other species, in the account of which I have placed it.

110. [528] *Acanthis linaria* (Linn.). Redpoll.

Irregular winter visitor.

"B. W. Evermann identified a single bird at Bloomington in December, 1882" (A. W. Butler). C. H. Bollman reports "one seen" in his list of 1886, and "Mr. Chauncey Juday obtained specimens from a flock of twenty at Bloomington, April 12, 1895" (A. W. Butler). W. S. Blatchley also reports one January 30, 1883.

111. [529] *Astragalinus tristis* (Linn.). American Goldfinch.*

Abundant resident.

Song March 29 (W. L. M.,'02). June 12, 1902, a nest and four eggs in a wild rose bush (C. G. L.). October 2, 1903, I shot a young Goldfinch with the short wings and tail and fluffy feathers of a fledgeling, that was unable to fly well and was still being fed by the mother.

The plumage changes are very interesting. It requires about a month for all the males to assume the summer plumage. None were seen

in summer dress until April 18, 1886 (B. W. E.). The record from the first appearance of a change till the moult is completed is as follows: March 29 ('02), two Goldfinches, one singing and in great part in summer plumage; April 1 ('03), eight Goldfinches, four singing and with the back and part of the breast yellow, and part of head black; April 2, four Thistlebirds, one in perfect plumage, the others in changing phases of attire; April 12, two, one in full dress; April 14, five, two in yellow and black; April 19, three, two in winter plumage. One of these which was black; April 19, three, two in winter plumage. One of the last two which was taken was a male, the other one of the trio was in summer attire; April 25, twenty, ten in transitional stages of plumage; April 30, an increase in those of full plumage to the usual summer number. Probably all of the males have completed the moult.

112. [533] *Spinus pinus* (Wils.). Pine Siskin.

A rather regular migrant in moderate numbers; a rare winter resident. October 27 to May 13.

MIGRATION RECORD.

Year	1883.	1885.	1885.	1886.	1886.
Observer	B. W. E.	I. U. Coll.	C. H. B.	G. G. W.	G. G. W.
First seen	2-6	3-23	10-27	.....	.....
Next seen	.....	3-25*	.....	.....	.....
Common	.....	3-25*	.....	.....	12-4
Last seen	.....	5-13*	12-29	4-24	12-29*
Abundance	Not rare.	Common.	Common.	.....	Not common
		*C. H. B.			*W. S. B.

Year	1887.	1896.	1902.	1903.
Observer	G. G. W.	A. W. B.	W. L. M.	W. L. M.
First seen	.....	.....	3-23	.....
Next seen	.....	.....	.....	.....
Common	.....	.....	.....	.....
Last seen	5-8	11-	5-*	3-18
Abundance	.....	.....	.....	.....
			*E. Muhse.	

113. [534] *Passerina nivalis* (Linn.). Snowflake.

Rare and irregular winter visitor (C. H. B., '86).

114. [536] *Calcarius lapponicus* (Linn.). Lapland Longspur.

Rare and irregular winter visitor. Observed February 2, 1883 (W. S. B.); taken February 10 and 12, 1883 (B. W. E.); seven seen February 9, 1901 (V. H. B.). All were associated with *Otocoris a. praticola*.

115. [540] *Poaecetes gramineus* (Gmel.). Vesper Sparrow.*

Abundant summer resident. February 19 to October 25.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	W. S. B.	G. G. W.	A. B. U.	E. M. K.
First seen	4-1	.....	4-8	3-24	4-2	3-30
Next seen	4-2	.....	4-10*	3-25*	4-9*	.....
Common	4-3	.....	.....	.....	4-17	.....
Last seen	.....	10-25	.....	.....	.....	.....
Abundance	Abundant.	Very common.	..... *G. G. W.	Abundant. *B. W. E.	Common. *E. M. K.	Common.

Year	1899.	1900.	1901.	1902.	1902.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	2-19	4-18	3-24	2-21	.....	3-17
Next seen	2-24	.....	.....	3-24	.....	3-18
Common	3-25	4-25	.....	3-29	.....	3-17
Last seen	.....	.....	.....	.....	10-19	.....
Abundance	Common.	Common.	Abundant.	Abundant.	Abundant.	Abundant.

116. [——] *Passer domesticus* (Linn.). European House Sparrow.*

Exceedingly abundant resident. Appeared in Bloomington in 1875 (Butler).

Nest and six eggs taken as early as February 20, '03 (C. G. L.). Two males were observed trying to mate with a female Song Sparrow, March

2, 1901 (W. L. M.). During the mating season English Sparrows often engage in such earnest fighting that one or the other of the contestants is left dead upon the field. Their pugnacious encounters are by no means confined to that season, however. On October 16, 1902, two males were so deeply interested in their battle that they were both easily picked up in the hand.

Flycatchers are found in the Sparrow family and the House Sparrow is one of these. They have been observed catching insects on the wing, swooping and returning to the same perch like Flycatchers. Some seem more adept than others; one seen, made two darts in the air before returning to the tree which was his headquarters. Other Sparrows which have been observed at this pursuit are: Junco, Chewink, Chippy, Field and White-throated Sparrows.

Quite a tendency to albinism is noticeable in this bird and it seems to be of recent development. A perfect albino was taken September 28, 1885 (C. H. B.). In the single spring of 1903, a perfect albino was captured by hand while on a nest containing four young (McCracken); a partial albino with the head and flecks everywhere snowy white was taken and three similar ones seen. Many specimens with one or two rectrices or remiges white were observed. In two months in the summer at another locality, three partial albinos were seen and two complete ones reported. A peculiarity in the coloration is that the light color in the partial albinos is pure snowy white, while the entirely albinistic specimens are deep buffy white.

117. [542a] *Passerculus sandwichensis savanna* (Wils.). Savanna Sparrow.

Common migrant and probably rare summer resident. The majority of migration records do not show this bird in what is probably its true position. There are several rather early spring and late fall reports, but the greater number of dates given nearly coincide with those for the next species as if they were inseparably connected in time of migration as they have been, heretofore, generically united. This bird breeds farther north and winters farther north; the fact that it winters in the lower Wabash valley in our own State makes it seem probable that it should be seen earlier all over the State and that it has probably been overlooked during many seasons until its more conspicuous cousin, with the brighter colors and startling insect-like trill, arrived. It is true that the two birds are generally found together, but it is probable that the obscure

little Savanna Sparrow is present at a given point in the State from a week to a month in advance of the Yellow-winged Sparrow every year.

A nest identified as belonging to a bird of this species by Prof. J. R. Slonaker was found May 17, 1901. It was built in a depression in the ground and was lined and partly arched over with dry grass. On May 22, there were five eggs. June 3, they were hatched. June 7, the nest was empty but probably not as a result of the natural course of events.

In 1885 most of the individuals departed May 2. The Savanna Sparrow was taken March 29, 1894, by E. M. Kindle in Brown County.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.
Observer	C. H. B.	C. H. B.	G. G. W.	E. M. K.
First seen	4-18	10-17	4-10	3-30
Next seen	4-20	.....	4-16	.....
Common	4-22	.....	.....	.....
Last seen	5-11	11-6	4-27*	.....
Abundance	Very common	Not common	Not common	.....
			*B. W. E.	

Year	1901.	1902.	1902.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	.....	3-23	.....	3-17
Next seen	.....	3-24	.....	3-18
Common	5-10	4-3	.....	4-12
Last seen	.....	.....	9-1	.....
Abundance	Common.	Common.	Common.	Common.

118. [546] *Coturniculus savannarum passerinus* (Wils.) Grasshopper Sparrow.

Rather common summer resident (B. W. E.). April 12 to Oct. 4.

Song April 12, '03 (W. L. M.). A nest and well incubated eggs found June 6, 1902 (C. G. L.).

MIGRATION RECORD.

Year	1869.	1885.	1885.	1886.	1887.
Observer	I. U. Coll.	C. H. B.	S E. Meek.	B. W. E.	G. G. W.
First seen	.....	4-20	.....	4-25	4-25
Next seen	.....	4-23	.....	4-27	.....
Common	.....	4-25	8-1	4-27	.....
Last seen	7-26	.....	10-4*	.....	.....
Abundance	.....	Common.	..... *C. H. B.	Rather Common.	.....

Year	1899.	1901.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-11	5-1	4-19	4-12
Next seen	5-13	5-5	4-25	4-19
Common	5-16	5-6	.....	4-12
Last seen	.....	.....	.....	.....
Abundance	Common.	Common.	Common.	Abundant.

119. [547] *Ammodramus henslowii* (Aud.). Henslow's Sparrow.

Rare summer resident. Mr. C. G. Littell saw a nest on the ground which contained four young almost ready to fly, June 3, 1902. Mr. Littell made this report in 1903, after he had become better acquainted with the bird at Winona Lake where it was collected. The accuracy of the record is thus assured.

120. [552] *Chondestes grammacus* (Say). Lark Sparrow.

Abundant summer resident. March 26 to August 26. In 1887 B. W. Evermann classed it as rare and said it had not been seen here until in recent years. However C. H. Bollman found it abundant in 1885. The Lark Sparrow has probably been increasing in numbers every year here.

Song April 12, 1903. Mating May 6, 1902. Nest and four young on ground under a cedar limb. May 30, 1903 (C. G. L.).

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1887.
Observer	C. H. E.	C. H. B.	C. H. B.	W. S. B.	G. G. W.
First seen	3-26	4-17	.....	4-21	4-26
Next seen	.....	4-18	.....	4-22*	4-27
Common	.....	4-23	.....	.....	.....
Last seen	.....	.....	8-26	.....	.....
Abundance	.....	Abundant.	Abundant.	Rare. *B. W. E.	.....

Year	1893.	1901.	1902.	1903.
Observer	E. M. K.	W. L. M.	W. L. M.	W. L. M.
First seen	4-17	5-6	4-24	4-12
Next seen	4-19	5-7	4-27	4-19
Common	.....	5-13	.....	4-19
Last seen	.....	.....	.....	.....
Abundance	Not common	Moderately common.	Common.	Abundant.

121. [554] *Zonotrichia leucophrys* (Forst.). White-crowned Sparrow. Moderately common migrant. April 10 to May 16. October 4 to 25. In 1885 most of them departed May 10 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1893.
Observer	C. H. B.	C. H. B.	W. S. B.	G. G. W.	E. M. K.
First seen	5-1	10-4	4-13	4-30	4-19
Next seen	5-2	10-11	4-22*	5-4	4-26
Common	5-4	.....	4-22†	.....	.....
Last seen	5-14	10-25	5-5‡	5-8	.....
Abundance	Very common.	Not common	Common. *B. W. E. †B. W. E. ‡G. G. W.	.....	.....

Year	1900.	1901.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-30	5-5	4-10	4-12
Next seen	5-5	5-6	4-20	4-28
Common	.....	5-7	.....	.....
Last seen	.....	5-15	5-4	5-16
Abundance	.....	Common.	Common.	Common.

122. [558] *Zonotrichia albicollis* (Gmel.). White-throated Sparrow.*

Abundant migrant. March 8, '03 (W. L. M.) to May 16. September 24 to November 22. Possibly rare winter resident. Reported January 29, 1903 (P. J. H.).

Song heard as early as March 9, 1903 and as late as November 8, 1902. On this late date the songs were loud, clear and distinct. "They remain with us in spring as late as they can. Often they are seen mating, and some years, when they lingered long, they have been observed carrying sticks, as though they had thought to begin nest-building. Some year when they remain late, I shall not be surprised to learn that the imperative demands of nature have impelled some of them to make their summer homes with us and build their nests" (A. W. Butler). "April 30, 1902, in a brush heap, in an old orchard, I found a White-throated Sparrow building a nest. The bottom of the nest was made of twigs, but every time she carried any material to the nest, a Catbird would fly down and take it away. The Catbird fought and chased the Sparrows until they left the nest unfinished" (Gertrude Hitze).

The bulk of the species departed May 10, 1885 (C. H. B.).

MIGRATION RECORD.

Year	1884.	1885.	1885.	1885.	1886.	1887.
Observer	C. H. E.	C. H. B.	C. H. B.	C. H. B.	B. W. E.	G. G. W.
First seen	3-18	♂3-16	♀4-8	9-24	4-12	4-11
Next seen	.....	3-18	4-20	10-3	4-17*	.....
Common	.....	4-25	4-25	10-10	4-22	.....
Last seen	.....	5-14	5-15	11-8	5-6	.....
Abundance	.....	Abundant.	Abundant.	Abundant.	Common *G. G. W.	.....

Year	1892.	1900.	1901.	1902.	1902.	1903.	1903.
Observer	A. B. U.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	.....	4-17	.....	3-9	10-5	3-8	.....
Next seen	.....	.....	.....	3-14	10-12	3-9	.....
Common	.....	.....	.....	3-25	10-26	3-20	.....
Last seen	4-30	.....	5-13	5-4	11-9	5-16	11-22
Abundance	.....	.....	Common	Common	Common	Abundant.	Abundant.

123. [559] *Spizella monticola* (Gmel.). Tree Sparrow.*

Abundant winter resident. October 12 to April 19. The song is often heard in spring: March 1 and 5, 1902, and March 9 and 17, 1903.

MIGRATION RECORD.

Year	1885.	1885.	1901.	1902.	1902.	1903.
Observer	C. H. B.	C. H. B.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	.....	11-4	.....	.....	10-12	.....
Next seen	.....	11-15	.....	.....	10-19	.....
Common	3-23	12-26	.....	.....	11-28	.....
Last seen	4-19	.....	3-17	3-26	.....	3-17
Abundance	Abundant.	Abundant.	Common.	Very Common.	Common.	Abundant.

124. [560] *Spizella socialis* (Wils.). Chipping Sparrow.* Fig. 18.

Abundant summer resident. March 16 to November 9.

Song March 17, 1903; March 26, 1902. Mating March 27, 1903. Nest found April 28, 1899 (N. B. M.); nest and four eggs May 2, 1903 (C. G. L.). Nearly full grown young seen with mother and being fed by her May 29, 1903. There is a nest in the collection of the University which is composed of soft vegetable fibers or rootlets without a trace of horsehair.

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. E.	C. H. B.	C. H. B.	W. S. B.	G. G. W.	E. M. K.	E. M. K.
First seen	3-24	4-1	.....	3-19	4-1	3-27	3-20
Next seen	.....	4-2	.....	.....	.....	4-9	3-23
Common	.....	4-3	.....	5-24*	.....	.....	.....
Last seen	.....	.....	11-7	.....	.....	.....	.....
Abundance	.....	Abund't.	Abund't.	Common	.....	Common	Common

*G. G. W.

Year	1899.	1900.	1901.	1902.	1902.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-12	4-8	3-25	3-16	.....	3-27
Next seen	4-15	4-12	3-27	3-23	.....	3-18
Common	.....	4-17	.....	3-26	.....	3-20
Last seen	.....	.....	.....	.....	11-9	.....
Abundance	Common.	Common.	Common.	Common.	Common.	Abundant.

125. [563] *Spizella pusilla* (Wils.). Field Sparrow.* Fig. 19.

Abundant summer resident. February 26 to November 8. Possibly rare winter resident. Reported January 17 and February 2, 1903 (P. J. H.).

Singing weakly February 26, 1902; in full song March 10, 1903. Mating March 29, 1902. Nest and 3 eggs, May 3, 1903 (C. G. L.). This nest was on the ground at the base of a large weed. Nest and full set of eggs May 14, 1899; hatched May 18 (N. B. M.).

A most abundant species in weedy fields.

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1887.	1893.
Observer	C. H. E.	C. H. B.	C. H. B.	B. W. E.	G. G. W.	E. M. K.
First seen	3-18	3-31	.....	3-15	3-24	3-30
Next seen	.....	4-1	.....	3-25	.....	.....
Common	.....	4-2	.....	3-26	.....	.....
Last seen	.....	.....	11-8	.....	.....	.....
Abundance	.....	Abundant.	Abundant.	Common.	.....	Common.

Year	1899.	1901.	1902.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	.....	3-17	2-26	.....	3-1
Next seen	.....	3-24	3-14	.....	3-3
Common	4-15	3-24	3-21	.....	3-15
Last seen	.....	.....	.....	11-5	.....
Abundance	Common.	Common.	Common.	Common.	Abundant.

126. [567] *Junco hyemalis* (Linn.). Slate-colored Junco.*

Abundant winter resident. October 6 to May 1.

Snatches of song are often heard in March and April and it has been heard singing in the fall; November 9 and 23, 1902. On November 23, 1902, a bright, sunshiny day, one of three Juncos was observed carrying dry blades of grass in its beak. It always gave them up in favor of new ones every little while and did not put many of them in the same place. On this same day a Junco was also heard singing a quite loud and pleasing song. This occurrence should probably be classed with those phenomena which were discussed under the heading, "A Revival of Sexual Instinct" in "The Auk" a year or more ago. A similar thing has been noticed in the case of the English Sparrow. One was seen nest-building November 6, 1902.

Where there are weeds there are Juncos. But briary fence rows, and thicketed gullies are centers of density in the Junco population.

MIGRATION RECORD.

Year	1885.	1892.	1899.	1901.	1902.	1902.	1903.
Observer	C. H. B.	E. M. K.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	10-6	.....	.....	.....	.....	10-12	.....
Next seen	10-7	.....	.....	.....	.....	10-14	.....
Common	10-20	.....	.....	.....	.....	10-19	.....
Last seen	.....	4-21	4-6	4-14	4-27	.....	5-1
Abundance	Abundant.	.....	.....	Abundant.	Abundant.	Abundant.	Abundant.

127. [575a] *Peucæa æstivalis bachmanii* (Aud.). Bachman's Sparrow.

Common migrant and not uncommon summer resident. April 6. —.

"April 24, 1884, Prof. W. S. Blatchley took two Bachman's Sparrows from a brush-pile in Monroe County. That was its first record there. It appeared regularly thereafter between April 6 (1885) and April 29 (1886). In 1886 two sets of eggs and perhaps a half-dozen taken (Evermann)" [A. W. Butler]. Song April 7, 1903. Common April 12, 1903; 31 of these birds were seen in a single high, brushy meadow. Here and in clearings where there are many oak saplings and in the uneven pastures where rosebushes and stunted cedars are plentiful, Bachman's Sparrow is most often found.

MIGRATION RECORD.

Year	1884.	1885.	1886.	1887.	1902.	1903.
Observer	W. S. B.	C. H. B.	C. H. B.	G. G. W.	W. L. M.	W. L. M.
First seen	4-24	4-6	4-29	4-27	4-19	4-7
Next seen	.....	4-26	5-8*	4-28	4-20	4-8
Common	.....	.....	.....	.....	.....	4-12
Last seen	.....	.....	.....	.....	.....	.....
Abundance	.....	Not rare.	Not rare. *G. G. W.	.....	Rare.	Common.

128. [581] *Melospiza cinerea melodia* (Wils.). Song Sparrow.* Fig. 20.

Abundant during migration; common at other times but more so in winter than in summer. The Song Sparrow is not a common breeder here.

The most common songster, whose value is enhanced by his habit of singing when most other birds are silent. The writer has heard Song

Sparrows singing every month in the year. Following are dates when their song was heard in this locality, for ten months of the year: 9-28; 10-12; 11-8; 12-14, '02; 1-21; 2-22; 3-4; 4-4; 5-1; 6-9, '03. On April 8, 1900, one was observed singing during flight. Though not a performer of intricate music, nor ostentatious either in his lay or his pretty self, to the person to whom are familiar our country lanes as they appear in the cool, quiet duskiness of vernal evenings, this domestic songster is the most welcome and the most cheerful and cheering of singing birds.

May 3, 1903, nest and four young in a small, thick cedar in a sinkhole (C. G. L.). Many nests and eggs are found during the first week in June.

129. [583] *Melospiza lincolnii* (Aud.). Lincoln's Sparrow.

Rare migrant; probably a more common and regular one, however than can be inferred from the data at hand.

MIGRATION RECORD.

Year	1885.	1885.
Observer	C. H. B.	C. H. B.
First seen	5-3	10-10
Next seen	5-5	10-11
Common		
Last seen		10-25
Abundance	Not common	Not common

130. [584] *Melospiza georgiana* (Lath.). Swamp Sparrow.

Common migrant. March 5 to April 29, October 2 to November 3. "Reported by B. W. Evermann in winter, not seen by me before March 19" (W. S. B.). There is a possibility that the Swamp Sparrow is an occasional summer resident. A nest in the University collection from this locality is identified as belonging to this bird.

In speaking of the breeding grounds, A. W. Butler says: "There it sings its song, but during the migrations it is songless." P. J Hartman and the writer saw and heard the Swamp Sparrow singing during a steady drizzling rain March 8, 1903, the first date for the bird in that year.

MIGRATION RECORD.

Year	1885.	1886.	1887.	1895.
Observer	C. H. B.	W. S. B.	G. G. W.	Butler.
First seen	10-17	3-19	3-26	3-5
Next seen	10-28	.....	.....	.....
Common	.....	.....	.....	.....
Last seen	11-3	.....	.....	4-19
Abundance	Common.	.....	.....	.....

Year	1902.	1902.	1903.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	3-26	10-12	3-8	.....
Next seen	3-27	.....	3-9	.....
Common	.....	.....	.....	.....
Last seen	4-24	10-26	4-29	10-2
Abundance	Common.	Common.	Common.	Common.

131. [585] *Passerella iliaca* (Merr.). Fox Sparrow.*

Common to abundant migrant. February 20 to May 16. October 5 to November 28. Rare winter resident. January 17, 1903. In winter they are very restricted in their range. Though seen several times from November 28, 1902, to March 8, 1903, none were seen outside of a portion of the valley of Griffey Creek about one fourth of a mile long. The exceedingly late date, May 16, 1903, is a record of six or seven Fox Sparrows seen by the Nature Study Class and the writer along a creek bottom in the extreme eastern part of the county.

"It is said to have a clear, loud, melodious voice, and to sing a sweet song, which I have never heard, but hope to some spring, as they should occasionally give us a foretaste of the musical treat that is wasted—humanly speaking—on the uninhabited Hudson Bay Region" (A. W. Butler). The song of the Fox Sparrow is indeed loud and melodious and is in tone similar to that of the Chewink. I have heard it singing every spring that I have made observations in this locality. P. J. Hartman and myself heard the song many times during the spring of 1903. They began singing March 9.

The bulk departed April 12, 1885 (C. H. B.).

Year	1884.	1885.	1885.	1886.	1892.	1895.
Observer	C. H. E.	C. H. B.	C. H. B.	B. W. E. G. G. W. W. S. B.	E. M. K. A. B. U.	A. W. B.
First seen	3-19	3-18	10-10	3-14	2-20	.....
Next seen	.....	3-27	10-14	3-16	2-27	.....
Common	.....	3-31	.....	.....	.....	.....
Last seen	.....	4-19	11-3	3-25	3-30	4-20
Abundance	.....	Common.	Rare.	Common.	Common.	.....

Year	1901.	1902.	1902.	1903.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	3-24	3-1	.....	.....	.....
Next seen	.....	3-2	.....	.....	.....
Common	.....	3-23	10-5	3-8	.....
Last seen	.....	4-16	10-28	5-16	11-22
Abundance	Common.	Common.	Common.	Abundant.	Common.

132. [587] *Pipilo erythrophthalmus* (Linn.). Towhee.* Fig. 21.

Abundant migrant and summer resident; common winter resident. There is always a noticeable period in spring when Chewinks are very scarce. This is probably due to the departure of our winter residents before the arrival of migrants and summer residents. A marked example of this period of scarcity is found in the record for the spring of 1902. Up to the fifteenth of February, males and females were common and present in about equal numbers. From this date until the ninth of March, no Chewinks were seen. On the latter date, and for nearly a week thereafter, although males were present, no females were seen. But on the twenty-fourth of March both sexes were equally abundant and the season of song was at its height. Thus in this spring there was a period twenty-three days in length when they were absent; a period of a week when males only were present; and finally another period of fifteen days during which the arrival of other birds brought the numbers up to the usual summer abundance. This hiatus is more or less marked in every

year's record. That the males migrate first to the breeding ground is also upheld by all other available data.

MIGRATION RECORD.

Year.	Male.	Female.	Observer.
1885	3-14	4-1	C. H. B.
1886	2-22*	3-9	W. S. B.
1902	3-9	3-16	W. L. M.
	*B. W. E.		

The Chewink begins singing early. The first perfect song was heard March 1, 1903. On February 20, however, and again on March 1, two of these birds were found rehearsing in low tones. The first was scratching among some briars and was going over his spring song very softly. The notes were exactly the same; the only difference was in the volume and the tone which seemed to express contentment rather than ecstacy. The other one, heard on the first of March, was sitting in some cedar brush with his feathers ruffled up, his bill sunk in his breast, muttering his score. This whole effort was accomplished in rather a drowsy manner and he was so oblivious to his surroundings, that he was not frightened by the presence of a human being within three feet of him. Immediately after this, I heard another Chewink give the song perfectly from the top of a chestnut tree. It was a beautiful chant and seemed unusually attractive on this rainy March morning. The same habit of rehearsal has been observed in several other birds, among which are the Song Sparrow, White-throated Sparrow and Brown Thrasher.

Nest and three eggs found April 15, '03. Birds hatched on June 11, 1901, had flown June 19 (W. L. H.).A very late date is given by B. W. Evermann. "August 19, 1881, I found a Chewink's nest containing three fresh eggs, built at least three feet from the ground in a spice bush. Such is not common I believe." (Orn. and Oöl., 1881.)

133. [593] *Cardinalis cardinalis* (Linn.). Cardinal.* Fig. 22.

Abundant resident.

Mating February 18, 1901; March 23, 1903. Nestbuilding April 12, 1903, but, on the same date a nest was found which contained three eggs. This was afterwards ascertained to be the full set.

The Cardinal is another one of those cheery birds which may be heard singing at all times of the year. Some winter dates of singing are: 10-19; 11-9, '02 and 1-1; 2-8, '03. On February 13, 1903, I heard a Cardinal singing from the top of a cedar tree at 6 a. m., and on passing the same place at 7 a. m. found him still at his music.

134. [595] *Zamelodia ludoviciana* (Linn.). Rose-breasted Grosbeak.*

Common migrant. "But few breed here" (B. W. E.). Although the Rose-breasted Grosbeak has been reported a summer resident from localities farther south than this (St. Louis, Cincinnati), such an occurrence is very unusual. The only record of its making its summer home at Bloomington is that of B. W. Evermann in 1886. Song May 8, 1903.

The date, November 12, 1888, is from an uncatalogued specimen in the Museum of Indiana University which was collected by a Mr. Chambers. The males seem to arrive earlier and depart later than the females. Neither so common nor so early a migrant now as formerly.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.	1887.
Observer	C. H. B.	C. H. B.	C. H. B.	B. W. E.	G. G. W.
First seen	4-23	4-30	9-11	4-23	4-28
Next seen	4-26	5-5	9-17	4-24*	.....
Common	5-6	5 6	9-18	5-4	.....
Last seen	6-16	5-15	10-10	5-4	.....
Abundance	Abundant.	Abundant.	Abundant.	Common. *W. S. B.	.....

Year	1888.	1901.	1902.	1903.
Observer	Chambers.	W. L. M.	W. L. M.	W. L. M.
First seen	.....	5-7	5-5	5-7
Next seen	.....	.....	.....	5-8
Common	.....	.....	.....	.....
Last seen.	11-12	.....	.....	.....
Abundance	.....	Common.	Common.	Common.

135. [598] *Cyanospiza cyanea* (Linn.). Indigo Bunting.*

Abundant summer resident. April 13 to October 17; which are the limits of its stay in the State.

Song April 29, '03; also heard as late as August 9, in a latitude but little south of this. May 19, '03, nest and one egg found in a small bush along a road (C. G. L.). The males migrate from a few days to two weeks in advance of the females.

MIGRATION RECORD.

Year.....	1885.	1885.	1885.	1882.	1886.	1887.	1892.
Observer.....	C. H. B.	C. H. B.	C. H. B.	B. W. E.	C. H. B. W. S. B. G. G. W.	G. G. W.	E. M. K.
First seen ...	4-25	5-9	.....	4-13	4-22	4-27	5-4
Next seen....	5-2	5-10	.....	.....	4-23	4-30	.....
Common.....	5-16	5-16	.....	.....	4-24	.....	.....
Last seen.....	.....	.....	10-17	.....	.....	.....	.....
Abundance...	Abundant.	Abundant.	Abundant.	Abundant.	Abundant.	.....	.....

Year.....	1893.	1895.	1900.	1901.	1902.	1902.	1903.	1903.
Observer...	E. M. K.	A. W. B.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen..	5-6	5-2	4-28	5-6	.....	.....	4-28	.....
Next seen..	.....	.....	.....	5-7	.....	.....	4-29	.....
Common...	.....	.....	.....	5-14	5-4	.....	4-29	.....
Last seen ..	.....	.....	.....	.....	.....	9-1	.....	10-6
Abundance	.....	.....	Common	Common	Common	Common	Abundant	Abundant

136. [604] *Spiza americana* (Gmel.). Dickcissel.

Abundant summer resident. April 23 to October 2.

Song May 5, 1903. Nest and 5 eggs in a low bush, in an old orchard, May 15, 1901. Nest and four eggs about three feet up in a bush in a pasture, June 2, 1902 (C. G. L.).

Both sexes arrive at the same time, and they are either mated upon arrival or mate very soon afterwards.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	C. H. B. G. G. W.	G. G. W.	A. B. U.	E. M. K.
First seen	4-30	.....	4-23	5-2	5-7	4-28
Next seen	5-1	.....	4-29	.....	.....	5-4
Common	5-10	.....	5-1	.....	.....	.....
Last seen	.....	10-2	.....	.....	.....	.....
Abundance	Abundant.	Abundant.	Abundant.	.....	.....	.....

Year	1895.	1899.	1901.	1902.	1903.
Observer	A. W. B.	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-4	5-11	.....	5-4	5-5
Next seen	.....	5-13	.....	.....	5-10
Common	.....	5-16	5-15	5-10	5-16
Last seen	.....	.....	.....	.....	.....
Abundance	.....	.....	Common.	Common.	Abundant.

137. [608] *Piranga erythromelas* Vieill. Scarlet Tanager.*

Common migrant. Moderately common summer resident (B. W. E., '87). April 22 to September 19. Song and mating April 29, 1903. Usually the males arrive before the females, sometimes as much as a week in advance. They arrive at the same time, however, in some years. B. W. Evermann says that this species was moderately common here in the spring of 1881. Six were seen on one morning in May. He says that this was the farthest north it had been reported in the State up to that time.

MIGRATION RECORD.

Year	1882.	1885.	1885.	1885.	1886.
Observer	B. W. E.	C. H. B.	C. H. B.	C. H. B.	B. W. E. G. G. W.
First seen	5-6	4-26	5-3	.....	4-22
Next seen	.....	4-28	5-9	.....	4-23
Common	.....	5-10	5-10	.....	4-24
Last seen	.....	.....	.....	9-19	.....
Abundance	.....	Abundant.	Abundant.	Abundant	Common.

Year	1887.	1892.	1902.	1903.
Observer	G. G. W.	E. M. K.	W. L. M.	W. L. M.
First seen	4-28	5-4	4-23	4-28
Next seen	4-29	.....	4-27	4-29
Common	.....	.....	.....	4-29
Last seen	.....	.....	.....	.....
Abundance	.....	.....	Common.	Common.

138. [610] *Piranga rubra* (Linn.). Summer Tanager.*

Abundant migrant and common summer resident. April 1 to September 28.

Mated May 4, 1903; nest and five eggs in a small apple tree near a pond, May 19, 1902 (C. G. L.); nest and four eggs May 29, '01.

The date, April 1, 1886, is from an uncatalogued specimen in the museum of Indiana University, by W. A. Millis. The first migrant in 1901 was a male in variegated plumage. The males precede the females in migration.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	C. H. B.	C. H. B. B. W. E.	G. G. W.	A. B. U. E. M. K.	E. M. K.
First seen	4-22	4-26	.....	4-1*	4-27	5-1	5-1
Next seen	4-25	5-2	.....	4-18	.....	5-28	.....
Common	5-3	5-3	.....	5-4	.....	.....	.....
Last seen	.....	.....	9-28	.....	.....	.....	.....
Abundance	Abundant.	Abundant.	Abundant.	Common.	.....	.....	.....

*W. A. Millis.

Year	1899.	1900.	1901.	1902.	1902.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-9	4-29	5-6	4-27	.....	4-28
Next seen	5-11	5-5	5-7	5-4	.....	5 2
Common	5-16	5-9	5-13	4-27	.....	5-10
Last seen	.....	.....	.....	.....	9-1	.....
Abundance	Common.	Common.	Common.	Common.	Common.	Common.

In 1894 E. M. Kindle remarked upon the absence of this bird from Brown County while it was common in this, the adjoining county. During the last spring (1903) the Summer Redbird was common also in Brown County.

139. [611] *Progne subis* (Linn.). Purple Martin.*

Common summer resident. March 28 to September 10.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.	1895.
Observer	C. H. B.	C. H. B.	B. W. E. G. G. W.	G. G. W.	A. B. U. E. M. K.	E. M. K.	A. W. B.
First seen	3-31	.....	3-28	3-29	3-31	3-31	4-17
Next seen	4-1	.....	4-9	.....	4-2	.....	.....
Common	4-6	.....	.....	.....	4-19	.....	.....
Last seen	.....	9-10	.....	.....	.....	.....	.....
Abundance	Abundant.	Abundant.	Common.	.....	Common.	Common.	.....

Year	1899.	1900.	1901.	1902.	1902.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-12	4-7	4-16	4-5	.....	3-28
Next seen	4-13	4-8	4-17	4-6	.....	4-2
Common	4-20	4-10	4-18	4-15	.....	4-11
Last seen	.....	.....	.....	.....	9-1	.....
Abundance	Common.	Common.	Common.	Common.	Common.	Abundant.

There are only two large ponds in the region, and as the Swallows are seen at these places for a long time before they are in any other part of the country it is easy to record their migration.

One of the peculiarities of their migration is the arrival at the same time of all or several of the species. On one day we can find no Swallows at all; on the next, perhaps, all, from the Martin to the little Bank Swallows, will be present about our ponds. Four of the species came on the same day in 1885, and three on the same day in 1902 and 1903. After their arrival they are augmented in numbers at the same time, or they leave, or arrive again in full strength. Thus on four days in April, 1903—the 10th, 13th, 19th and 30th—large mixed flocks were observed, when all or nearly all of the species had been

absent the day before. Their departure was similar. On April 11, 17, 27 and May 1, the less vagrant summer resident *Progne* was the only Swallow remaining of the motley companies of the day before. In other years this mode of migration has been just as marked; in 1902, two species arrived together on the fifth of April and three on the thirteenth; and in 1885, four species, the Bank, Tree, Barn and Cliff Swallows arrived in one flock on the 15th of April, and were seen together again on the next day. Tree and Cliff Swallows became common on the 22d, the Barn Swallow a day before, and on the 25th the Bank and Roughwinged Swallows became common.

A more detailed discussion of the migration of the *Hirundinidæ* in 1903, will bring out another point, i. e., the relation of weather conditions to the phases of the migratory movement.

From April 10, the date when three species had arrived, to May 3, inclusive, when the last flock of migrants was seen, there were just fifteen cloudy or rainy days, with an average temperature of 47° at 5 a. m., and ten clear days with a temperature of 44.° Swallows, sometimes, with the exception of the Purple Martin, were absent [three specimens of *Hirundo* seen one day and two of *Petrochelidon* another] during the ten days, and were very much in evidence fifteen days. South winds prevailed during this period and migration was high among all the small land birds, especially on the 28th and 29th; but on these dates no flocks of swallows were seen. If a clear or partly clear period was succeeded by a rainy, cloudy, or misty one, swallows were surely to be found. As long as the weather remained cloudy, these birds remained, but on the first fair day they disappeared. The only species that arrived on a clear day was the Tree Swallow; but after its arrival its movements agreed with those of its cousins. There was only one cloudy day on which the crowds of swallows were absent and even that day brought an increase in the number of Martins.

A synopsis of the period follows: April 10, cloudy, 3 species; April 11, cloudy, an increase in number of Purple Martins; April 12, fair, no Swallows (Martin ignored); April 13-16, inclusive, cloudy and rainy, all species present; April 17-18, clear, no Swallows; 19-25, inclusive, cloudy or rainy, all species present in considerable numbers; 26-29, fair, few Swallows seen and their number decreased during this period; April 30, cloudy, a large flock of four kinds; May 1-2, clear, no Swallows; May 3, rainy, a

flock of eighty Bank Swallows and twelve Purple Martins. After this date only the usual summer numbers of the breeding species were seen; there were no more migrants. The Purple Martin which seemed to be less affected by weather conditions after arrival than the other species, was orthodox in its arrival which occurred on a cloudy morning after a clear night.

There is no other record so complete; and it can not be stated whether this relation between weather and migration is a fixed one, but in regard to the migratory movements of Swallows in 1903, it may be said that the relation was so close that one could predict the numbers to be found on any day from the condition of the weather.

140. [612] *Petrochelidon lunifrons* (Say). Cliff Swallow.

Abundant migrant and common summer resident. April 12 to September 14. Nest and four eggs in University collection (C. H. B.).

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1887.
Observer	A. W. B.	C. H. B.	C. H. B.	C. H. B.	G. G. W.
First seen	4-18	4-15	.....	4-19	4-12
Next seen	.....	4-16	.....	4-22	.....
Common	.....	4-22	.....	.....	.....
Last seen	.....	.....	9-14	.....	.....
Abundance	.....	Abundant.	Abundant.	Abundant.	.....

Year	1893.	1895.	1901.	1902.	1903.
Observer	E. M. K.	A. W. B.	W. L. M.	W. L. M.	W. L. M.
First seen	5-2	4-17	5-7	4-13	4-13
Next seen	5-6	.....	.....	.....	4-14
Common	.....	.....	.....	.....	4-14
Last seen	.....	.....	.....	.....	.....
Abundance	.....	.....	Common.	Common.	Common.

141. [613] *Hirundo erythrogastra* Bodd. Barn Swallow.*

Abundant migrant and summer resident. April 9 to September 12. May 12, 1903, nest about two-thirds completed on a rafter in a loft of a barn (C. G. L.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	G. G. W.	G. G. W.	A. B. U. E. M. K.
First seen	4-15	.....	4-10	4-12	4-18
Next seen	4-16	.....	4-17	.....	4-19
Common	4-21	.....	4-20	.....	4-24
Last seen	.....	9-12	.....	.....	.....
Abundance	Abundant.	Abundant.	Common.	.....	Common.

Year	18 3.	1899.	1902.	1903.
Observer	E. M. K.	N. B. M.	W. L. M.	W. L. M.
First seen	4-9	4-22	4-13	4-10
Next seen	4-10	.....	4-19	4-13
Common	.....	.....	.....	4-13
Last seen	.....	.....	.....	.....
Abundance	Common.	Common.	Common.	Abundant.

142. [614] *Iridoprocne bicolor* (Vieill.). Tree Swallow.

Abundant migrant. April 5 to 30. A common summer resident in 1886 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1902.	1903.
Observer	C. H. B.	W. L. M.	W. L. M.
First seen	4-15	4-5	4-5
Next seen	4-16	4-19	4-10
Common	4-22	.....	4-5
Last seen	.....	.....	4-30
Abundance	Very common.	Common	Abundant.

143. [616] *Riparia riparia* (Linn.). Bank Swallow.*

Abundant migrant and common summer resident. April 6. Young learning to fly, June 4, 1902 (C. G. L.).

MIGRATION RECORD.

Year	1884.	1885.	1900.	1902.	1903.
Observer	A. W. B.	C. H. B.	N. B. M.	W. L. M.	W. L. M.
First seen	4-6	4-15	4-17	4-13	4-13
Next seen	.....	4-16	4-20	.....	4-14
Common	.....	4-25	4-20	.....	4-22
Last seen	.....	.....	.....	.....	.....
Abundance	.....	Common.	Common.	Common.	Abundant.

144. [617] *Stelgidopteryx serripennis* (Aud.). Rough-winged Swallow.

Common migrant and rather common summer resident. April 13. B. W. Evermann found them abundant and mating at Gosport, May 8, 1886. Many nests were nearly complete.

MIGRATION RECORD.

Year	1885.	1886.	1903.
Observer	C. H. B.	B. W. E. W. S. B.	W. L. M.
First seen	4-18	5-1	4-13
Next seen	4-22	5-8	4-14
Common	4-25	5-8	4-22
Last seen	.....	.....	.....
Abundance	Common.	Rare.	Common.

145. [619] *Ampelis cedrorum* (Vieill.). Cedar Waxwing.

Common summer resident; irregular at other seasons of the year, sometimes entirely absent for considerable periods, and again appearing in large numbers for a longer or shorter time.

Nest and two eggs about six feet up in an isolated cedar, June 13, 1902 (C. G. L.).

146. [621] *Lanius borealis* Vieill. Northern Shrike.

Although stated to be a rare winter visitor by C. H. Bollman in 1886, there are no actual records for this region except those of February 8, and 23, 1902. It was observed in Brown County, November 18, 1894 (E. M. K.).

147. [622c] *Lanius ludovicianus migrans* (W. Palmer.). Migrant Shrike.*

Uncommon summer resident. March 3 to December 1. Rare in winter (W. S. B.). February 16, 1901 (V. H. B.).

Mating and attempts at song, March 15, 1903. The song resembles some of the more harsh calls of the Blue Jay. May 10, 1903, nest and five young just hatched, ten feet up in a hedge (C. G. L.).

MIGRATION RECORD.

Year	1885.	1886.	1892.	1893.	1901.
Observer	C. H. B.	W. S. B.	A. B. U.	E. M. K.	W. L. M.
First seen	4-1	3-28	3-25	3-15	3-3
Next seen	4-17	.....	.....	.....	3-17
Common	.....	.....	.....	.....	.....
Last seen	.....	.....	.....	.....	.....
Abundance	Rare.	Rare.	.....	Rare.	Common.

Year	1902.	1902.	1903.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	3-23	.....	3-11	.....
Next seen	.....	.....	3-15	.....
Common	.....	.....	.....	.....
Last seen	.....	11-30	.....	12-1
Abundance	Common.	Common.	Common.	Common.

148. [624] *Vireo olivaceus* (Linn.). Red-eyed Vireo.* Fig. 23

Abundant migrant and summer resident. April 19 to October 2.

Song April 28, 1903; mating April 29. Nest with three eggs of the owner and one of a Cowbird, May 25, '03. This nest was about four feet high, attached to a limb of a small cedar bush and thickly surrounded by blackberry vines.

This far from shy bird with its persistent song is found absolutely everywhere in the height of its migration. It sings as long as it is here; one was heard singing September 20, 1903.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	B.W.E. C.H.B.	G. G. W.	E. M. K.	E. M. K.
First seen	4-21	.....	4-23	4-27	4-27	5-1
Next seen	4-22	.....	4-24	.....	....	.....
Common	4-25	.....	.....	.....	.....	.....
Last seen	.....	10-2	.....	.....	.....	.....
Abundance	Abundant.	Abundant.	Abundant.	.....	Common.	Common.

Year	1899.	1900.	1902.	1902.	1903	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-26	5-2	4-23	.....	4-19	.....
Next seen	4 29	5-7	4-25	.....	4-27	.....
Common	4-29	5-8	4-27	.....	4-29	..
Last seen	.....	.....	.....	9-28	.....	9-20
Abundance	Common.	Common.	Common.	Common.	Abundant.	Abundant.

149. [626] *Vireo philadelphicus* (Cass.). Philadelphia Vireo.

Rare migrant. April 28th to September 28th. The dates are earlier and later respectively than the hitherto recorded extremes of the Philadelphia Vireo's stay in Indiana. Rare summer resident (B. W. E., '87).

MIGRATION RECORD.

Year	1885.	1885.	1903.
Observer	C. H. B.	C. H. B.	W. L. M.
First seen	4-30	.....	4 28
Next seen	5-4	.....	.....
Common	.....	.....	.....
Last seen	.....	9-28	.....
Abundance	Rare.	Rare.	Rare.

150. [627] *Vireo gilvus* (Vieill.). Warbling Vireo.*

Common summer resident. April 21 to October 10. Song April 28, 1903.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1903.
Observer	C. H. B.	C. H. B.	C. H. B. B. W. E.	G. G. W.	A. B. U.	W. L. M.
First seen	4-21	.....	4-25	4-28	5-7	4-28
Next seen	4-22	.....	4-27	.....	.....	4-29
Common	4-28	.....	.....	.....	.....	4-28
Last seen	.....	10-10	.....	.....	.....	.....
Abundance	Abundant.	.....	Common.	.....	.....	Common.

151. [628] *Vireo flavifrons* Vieill. Yellow-throated Vireo.*

Common migrant. April 16 to May 13; September 1 to October 19; the extreme dates are the limits of its residence in the State. Perhaps rare summer resident; its nest was found in Brown County, May 16, 1897 (V. H. B.). Song April 29, 1903. In the fall of 1902 Yellow-throated Vireos were found wherever there was undergrowth.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1896.
Observer	C. H. B.	C. H. B.	B. W. E. C. H. B.	G. G. W.	A. W. B.
First seen	4-20	9-12	4-16	4-25	4-20
Next seen	4-22	9-15	4-17	.....	.....
Common	.....	.....	.....	.....	.....
Last seen	5-13	9-28	.....	.....	.....
Abundance	Common.	Common.	.....	.....	.....

Year	1901.	1902.	1902.	1903.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-6	4-25	9-1	4-24	.....
Next seen	.....	4-27	10-5	4-28	.....
Common	.....	.....	10-19	.....	.....
Last seen	.....	.....	10-19	.....	9-29
Abundance	.....	Common.	Common.	Common.	Common.

152. [629] *Vireo solitarius* (Wils.). Blue-headed Vireo.

Rather uncommon migrant. April 28 to May 17. September 16 to 28.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1895.	1903.
Observer	C. H. B.	C. H. B.	G. G. W.	E. M. K.	A. B. U.	W. L. M.
First seen	4-28	9-16	5-1	5-9	4-28	4-29
Next seen	4-30	9-18	.....	.....	.....	5-13
Common	.....	.....	.....	.....	.....	.....
Last seen	5-17	9-28	.....	.....	.....	5 13
Abundance	Common.	Rare.	.....	.....	.....	Rare.

153. [631] *Vireo noveboracensis* (Gmel.). White-eyed Vireo. Fig. 24.

Abundant summer resident. April 17 to September 20.

Song April 28, 1903, to September 20, 1903. May 5, 1903, a nest was nearly completed. It was found along a narrow, little-frequented road, and was attached on one side to a cedar limb, and to a blackberry vine on the other. It was about four feet high. On April 11, this nest contained two Cowbird's eggs and one of the Vireo (C. G. L.).

Abundant and vociferous in the spring migration. Every thicket is filled with the jargon of its song.

The date of April 17, 1903, is given on the authority of a Nature Study Class.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	C. H. B. B. W. E. G. G. W.	G. G. W.	A. B. U.
First seen	4-21	.....	4-25	4-25	5-7
Next seen	4-22	.....	4-28	4-26	.....
Common	4-25	.....	5-8	4-30	.....
Last seen	.....	9-2	.....	.....	.....
Abundance	Common.	Common.	Common.	Common.	.....

Year	1893.	1899.	1900.	1903.	1903.
Observer	E. M. K.	N. B. M.	N. B. M.	W. L. M.	W. L. M.
First seen	4-30	5-1	4-21	4-17*	.....
Next seen	5-6	5-4	.....	4-24	.....
Common	.....	.....	.....	4-29	.....
Last seen	.....	.....	.....	.....	9-20
Abundance	.....	.....	.....	Abundant.	Abundant.

*See above.

154. [636] *Mniotilta varia* (Linn.). Black and White Warbler.*

Common migrant and rare summer resident. Considered a common summer resident in 1886 by C. H. Bollmann. April 7 to October 4. Song April 28, 1903.

In spring you will find this striped vision only on the trunks of the larger forest trees. Although you are searching for him and feel sure of his presence, the actual discovery is always a surprise. This little flake of sharply contrasted colors makes its appearance so quickly that we find it difficult to realize that it is not a piece of bark suddenly possessed of life, but our own dear little Black and White Creeper that is before us. In Autumn he is more democratic and is often found in lowly thickets. Is it not because we are sated with discovery, that the thrill of last spring is not felt when this leader of the band of wood warblers is espied? Is it not because we have met the timid glance of the rare Cape May, or the gaudy Magnolia through the interlacing branches, or that here the Redstart spins his glowing pin-wheel, that the Black and White Warbler is not again hailed as a distinguished visitor when we see him in September clinging to the slender stem of the hazel, inspecting its surface or gracefully reaching out for the slow-descending caterpillar?

Yes, we think the reason lies with the observer and not with the observed; for we are surely not at our best when we slight our tiny friend ever so little in the greeting. He remains always the most attractive, the most dear of his woodsy clan.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1893.
Observer	C. H. B.	C. H. B.	G. G. W. C. H. B.	G. G. W.	E. M. K.
First seen	4-17	.....	4-17	4-20	4-7
Next seen	4-18	.....	4-18	4-27	.....
Common	4-24	.....	.....	.....	.....
Last seen	.....	9-28	.....	.....	.....
Abundance	Common.	Common.	Common.	.....	.....

Year	1901.	1902.	1902.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-4	4-27	9-1	4-24
Next seen	.....	.....	9-7	4-28
Common	.....	.....	.....	4-28
Last seen	.....	.....	10-4	.....
Abundance	.....	Common.	Common.	Common.

155. [637] *Protonotaria citrea* (Bodd.). Prothonotary Warbler.

Rare migrant. "Mr. Chauncey Juday reports it from Monroe County, where a specimen was taken at Harrodsburg, April 26, 1895" (A. W. Butler). E. M. Kindle reported it May 28, 1892. As nests and eggs of this species have been taken in other parts of the State at an earlier date than this, it is possible that the Prothonotary Warbler may be found here as a rare summer resident.

156. [639] *Helmitheros vermivorus* (Gmel.). Worm-eating Warbler.

Common migrant and "rather common summer resident" (B. W. E.). April 20 to August 31. Song May 4, 1902. "Prof. W. S. Blatchley took a nest and six fresh eggs, and one of the Cowbird, near Bloomington, May 12, 1886. The nest was at the base of a clump of ferns, and was composed of the leaves of 'Maiden Hair' fern. The next day Prof. B. W. Evermann took a nest from a similar location, containing five of the owner's eggs and two of the Cowbird" (A. W. Butler).

Common in the fall of 1903 in the undergrowth along creeks.

MIGRATION RECORD.

Year.	1885.	1885.	1886.	1902.	1903.
Observer	C. H. B.	C. H. B.	W. S. B. B. W. E.	W. L. M.	W. L. M.
First seen	4-20	.....	5-1	4-27	4-28
Next seen	4-21	.....	5-4	5-4	.....
Common	.....	.....	.....	.....	4-28
Last seen	.....	8-31	.....	.....	.....
Abundance	Common.	Common.	Rare.	Common.	Common.

157. [641] *Helminthophila pinus* (Linn.). Blue-winged Warbler.*

Abundant migrant. Rare summer resident (C. H. B.—B. W. E.). April 19 to September 28. Song April 19, 1903.

Orchards and open woods are the favorite haunts of the Blue-winged Yellow Warbler.

On a bright day after a rainy morning in April, 1903, warblers of this species were observed to move from one part of the country to another about three miles away in from six to eight hours. In the morning they were plentiful in the orchard and clearings south of the city, while none were to be observed anywhere north of town. In the afternoon these conditions were reversed, they were common and singing in the orchards north of town, while they were entirely absent in the places where they had been seen in the morning. Their movements even for the shortest distances were always in the same direction, they flew from limb to limb, from tree to tree, in the same general trend, toward the north.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1902.	1902.	1903.
Observer	C. H. B.	C. H. B.	B. W. E.	G. G. W.	W. L. M.	W. L. M.	W. L. M.
First seen	4-20	.....	4-27	4-28	4-23	.....	4-19
Next seen	4-28	.....	.....	4-29	.....	.....	4-28
Common	.....	.....	.....	.....	.....	.....	4-19
Last seen	.....	8-31	.....	.....	.....	9-28	.....
Abundance	Rare.	Rare.	Common.	.....	Common.	Common.	Abundant.

158. [642] *Helminthophila chrysoptera* (Linn.). Golden-winged Warbler.

Very rare migrant. April 27, 1887 (G. G. W.); 28, 1901; May 4, 1886 (G. G. W.).

159. [645] *Helminthophila rubricapilla* (Wils.). Nashville Warbler.*

"Common in spring, abundant in fall" (C. H. B., 1886). "In Monroe County it was rather common, April 27 to May 1, 1886 (Evermann, Blatchley)" [A. W. Butler]. During the last few years the Nashville Warbler has been a more rare bird than the above quotations indicate. One or two records in a migration has been as much as could be hoped for concerning this species. April 24 to May 11. August 26 to October 10.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1899.
Observer	C. H. B.	C. H. B.	B. W. E. W. S. B.	N. B. M.
First seen	4-25	8-26	4-27	5-5
Next seen	4-26	9-22	.....	.....
Common	.....	.....	.....	.....
Last seen	5-11	10-10	5-1	.....
Abundance	Common.	Abundant.	Common.	.....

Year	1901.	1902.	1903.	1903.
Observer	C. H. E.	W. L. M.	W. L. M.	W. L. M.
First seen	4-29	4-24	4-29	.....
Next seen	.....	.....	.....	.....
Common	.....	.....	.....	.....
Last seen	.....	.....	.....	10-2
Abundance	Rare.	Rare.	Rare.	Rare.

160. [646] *Helminthophila celata* (Say). Orange-crowned Warbler.

Very rare migrant. One record; May 4, 1885 (C. H. B.).

161. [647] *Helminthophila peregrina* (Wils.). Tennessee Warbler.*

"Not common in spring, abundant in fall" (C. H. B., 1886). April 26 to May 16. August 30 to October 17. "At Bloomington, both Profs. Blatchley and Evermann thought it less numerous than the Nashville Warbler" (A. W. Butler). Decidedly the reverse is the case now. One

may observe in spring a hundred of the present species to one of the Nashville Warbler, and in fall a thousand. The Tennessee Warblers, in the latter season, literally fill all the trees, whether the neatly-trimmed maples along the city streets or the magnificent oaks of the forest. The underbrush is alive with them, they are in the weeds, in briars, and in the stubble. Swamp and hilltop, cultivated field and forest, alike, are animated by the hordes of Tennessee Warblers. They are everywhere.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1890.	1900.	1903.	1903.
Observer	C. H. B.	C. H. B.	C. H. B	A. W. B	N. B. M.	W. L. M.	W. L. M.
First seen	4-26	4-30	4-27	.....	.....	.....	.....
Next seen	4-30	9-4	.....	.....	.....	.....	.....
Common	.....	9-11	.....	5-3	.....	.....	.....
Last seen	5-14	10-7	.....	5-10	5-12	5-16	10-2
Abundance	Rare.	Abundant.	Rare.	Common	.....	Rare.	Abundant.

162. [648a] *Compsothlypis americana usnea* Brewster. Northern Parula Warbler.

Rare migrant.

In accordance with A. W. Butler's precedent, birds from Monroe County are referred to this subspecies.

MIGRATION RECORD.

Year	1885.	1886.
Observer	C. H. B.	G. G. W. W. S. B.
First seen	4-21	4-24
Next seen	.....	4-27
Common	.....	.....
Last seen	.....	.....
Abundance	Rare.	Rare.

163. [650] *Dendroica tigrina* (Gmel.). Cape May Warbler.

Rather rare migrant. April 22 to May 11. September 27 to October 7.

In the fall of 1903, the writer observed this species and the Tennes-

see Warbler puncturing grapes. They thrust their bills into the grapes and after poking around inside a little lifted their heads and acted as if drinking. After being punctured, the grapes, of course, shrivelled and became worthless. Scarcely a grape, and not a cluster were missed in the arbor under observation. The damage, however, was not great, as the birds did not begin their depredations until after the owners had harvested as much of the crop as they desired.

The males arrive and depart earlier than the females.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886	1899.	1903.
Observer	C. H. B.	C. H. B.	C. H. B.	C. H. B. G. G. W.	N. B. M.	W. L. M.
First seen	4-22	4-24	9-27	4-24	.....	.....
Next seen	4-23	4-30	.....	5-1	.....	.....
Common	.....	.....	.....	5-5	.....	.....
Last seen	5-8	5-11	10-7	5-5	5-8	9-29
Abundance	Rare.	Rare.	Rare.	Rare.	.....	Rare.

164. [652] *Dendroica æstiva* (Gmel.). Yellow Warbler.*

Abundant summer resident. April 12 to August 24.

Song April 26, 1903; mating April 27. Nest and eggs May 4, 1902. May 30, 1903. Nest with four, well-incubated eggs, in the top fork of a small plum tree about 20 feet from the ground (C. G. L.).

Very common in orchards; a persistent songster.

The earliest record for the State is April 4, 1894 (E. M. K.), from Brown County.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	B. W. E. C. H. B. G. G. W.	G. G. W.	A. B. U.
First seen	4-21	.....	4-22	4-25	4-30
Next seen	4-22	.....	4-23	.....	.....
Common	4-24	.....	5-1	.....	.....
Last seen	.....	8-24	.....	.....	.....
Abundacne	Abundant	Abundant.	Rare.	.....	.....

Year	1893.	1899.	1901.	1902.	1903.
Observer	E. M. K.	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-26	4-29	5-6	4-19	4-12
Next seen	.....	.....	.....	4-23	4-24
Common	4-26	4-29	.....	4-27	4-27
Last seen	.....	.....	.....	.....	.....
Abundance	Common.	Common.	.....	Common.	Abundant.

165. [654] *Dendroica cærulescens* (Gmel.). Black-throated Blue Warbler.

Rather uncommon migrant. April 30 to May 13. September 1 to October 4.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1902.	1903.
Observer	C. H. B.	C. H. B.	G. G. W.	G. G. W.	W. L. M.	W. L. M.
First seen	4-30	9-18	5-7	5-2	9-1	4-30
Next seen	5-3	.....	.....	.....	9-28	.....
Common	.....	.....	.....	.....	.....	.....
Last seen	5-13	.....	.....	.....	10-4	5-12
Abundance	Common.	Rare.	.....	.....	Rare.	Rare.

166. [655] *Dendroica coronata* (Linn.). Myrtle Warbler.*

Common migrant and not rare winter resident. September 24 to May 13. First in full plumage March 25, 1903. In winter this species seems to prefer certain restricted localities; most of the individuals that have been seen here in winter have been found in a dense pine and cedar grove, but in the winter of 1902-1903, some were seen at two other places—an open forest near a pond and an old orchard.

Recorded as wintering in 1882-3; 1884-5; 1885-6; 1886-7; 1891-2; 1892-3; 1899-1900; 1900-01; 1902-3.

The record of the appearance of individuals in different stages of plumage for a year is as follows: those seen at intervals through January, February and part of March were in the usual winter dress. On the tenth of March (1903) the first change was noted. A single Yellowrump

was found in some bushes along a street in town. The side-spots were large and brilliant as was also the rump. The back had the sharply defined black and gray streaking, but the head and breast were as in winter. March 21, a specimen in winter plumage was seen; March 23, two individuals, one in full plumage with the exception of the crown-spot which was somewhat obscured by dark tips to the feathers, the other in the usual autumnal and winter garb. March 25, four Myrtle Warblers were seen, and of these, one had the winter plumage, two had yellow crown and rump but no side-spots, and one was brilliant in a new and complete spring suit. March 27, one with winter colors; March 30, one in complete and one in winter plumage; April 1, two like the last. April 3, three specimens with all the spots showing but only dimly on the sides and crown. After April 3 all mentioned are in full plumage unless otherwise stated. April 5, two, one in winter dress; April 8, four, one in winter plumage; April 11, four; April 12, twelve; April 14, three, two of which were clothed as in winter; April 15, four; April 19, six, one looking just as he did in January, and he was the last one observed in this plumage, although of twenty-one seen on April 28, two were still in transition stages of plumage. Thus fifty days elapsed between the first and last observed changes in plumage, and, half as many days passed between the appearance of summer dress and the vanishing of winter garb.

In the fall the first yellowrumps were seen on October 12 (1902). Of thirty individuals, one had the sides yellow, while all of the others had already assumed the sombre shades of winter plumage. October 26, fourteen of these birds were observed and one was still in nearly perfect summer condition, the crown and sides being only slightly dusted with darker. All others seen during the remainder of the year were in ordinary winter plumage. From these observations it may be seen that, although about eight months are consumed in the change from winter, through summer, back to winter plumage again, by the species as a whole, yet it is possible that some individuals may complete this cycle of changes in six months.

On December 14, 1902, a Myrtle Warbler was seen flying in somewhat wide sweeps, like a flycatcher, but, hovering, he gleaned from the trees, fences and the ground, and not from the air.

MIGRATION RECORD.

Year.	1883.	1884.	1885.	1885.	1885.	1887.
Observer	B. W. E	C. H. E.	C. H. B.	C. H. B.	C. H. B.	G. G. W. B. W. E.
First seen	2-10	3-21	4-31	4-25	9-24	2-
Next seen	.....	.....	4-17	4-30	9-25	.....
Common	.....	.....	5-2	5-8	10-7	.....
Last seen	.....	.....	5-11	5-13	.....	5-4
Abundance	Common.	.....	Abundant	Abundant.	Abundant.	Common.

Year.	1892.	1900.	1901.	1902.	1902.	1903.
Observer	A. B. U.	N. B. M.	W. L. M. C. H. E	W. L. M.	W. L. M.	W. L. M.
First seen	2-19	.....	.....	3-23	10-12	.....
Next seen	3-31	.....	.....	3-38	10-26	.....
Common	.....	.....	4-29	.....	10-12	4-12
Last seen	.....	4-29	5-1	4-27	.....	5-3
Abundance	Common.	.....	Common.	Common.	Common.	Common.

167. [657] *Dendroica maculosa* (Gmel.). Magnolia Warbler.*

Rather common migrant. May 5 to 24. August 31 to October 4. In woods with undergrowth, you will find this warbler spying upon you from the lower limbs of the maples and beeches, or peeping through the network of leaves and branches of the thickets. He always has the attitude of peering. His black spectacles set off with white dots only enhance this expression.

Females were not seen until May 8, 1885.

MIGRATION RECORD.

Year.	1885.	1885.	1886.	1887.	1889.	1902.
Observer	C. H. B.	C. H. B.	G. G. W.	G. G. W.	N. B. M.	W. L. M.
First seen	5-5	8-31	5-8	5-5	5-10	9-1
Next seen	5-8	9-6	5-14	.....	.....	9-7
Common	.....	9-12	.....	.....	.....	9-28
Last seen	5-24	9-19	5-14	.....	.....	10-4
Abundance	Common.	Common.	.....	.....	Rare.	Common.

168. [658] *Dendroica cerulea* (Wils.). Cerulean Warbler.

Common migrant; not common summer resident (G. G. W.—N. B. M.). The males precede the females in migration.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.
Observer	C. H. B.	C. H. B.	W. S. B. C. H. B.	G. G. W.
First seen	♂4-28	♀5-9	4-23	4-27
Next seen	5-4	5-10	4-24	4-28
Common	.....	.....	.....	.....
Last seen	.....	.....	.....	.....
Abundance	Common.	Common.	Common.	Common.

Year	1892.	1900.	1901.	1903.
Observer	A. B. U.	N. B. M.	W. L. M.	W. L. M.
First seen	4-30	5-5	5-4	4-28
Next seen	5-7	.....	.....	.....
Common	.....	.....	.....	.....
Last seen	.....	.....	.....	.....
Abundance	.....	Common.	Common.	Common.

169. [659] *Dendroica pensylvanica* (Linn.). Chestnut-sided Warbler.

Rather common migrant. April 21 to May 10. August 28 to September 15.

The first migrants are males.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.	1892.	1901.	1902.	1903.
Observer	C. H. B.	C. H. B.	C. H. B.	G. G. W. B. W. E.	A. B. U.	C. H. E.	W. L. M.	W. L. M.
First seen	♂4-21	♀4-28	8-28	5-4	5-7	4-29	5-5	5-7
Next seen	4-28	4-30	8-29	5-8	.....	.....	.....	.....
Common	.....	.....	8-31	.....	.....	.....	.....	.....
Last seen	5-10	.....	9-15	.....	.....	.....	.....	.....
Abundance	Common	Common	Common	Common	.....	.....	.....	Rare.

170. [660] *Dendroica castanea* (Wils.). Bay-breasted Warbler.

Rather rare migrant. April 29 to May 13. September 18 to October 10. The limiting dates each extend the recorded period of its stay in Indiana one day.

MIGRATION RECORD.

Year	1885.	1886.	1903.	1903.
Observer	C. H. B.	B. W. E. G. G. W.	W. L. M.	W. L. M.
First seen	9-18	5-4	4-29	.....
Next seen	9-19	5-6	.....	.....
Common	10-3	.....	.....	.....
Last seen	10-10	5-8	5-13	10-3
Abundance	Abundant.	Rare.	Rare.	Rare.

171. [661] *Dendroica striata* (Forst.). Black-poll Warbler.

Rather rare migrant. April 28 to May 19. September 18 to October 26.

The last date for the species in 1885, May 19, was the date of arrival of the females. October 26, is the latest record for this State. The last one taken in 1903 was a female.

MIGRATION RECORD.

Year	1885.	1885.	1902.	1903.
Observer	C. H. B.	C. H. B.	W. L. M.	W. L. M.
First seen	4-28	9-18	.....	.....
Next seen	5-13	9-19	.....	.....
Common	.....	9-25	.....	.....
Last seen	5-19	10-12	10-26	5-13
Abundance	Rare.	Abundant.	Rare.	Rare.

172. [662] *Dendroica blackburniæ* (Gmel.). Blackburnian Warbler.

Rather rare migrant. April 21 to May 14. August 27 to October 10.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.
Observer	C. H. B.	C. H. B.	C. H. B.	B. W. E.
First seen	4-21	5-13	8-27	4-27
Next seen	5-2	5-14	8-30	.....
Common	.....	.....	.....	.....
Last seen	5-14	5-14	10-10	.....
Abundance	Common.	Common.	Rare.	Rare.

Year	1892.	1901.	1902.	1903.
Observer	A. B. U.	W. L. M.	W. L. M.	W. L. M.
First seen	5-7	5-7	9-1	4-28
Next seen	.....	.....	.....	.....
Common	.....	.....	.....	.....
Last seen	.....	.....	.....	.....
Abundance	.....	Rare.	Rare.	Rare.

173. [663a] *Dendroica dominica albilora* Ridgw. Sycamore Warbler.*

Common migrant; not uncommon summer resident (B. W. E., '87). April 12 to October 9.

Song and mating April 12, 1903.

On September 18, 1902, it seemed that every shade tree in town contained five or six of these birds; sometimes they descended and fed for a short time in the lawns. Some were also seen feeding upon ragweeds.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1892.	1893.
Observer	C. H. B.	C. H. B.	B. W. E. A. W. B.	E. W. K.	E. W. K.
First seen	4-21	.....	4-14	4-21	4-16
Next seen	4-24	.....	4-16	.....	.....
Common	.....	.....	4-27	.....	.....
Last seen	5-16	9-27	.....	.....	.....
Abundance	Common.	Rare.	.....	.....	.....

Year	1901.	1902.	1902.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-5	4-23	.....	4-12
Next seen	.....	4-27	.....	4-19
Common	.....	4-23	9-28	4-28
Last seen	.....	.....	10-9	.....
Abundance	Common.	Common.	Common.	Common.

174. [667] *Dendroica virens* (Gmel.). Black-throated Green Warbler.*

Abundant migrant. April 18 to May 16. September 1 to October 17. These dates indicate a longer stay in this county than has heretofore been recorded for the State.

In spring this species is nearly confined to the woods, in fall it is found everywhere.

The males arrive and depart earlier than the females.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	C. H. B.	G. G. W. C. H. B. B. W. E.	G. G. W.	E. M. K.
First seen	♂4-20	♀5-5	9-11	4-18	4-25	.....
Next seen	4-21	5-9	9-12	4-22	4-28	.....
Common	5-9	5-9	9-18	4-23	.....	.....
Last seen	5-13	5-14	10-17	5-4	5-7	5 7
Abundance	Abundant.	Abundant.	Abundant.	Common.	.....	.....

Year	1901.	1902.	1902.	1903.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	.....	.....	9-1	4-27	.....
Next seen	.....	.....	9-7	4-28	.....
Common	.....	.....	.....	4-27	.....
Last seen	5-7	5-4	10-5	5-16	10-2
Abundance	Common.	Common.	Common.	Abundant.	.....

175. [671] *Dendroica vigorsii* (Aud.). Pine Warbler.

Rare migrant. April 23-26. September 7-29.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1902.	1903.
Observer	C. H. B.	C. H. B.	W. S. B.	W. L. M.	W. L. M.
First seen	4-23	.....	4-26	.....	.....
Next seen	.....	.....	.....	.....	.....
Common	.....	.....	.....	.....	.....
Last seen	.....	9-27	.....	9-7	9-29
Abundance	Rare.	Rare.	.....	Rare.	Rare.

176. [672] *Dendroica palmarum* (Gmel.). Palm Warbler.*

Common migrant. April 23 to May 13. September 22-27. "Rare in 1886 but usually a common migrant" (C. H. B., '86).

Found in orchards and open woods.

The males appear to migrate slightly in advance of the females.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.
Observer	C. H. B.	C. H. B.	C. H. B.	C. H. B. W. S. B. G. G. W.
First seen	4-23	4-25	9-22	4-24
Next seen	4-25	5-2	.....	4-26
Common	5-3	5-3	.....	.....
Last seen	5-13	5-13	9-27	5-6
Abundance	Common.	Common.	Not Common.	Rare.

Year	1887.	1902.	1903.
Observer	G. G. W.	W. L. M.	W. L. M.
First seen	.....	4-27	4-30
Next seen	.....	.....	5-1
Common	.....	.....	5-3
Last seen	5-4	.....	5-5
Abundance	.....	Rare.	Common.

177. [673] *Dendroica discolor* (Vieill.). Prairie Warbler.

Rare migrant. April 26 to May 16. Song May 12 and 16, 1903. Has always been found in deeply-thicketed woods.

MIGRATION RECORD.

Year	1885.	1900.	1903.
Observer	C. H. B.	N. B. M.	W. L. M.
First seen	4-26	5 5	5-12
Next seen	.....	.....	5-16
Common	.....	.....	.....
Last seen	.....	.....	.....
Abundance	Rare.	.....	Rare.

178. [674] *Seiurus aurocapillus* (Linn.). Oven-bird.

Common summer resident. April 19 to October 12. Formerly abundant (C. H. B., 1886).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1901.
Observer	C. H B.	C. H. B.	C. H. B.	W. L. M.
First seen	4-19	.....	4-22	5-7
Next seen	4-20	.....	4-24	.....
Common	4-25	.....	.....	.....
Last seen	.....	10-3	.....	.....
Abundance	Abundant.	Abundant.	Common.	Common.

Year	1902.	1902.	1903.	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-20	.....	4-28	.....
Next seen	.....	.....	.....	.....
Common	.....	.....	.....	.....
Last seen	.....	10-12	.....	9-20
Abundance	Common.	Common.	Common.	Common.

179. [675] *Seiurus noveboracensis* (Gmel.). Water-Thrush.

Common migrant. March 27 to May 5. September 14 to 18. Song April 12, 1903.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1900.	1902.	1903.
Observer	C. H. B.	C. H. B.	G. G. W.	G. G. W.	N. B. M.	W. L. M.	W. L. M.
First seen	4-3	9-14	4-17	4-11	4-17	3-27	4-12
Next seen	4-4	.....	4-23	4-12	5-5	4-10	4-16
Common	4-5	.....	4-17	.....	.....	.....	4-28
Last seen	4-21	9-18	4-23	.....	5-5	.....	.....
Abundance	Abundant	Common	Common	.....	.....	Common	Common

180. [675a] *Seiurus noveboracensis notabilis* (Ridgw.). Grinnell's Water-Thrush.

Rare migrant. A specimen taken April 23, 1886, by G. G. Williamson is referred to this form. Probably Grinnell's Water-Thrush will be found to be as numerous as the last when more specimens are obtained for exact identification. The differences are rather slight and more relative than absolute, and as the birds seem to vary considerably, it is no wonder that there has been no distinction made between the two forms in the migration records.

A specimen of this Water-Thrush taken at Indianapolis, May 14, 1875 (D. S. Jordan), shows a variation in a generic character. All parts of definitions of the genus *Seiurus* and of keys referring to the tail feathers are substantially as the following from Ridgway (1902): "Inner webs of lateral rectrices without white terminal spot." The individual under consideration has distinctly marked, white, terminal spots on the first and second outer rectrices of the right side, and slight indications of spots on the two opposite, outermost tail feathers.

181. [676] *Seiurus motacilla* (Vieill.). Louisiana Water-Thrush.

Rather common summer resident. March to September 1.

Song April 12, 1903. May 10, 1903, nest and six eggs, among rocks and roots above the mouth of a cave (C. G. L.). June 3, 1901, nest of leaves, grass-lined, under an overhanging ledge (at the same place). It contained six young (W. L. H.).

All the tangled ravines and cascaded cave outlets ring with the striking song of the Louisiana Water-Thrush in April and early May.

A specimen labeled, Bloomington, March, 1885, Foster Hight, is in the University collection. It has been recorded as early in Indiana at least once before (March 30, '96—Sedan), but such dates are rare.

MIGRATION RECORD.

Year	1885.	1886.	1901.	1902	1902.	1903.
Observer	C. H. B.	G. G. W. B. W. E. W. S. B.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-18	4-4	4-12	4-13	.....	4-5
Next seen	4-19	4-10	.....	4-20	.....	4-7
Common	4-25	4-27	.....	.....	.....	.....
Last seen	.....	.....	.....	.....	9-1	.....
Abundance	Common.	Common.	.....	Common.	Common.	Common.

182. [677] *Geothlypis formosa* (Wils.). Kentucky Warbler.

Common summer resident. April 13 to August 26.

Song May 3, 1903. "They were found breeding near Bloomington, May 6, 1886 (Evermann), where young were noted just out of the nest, June 4, 1886 (Blatchley)" [A. W. B.].

An inhabitant of dense, moist thickets.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.
Observer	C. H. B.	C. H. B.	B. W. E. W. S. B	G. G. W.
First seen	.....	5-2	4-17	5-7
Next seen	.....	5-16	4-27	.....
Common	.....	.....	.....	.....
Last seen	8-26	.....	.....	.....
Abundance	Common.	Common.	Common.	.....

Year	1892.	1899.	1902.	1903.
Observer	A. B. U.	N. B. M.	W. L. M.	W. L. M.
First seen	5-7	4-13	4-24	4-28
Next seen	.....	4-15	4-27	5-3
Common	.....	.....	.....	5-13
Last seen	.....	.....	.....	.....
Abundance	.....	Rare.	Common.	.....

183. [678] *Geothlypis agilis* (Wils.). Connecticut Warbler.

Rare migrant (C. H. B., '86—B. W. E., '87). April 27 and May 6, 1886 (B. W. E.). May 18, 1885 (C. H. B.).

184. [679] *Geothlypis philadelphia* (Wils.). Mourning Warbler.

Rare migrant. Seen on the 16th, 17th, and 27th of May, 1885, by C. H. Bollmann.

185. [681] *Geothlypis trichas* (Linn.). Maryland Yellow-throat.

Abundant summer resident. April 20 to October 19.

Song April 28 to September 20, 1903. May 29, 1901, five young with pin-feathers were found in an arched nest in a bunch of dry grass. June 12, 1903, four young about four or five days old were found in a clump of grass about six inches above the ground (C. G. L.).

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	C. H. B.	B. W. E. C. H. B.	G. G. W.	E. M. K.	E. M. K.
First seen	.....	4-20	4-28	4-25	4-25	5-	4-30
Next seen	.....	4-21	4-30	4-28	4-27	.....	.....
Common	.....	5-5	5-5	.....	.....	.....	.....
Last seen	10-17	.....	.....	.....	.....	.....	.....
Abundance	Abundant	Abundant	Abundant	Abundant	.....	.....	.....

Year	1899.	1900.	1902.	1902.	1903.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-29	4-24	4-24	.....	4-24	.....
Next seen	.....	5-5	4-25	.....	4-28	.....
Common	.....	.....	5-4	.....	4-28	.....
Last seen	.....	.....	.....	10-19	.....	9-24
Abundance	.....	Common.	Abundant.	Abundant.	Abundant.	Abundant.

186. [683] *Icteria virens* (Linn.). Yellow-breasted Chat.

Abundant summer resident. April 24 to September 28.

Song April 28, 1903. May 17, 1903, a nest and one egg found in a dead bush, which was, however, in a dense clump of living bushes. The nest was found four feet high. It contained four eggs, May 20 (C. G. L.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892	1903.
Observer	C. H. B.	C. H. B.	G. G. W. C. H. B.	G. G. W.	A. B. U. E. M. K.	E. M. K.
First seen	.....	4-25	4-24	4-30	5-4	4-30
Next seen	.....	5-3	4-25	.....	5-7	.....
Common	.....	5-8	.....	.....	5-13	.....
Last seen	8-30	.....	.....	.....	.....	.....
Abundance	Abundant.	Abundant	Common.	.....	Common.	.....

Year	1899.	1901.	1902.	1902.	1903.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-29	5-4	4-24	.....	4-28	.....
Next seen	.....	5-7	4-27	.....	4-29	.....
Common	4-29	.....	5-4	.....	5-3	.....
Last seen	.....	.....	.....	9-28	.....	9-24
Abundance	Common.	Common.	Abundant	Abundant.	Abundant.	Abundant.

187. [684] *Wilsonia mitrata* (Gmel.). Hooded Warbler.

Rare summer resident. April 20 to September 14.

"At Bloomington, Mr. G. G. Williamson found a nest with six young of this species in a bush, May 27, 1886. It seems to occur there regularly" (A. W. Butler).

No females were seen in 1885 until May 2. The last migrants in the fall of that year were males.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1902.
Observer	C. H. B.	C. H. B.	G. G. W. B. W. E.	G. G. W.	W. L. M.
First seen	4-20	8-29	5-8	5-7	.....
Next seen	4-21	9-11	5-26	.....	.....
Common	.....	.....	.....	.....	.....
Last seen	5-9	9-14	.....	.....	9-1
Abundance	Rare.	Rare.	Rare.	.....	Rare.

188. [685] *Wilsonia pusilla* (Wils.). Wilson's Warbler.

Rare migrant. May 8-14. August 31 to September 18. The extreme dates are also the limits of its stay in Indiana.

MIGRATION RECORD.

Year	1885.	1885.	1886.
Observer	C. H. B.	C. H. B.	B. W. E.
First seen	5-14	8 31	5-8
Next seen	.....	.....	.....
Common	.....	.....	.....
Last seen	.....	9-18	.....
Abundance	Rare.	Rare.	Rare.

189. [686] *Wilsonia canadensis* (Linn.). Canadian Warbler.

A more common migrant than either of the last two species. April 27 to May 18. August 26 to September 15.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.
Observer	C. H. B.	C. H. B.	C. H. B.	W. S. B. B. W. E.
First seen	4-28	5-9	8 26	4-27
Next seen	5-8	5-12	8-28	5-4
Common	.....	.....	.....	.....
Last seen	5-17	5-18	9-15	5-15
Abundance	Common.	Common.	Common.	Common.

190. [687] *Setophaga ruticilla* (Linn.). American Redstart.*

Abundant migrant and common summer resident. April 12 to October 19; the limits of its residence in the State. Scarce in 1885 and 1886 (B. W. E.).

Song April 12, 1903. Nest and three eggs June 12, 1882.

The males arrive about a week in advance of the females. In fall Redstarts are very abundant and are found nearly everywhere.

MIGRATION RECORD.

Year	1885.	1885.	1885.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	C. H. B.	G. G. W. A. W. B.	G. G. W.	A. B. V.
First seen	♂4-21	♂4-30	.....	5-12	4-29	4-30
Next seen	4-22	5-10	.....	5-26	5-1	.....
Common	5-11	5-11	.....	.....	.....	.....
Last seen	.....	.....	10-9	.....	.....	.....
Abundance	Common.	Common.	Common.	.....	.....	.....

Year	1893.	1900.	1902.	1902.	1903.	1903.
Observer	E. M. K.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-6	5-5	4-27	.....	4-12	.....
Next seen	.....	.....	.....	.....	4-13	.....
Common	.....	.....	.....	.....	4-28	.....
Last seen	.....	.....	.....	10-19	.....	9-20
Abundance	.....	.....	Not common	Abundant.	Abundant.	Common.

191. [697] *Anthus pensilvanicus* (Lath.). American Pipit.*

Common migrant (C. H. B., '86). May 17-18—common 19. 1885 (C H. B.). April 1, 1901.

The Pipit probably occurs regularly in considerable numbers, and the above record is imperfect on account of faulty observation.

192 [703] *Mimus polyglottos* (Linn.). Mockingbird.*

Moderately common summer resident.

The Mockingbird was first noted in this locality April 29, 1882, by B. W. Evermann. He says that Bloomington was the farthest north it had been observed in the State at that time. C. H. Bollmann says it was very rare in 1886. He obtained a set of eggs in 1884.

Song April 2, 1903. Two nests were complete April 30, 1901. They were on the northeast pike about one fourth mile apart. The males were singing about these nests both day and night. May 2, 1902, a nest and two eggs were taken from a small thorn bush. The eggs had been broken in some manner (W. L. H.). June 6, 1902, a nest and fresh eggs were found about three feet up in a hedge (C. G. L.).

MIGRATION RECORD.

Year	1882.	1885.	1886.	1893.	1901.	1902.	1903.
Observer	B. W. E.	C. H. B.	G. G. W. C. H. B.	E. M. K.	V. H. B. W. L. M	W. L. M.	W. L. M.
First seen	4-29	5-13	5-2	5-15	3-24	3-31	4-2
Next seen	.....	.....	6-1	5-18	4-30	4-27	4-3
Common	.....	.....	.....	.....	.....	5-10	.....
Last seen	.....	.....	.....	.....	.....	.....	.....
Abundance	Rare.	Rare.	Rare.	.....	Common.	Common.	Common.

193. [704] *Galeoscoptes carolinensis* (Linn.). Catbird.*

Abundant summer resident. April 2 to October 6.

Song April 9 to September 20, 1903. Nestbuilding May 3, 1903. Nest and two eggs May 7, 1902 (G. Hitze). On May 12, 1902, five eggs were taken from a nest; a new nest was begun on the next day; the lining was partly made on the 14th and the nest was finished on the 16th. There was one egg on the 17th and four on the 20th. A nest with four fresh eggs was found June 4, 1901 (W. L. H.).

The earliest and latest individuals seen are generally found in the woods in deep-tangled thickets; consequently Catbirds are rarely seen at the extreme dates indicated above.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	W. S. B. C. H. B.	G. G. W.	E. M. K.	E. M. K.
First seen	.....	4-20	4-16	4-25	4-22	4-10
Next seen	.....	4-21	4-17	4-27	4-27	4-17
Common	.....	4-24	.....	.....	4-27	4-20
Last seen	10-6	.....	.....	.....	.....	.....
Abundance	Abundant	Abundant.	.....	.....	Common.	Common.

Year	1899.	1900.	1901.	1902.	1903.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-28	4-14	4-28	.....	4-5	.....
Next seen	4-29	4-16	5-3	.....	4-9	.....
Common	4-29	4-20	5 5	.....	4-28	.....
Last seen	.....	.....	.....	10-5	.....	9-20
Abundance	Common.	Common.	Common.	Common.	Abundant	Abundant.

194. [705] *Toxostoma rufum* (Linn.). Brown Thrasher.* Figs. 25-6.

Common summer resident. March 16 to October 12.

Song March 20, 1903. Nest begun April 4, 1903. Nest and four eggs in a berry bush in a corner of a yard, April 20. Young out of nest May 8 (C. G. L.). Four young flying about freely May 13. Nest with 3 eggs as late as June 9, '02 (G. Hitze).

One of our best songsters; most often found just on the outskirts of town.

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. E.	C. H. B.	C. H. B.	W. S. B. B. W. E. G. G. W.	G. G. W.	E. M. K. A. B. U.	E. M. K.
First seen	3-23	4-4	.....	3-28	4-12	4 2	4-2
Next seen	.....	4-5	.....	4-5	.....	4-9	4-6
Common	.....	4-18	.....	4-14	.....	4-9	4-6
Last seen	.....	.....	10-3	.....	.....	.....	.....
Abundance	.....	Common.	Common.	Common.	.....	Common.	Common.

Year	1899.	1900.	1901.	1902.	1902.	1903.
Observer	N. B. M.	N. B. M.	W. L. M. V. H. B.	W. L. M.	W. L. M.	W. L. M.
First seen	4 16	4-23	4-7	3-16	.....	3-20
Next seen	4-19	.....	4-10	3-24	.....	3-21
Common	4-21	.....	4-14	4-23	.....	4-3
Last seen	.....	.....	.....	.....	10-12	.....
Abundance	Common.	Common.	Common.	Common.	Common.	Common.

195. [718] *Thryothorus ludovicianus* (Lath.). Carolina Wren.*

Common resident. Sings at all times in the year. The Carolina Wren became common here about 1883 (B. W. E.). "It was heard nearly every day that winter."

An inhabitant of dense thickets and brush-piles. Not often seen away from these places except when singing. Ordinarily a very hard bird to flush. Several times the writer has cornered a Carolina Wren in a brush-pile, and walked up to the edge of it without the bird leaving. Once, even, I walked over a brush-heap with a wren in it and the bird left only when the heap was torn to pieces. (March 3, '01). Another instance of this habit is as follows: On a cold, snowy, windy day, I was investigating the base of a hollow tree. After rummaging around on the inside for three or four minutes, I touched a Carolina Wren which then flew hastily out (February 2, '02).

196. [719] *Thryomanes bewickii* (Aud.). Bewick's Wren.*

Very common summer resident. March 6 to October 12. Bewick's Wren was taken in this county as early as 1876 (Ind. Univ. Mus.). It was a common summer resident ten years later, and now is very common and almost entirely replaces the next species (*T. aëdon*) which is a rather rare bird.

Song March 13, 1903; breeding March 25, 1901. Nest and eight eggs in an old sack hung over a fence, April 14, 1903 (C. G. L.).

Most frequently found near houses; common in the city; a persistent songster in March and April.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1893.
Observer	C. H. B.	C. H. B.	G. G. W. W. S. B.	G. G. W.	E. M. K.
First seen	4-5	.....	3-26	4 2	3-20
Next seen	4-7	.....	4-8	4-13	.....
Common	4-18	.....	.....	.....	.....
Last seen	.....	9-27	.....	.....	.....
Abundance	Common.	Not common	Common.	Common.	.....

Year	1899.	1900.	1901.	1902.	1903.
Observer	N. B. M.	N. B. M.	W. L. M.	W. L. M.	P. J. H. W. L. M.
First seen	4-13	4-2	3-25	.....	3-6
Next seen	4-14	4-7	3-26	.....	3-8
Common	4-21	4-15	.....	.....	3-21
Last seen	.....	.....	.....	10-12	.....
Abundance	Common.	Common.	Common.	Common.	Common.

197. [721.] *Troglodytes aëdon* Vieill. House Wren.* Fig. 9.

Rather rare summer resident. March 9 to September 16. The House Wren was a rare summer resident and less common than *T. bewickii* in 1887 (B. W. E.).

A nest of the House Wren was found April 25, 1903, in a tin can sitting on a fence. The nest was just completed and contained no eggs (C. G. L.). May 21, 1902, seven well-feathered young were found; two days later these had flown (G. Hitze).

The dates for 1901 would probably be more correctly attributed to *T. bewickii.* The song was heard that year on February 21 (V. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.
Observer	C. H. B.	C. H. B.	G. G. W.	G. G. W.
First seen	4-19	.....	5-1	4-30
Next seen	4-20	.....	5-14	.....
Common	5-6	.....	.....	.....
Last seen	.....	9-16	.....	.....
Abundance	Common.	Not common	.....	Not common

Year	1892.	1901.	1903.
Observer	A. B. U. E. M. K.	V. H. B.	W. L. M.
First seen	3-27	2-11	3-9
Next seen	3-31	2-13	4-29
Common	.....	3-18	.....
Last seen	.....	.....	.....
Abundance	.....	Common.	Rare.

198. [722] *Olbiorchilus hiemalis* (Vieill.). Winter Wren.*

Rare in winter; more common during the migrations. October 4 to May 3. Absent during the winter 1902-3.

Most of the individuals departed April 19, 1885 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1900.	1901.	1903.
Observer	C. H. B.	C. H. B.	G. G. W.	G. G. W.	N. B. M.	V. H. B.	W. L. M.
First seen	.....	10-4	.....	.....	.....	.....	.....
Next seen	.....	10-9	.....	.....	.....	.....	.....
Common	4-4	.....	.....	.....	.....	.....	.....
Last seen	5-3	.....	4-24	4-20	4-17	3-3	4-30
Abundance	Not common	Common	Not common	Not common	.....	.....	Rare.

199. [725] *Telmatodytes palustris* (Wils.). Long-billed Marsh Wren.

Rare migrant. May 10, 1886 (C. H. B.—G. G. W.); May 13 (B. W. E.); September 29, 1903, common.

200. [726] *Certhia familiaris americana* (Bonap.) Brown Creeper.*

Rare in winter, common in spring and fall (C. H. B., '86). September 27 to May 30.

In April this bird may generally be found wherever there are Kinglets.

Most of them departed April 20, 1885 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1888.	1899.
Observer	C. H. B.	C. H. B.	G. G. W.	G. G. W.	G. G. W.	.....
First seen	4-1	9-27	4-13	4-9	.....	.....
Next seen	4-2	10-4	4-18	4-11	.....	.....
Common	4-4	.....	.....	.....	.....	.....
Last seen	4-25	.....	.....	.....	5-30	4-10
Abundance	Common.	Common.	Common.	Common.	.....	Rare.

Year	1900.	1901.	1902.	1902.	1903.	1892.
Observer	N. B. M.	V. H. B.	W. L. M.	W. L. M.	W. L. M.	E. M. K.
First seen	4-8	3-9	3-12	11-18	1-17	.....
Next seen	4-12	3-18	3-27	.....	1-18	.....
Common	.....	.....	4-13	.....	.....	.....
Last seen	4-17	.....	4-19	12-14	4-12	4-7
Abundance	Not common	.....	Common.	Common.	Common.	Common.

201. [727] *Sitta carolinensis* Lath. White-breasted Nuthatch.*

Common resident. Attempts at song March 8, 1902; five days earlier they were seen going in and coming out of a cavity in a tree, which they afterwards used as a nest.

202. [728] *Sitta canadensis* Linn. Red-breasted Nuthatch.*

Common migrant and rare winter resident. September 20 to May 12. "They were found wintering at Bloomington the winters of 1882-3 and 1885-6" (Blatchley). Also winters of 1884-5; 1902-3.

MIGRATION RECORD.

Year	1883.	1885.	1885.	1886.	1886.	1887.
Observer	B. W. E.	C. H. B.	W. S. B. C. H. B.	B. W. E. W. S. B.	W. S. B.	G. G. W.
First seen	2-10	1-31	10-2	2-22	.....	.....
Next seen	.....	2-2	10-7	2-23	.....	.....
Common	.....	.....	.....	.....	.....	.....
Last seen	.....	5-12	11-25	4-24	12-21	5-7
Abundance	Rare.	Not Common.	Not Common.	Not Common.	Common.	.....

Year	1901.	1902.	1902.	1903.	1903.
Observer	V. H. B.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	.....	2-28	10-12	1-14	9-20
Next seen	.....	3-10	10-26	1-18	9-24
Common	.....	.....	.....	4-29	9-25
Last seen	4-7	4-24	11-30	5-2	.....
Abundance	.....	Rare.	Rare.	Common.	Common.

203. [731] *Bæolophus bicolor* (Linn.). Tufted Titmouse.*

Abundant resident. Nestbuilding April 12, 1903; May 7, 1901.

An ubiquitous species with a great variety of calls and songs.

204. [735] *Parus atricapillus* Linn. Chickadee.*

Seen here only as a winter visitor. November 7 to May 15. It is probably not a common winter resident, though so reported by C. H. Bollman ('86). W. S. Blatchley says it was as common a winter resident, and B. W. Evermann says it was as common a resident as *P. carolinensis* in 1886. N. B. Myers says a few breed, but most of them go north. The latter records are probably due to confusion with the next species. All the specimens in the University collection have been examined and only one from this locality that was labeled *P. atricapillus* was identified correctly. There are, however, several unlabeled ones which come under this species. Its true status is that of an uncommon winter visitor.

MIGRATION RECORD.

Year	1884.	1885.	1886.	1892.	1895.	1899.	1900.
Observer	C. H. E.	C. H. B.	W. S. B.	A. B. U.	L. Hughes.	N. B. M.	N. B. M.
First seen	.....	.....	.....	.....	11-7	.....	.....
Next seen	.....	.....	.....	.....	.....	.....	.....
Common	.....	3-26	.....	.....	.....	.....	.....
Last seen	3-3	4-16	5-15	2-13	.....	5-2	4-28
Abundance	.....	Common.	.....	.....	.....	.....	.....

205. [736] *Parus carolinensis* Aud. Carolina Chickadee.*

Common resident. Seen more often and in greater numbers after March 8, 1903; February 18, 1902; April 30, 1885 (C. H. B.).

Song January 18 to November 28, 1902. Mating March 15, 1902; nestbuilding April 14, 1901. May 29, 1901, four young with pin-feathers and one egg were found in a nest about three feet from the ground in a willow stub. The nest was about three inches in depth and was lined with rabbit fur and other soft materials. The young were not yet able to sit on a perch, June 3 (W. L. H.).

206. [748] *Regulus satrapa* Licht. Golden-crowned Kinglet.*

Abundant migrant and rare winter resident. February 4 to May 7. September 21 to November 28. "They are reported as winter residents from Bloomington (Evermann, Blatchley). Also by G. G. Williamson.

Song heard April 16, 1902. This bird has a surprisingly loud, sharp whistle, with a somewhat ventriloquial effect.

On April 6, 1902, a Golden-crowned Kinglet was observed to catch a moth of apparently half its own size. It took several minutes time and much trouble to finish the insect and it was dropped once but was recovered and finally disposed of.

MIGRATION RECORD.

Year	1884.	1885.	1885.	1886.	1887.	1892.	1893.	1895.
Observer	B. W. E.	C. H. B.	C. H. B.	G. G. W.	G. G. W.	E. M. K.	E. M. K.	L. Hughes.
First seen	2-10	.....	10-3	3-19	.....	4-4	2-4	.....
Next seen	.....	.....	10-5	.....	.....	4-9	2-11	.....
Common	.....	4-2	10-9	4-13	.....	4-9	.....	.....
Last seen	.....	4-19	10-25	4-13	5-7	4-24	.....	11-7
Abundance	Rare.	Abundant	Abundant	.....	.....	Common	Common	.....

Year	1899.	1900.	1901.	1902.	1902.	1903.	1903.
Observer	N. B. M.	N. B. M.	W. L. M. V. H. B.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	4-10	4-4	3-20	3-27	10-5	3-18	9-21
Next seen	4-13	4-6	3-22	3-28	10-16	3-19	9-22
Common	.....	.....	4-5	4-15	10-18	3-23	9-21
Last seen	.....	4-12	4-21	4-23	11-28	4-19	.....
Abundance	.....	.....	Abundant.	Common	Common	Abundant.	Abundant.

207. [749] *Regulus calendula* (Linn.). Ruby-crowned Kinglet.*

Abundant migrant and rare winter resident. March 23 to May 18. September 21 to October 24. "They have been noted, in winter, in Monroe County, by Profs. Evermann and Blatchley." (A. W. Butler.)

Song April 5, 1901; 10, 1903. Mating April 19 and 24, 1903. April 10, 1903. Heard a Ruby-crowned Kinglet singing a varied and pretty song which was so loud that it did not seem possible that so small a bird could produce it. The Ruby-crown also gave a little *chuck*, a short whistle, and another note like that of a Canada Nuthatch, but less complaining. The last note was repeated several times. On April 19, two Ruby-crowns were seen, one of which with crown erected and singing, was chasing the other. Was this not mating? On the 24th two other in-

dividuals were seen doing the same thing, and another was heard singing. The song reminds one of nothing more plainly, than of the softer, less ambitious efforts of a canary. It is varied with little chirps and *chuck* and *chirr* notes.

The bulk left May 2, 1885 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	C. H. B. G. G. W.	G. G. W.	E. M. K.	E. M. K.
First seen	4-18	9-28	4-19	4-10	4-9	4-19
Next seen	4-19	10-3	4-22	4-11	4-23	.....
Common	4-22	19-8	.....	.....	4-27	.....
Last seen	5-11	10-24	4-24	.....	5-18	.....
Abundance	Abundant.	Abundant.	Common.	.....	Not common	.....

Year	1901.	1902.	1902.	1903	1903.
Observer	W. L. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	3-29	4-6	10-2	3-23	9-21
Next seen	.....	4-11	10-4	3-25	9-22
Common	.....	4-13	10-2	3-23	9-21
Last seen	4-5	4-27	10-15	4-30	.....
Abundance	Common.	Common.	Common.	Abundant.	.....

208. [751] *Polioptila cærulea* (Linn.). Blue-gray Gnatcatcher.* Figs. 27–8.

Common summer resident. April 5 to September 12.

Song and mating April 12, 1903. A nest containing one egg of a Cowbird was found April 22, 1886 (B. W. E.). This was ten days after their arrival. Three days after they arrived in 1902 Gnatcatchers were seen nestbuilding (April 24); the nest was half-finished on the 27th. In 1903 no completed nest was found until the 27th of April, which was 20 days after their arrival. On May 26, 1903, a nest and four well-incubated eggs were found. The nest was saddled on a limb of a small elm, about fourteen feet from the ground (C. G. L.). W. S. Blatchley (1888), in "The Audubon Magazine," describes a two-story nest of the Blue-gray Gnatcatcher, taken near Bloomington. A Cowbird had deposited an egg

in the nest proper and the second story was built over this egg (A. W. Butler).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	B. W. E.	G. G. W.	A. B. U. E. M. K.
First seen	4-5	.....	4-12	4-11	4-17
Next seen	4-6	.....	4-13	.....	4-23
Common	4-17	.....	.....	.....	.....
Last seen	.....	9-12	.....	.....	.....
Abundance	Common	Common.	Common.	.....	.....

Year	1893.	1899.	1901.	1902.	1903.
Observer	E. M. K.	N. B. M.	W. L. M. C. H. E.	W. L. M.	W. L. M.
First seen	4-6	4-13	4-29	4-15	4-7
Next seen	5-4	4-15	5-1	4-19	4-11
Common	.....	.....	.....	4-19	4-12
Last seen	.....	.....	.....	.....	.....
Abundance	.....	.....	.....	Common.	Common.

209. [755] *Hylocichla mustelina* (Gmel.). Wood Thrush.*

Common summer resident. April 12 to October 12.

Song May 4, 1904 (F. E. L.). Nest and eggs May 6, 1886 (B. W. E.).

A resident of the deeper woods. There his fine song may be heard at its best in early May.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.
Observer	C. H. B.	C. H. B.	W. S. B. C. H. B. G. G. W.	G. G. W.	A. B. U.
First seen	4-20	.....	4-17	4-25	5-7
Next seen	4-21	.....	4-22	.....	.....
Common	4-28	.....	4-24	.....	.....
Last seen	.....	9-19	.....	.....	.....
Abundance	Abundant.	Abundant.	Abundant.	.....	.....

Year	1900.	1901.	1902.	1902.	1903.
Observer	N. B. M.	W. L. M.	W. L. M.	W. L. M.	W. L. M.
First seen	5-2	5-6	4-24	.....	4-12
Next seen	5-4	.....	4-25	.....	4-17
Common	5-9	.....	.....	.....	5-5
Last seen	.....	.....	.....	10-12	.....
Abundance	Common.	.....	Moderat'ly Common.	Moderat'ly Common.	Common.

210. [756] *Hylocichla fuscescens* (Steph.). Wilson's Thrush.

Rather rare migrant. April 23 to May 16. September 1 to 13. Apparently common in 1885 (C. H. B.) now the rarest of the Thrushes.

Most of the birds departed May 10, 1885 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1885.	1902.	1903.
Observer	C. H. B.	C. H. B.	C. H. B.	W. L. M.	W. L. M.
First seen	4-23	9-1	.....	5-4	4-26
Next seen	4-26	9-8	.....	.....	.....
Common	5-4	.....	.....	.....	.....
Last seen	5-16	9-13	5-13	.....	.....
Abundance	Common.	Common.	Common.	Rare.	Rare.

211. [757] *Hylocichla alicia* (Baird). Gray-cheeked Thrush.

Rather uncommon migrant. April 10 to May 17. September 2 to 25. Formerly much more common; abundant in 1885 (C. H. B.).

Some question has been raised about the validity of the records of early arrival of the present species in the central states. The dates recorded are earlier than those noted for the arrival of the species on the southern coast of the United States. If these records are proved to be correct, they will establish what is at least not a common phenomenon of migration a journey from Central America, at least, across the Gulf and half across the continent before a stop is made. The very number of these early records from different points and by different observers in Indiana, is almost sufficient proof of their reliability. Some of these records are: Spearsville, April 14 and 15, 1894; April 3 to 10, 1895 (V. H. Barnett); Laporte, April 10 to 12, 1892 (Charles Barber); Brown County,

April 14, 1894 (E. M. Kindle) and Bloomington, April 10, 1903 (W. L. M.). It is claimed that the more usual and expected occurrence would be the arrival of this species at about the time of arrival of Wilson's and the Olive-backed Thrushes. Further observation and especially collection of specimens is needed to settle the question. The Gray-cheeked Thrush is only rarely recorded as late as early October, as are also the Veery and Swainson's Thrushes. But a specimen is recorded in the catalogue of the Indiana University Museum, taken by David Starr Jordan, November 1, 1875, at Indianapolis.

MIGRATION RECORD.

Year	1885.	1885.	1886.	1903.
Observer	C. H. B.	C. H. B.	G. G. W. W. S. B.	W. L. M.
First seen	4-22	9-2	5-1	4-10
Next seen	4-25	9-4	5-17	4-20
Common	5-3	9-5	.....	.....
Last seen	5-17	9-25	.....	.....
Abundance	Abundant.	Abundant.	.....	Rather rare.

212. [758a] *Hylocichla ustulatus swainsonii* (Cab.). Olive-backed Thrush.

Rather rare migrant. April 28 to May 19. September 1 to October 2. C. H. Bollmann considered this species an abundant migrant in 1885. At present only a few are seen each year.

Most of the individuals departed May 17, 1885 (C. H. B.). Perhaps the reduction in numbers of all the less hardy, wood-loving thrushes, in recent years is due to the cutting away of timber in this region. There are very few of those cool, dark, virgin forests, which are said to be the favorite haunts of our wood thrushes, remaining in this region at present.

MIGRATION RECORD.

Year	1885.	1885.	1887.	1892.	1903.
Observer	C. H. B.	C. H. B.	G. G. W.	A. B. U. E. M. K.	W. L. M.
First seen	5-2	9-1	4-28	5-9	4-29
Next seen	5-3	9-6	.....	5-14	4-30
Common	5-10	9-18	.....	.....	.....
Last seen	5-19	10-2	.....	5-15	.....
Abundance	Abundant.	Abundant.	.....	.....	Rare.

213. [759b] *Hylocichla guttata pallasii* (Cab.). Hermit Thrush.

Common migrant March 23 to May 3. October 3 to November 21. The extreme dates mark the limits of its stay in the State, unless it has recently been found to winter in the lower Wabash Valley.

The most common of the Thrushes in the migratory season. Found in second-growth and open woods.

The majority left April 25, 1885 (C. H. B.).

MIGRATION RECORD.

Year	1885.	1885.	1886.	1887.	1892.	1893.
Observer	C. H. B.	C. H. B.	W. S. B.	G. G. W.	E. M. K. A. B. U.	E. M. K.
First seen	3-31	10-3	4-17	4-12	4-2	4-19
Next seen	4-1	10-4	.....	.....	4-9	4-27
Common	4-19	10-10	.....	.....	.....	.....
Last seen	4-28	10-25	.....	.....	4-23	.....
Abundance	Common.	Common.	.....	.....	Common.	Common.

Year	1900.	1901.	1902.	1903.	1903.
Observer	N. B. M.	C. H. E.	W. L. M.	W. L. M.	W. L. M.
First seen	4-9	4-29	3-23	4-5	.....
Next seen	.....	.....	3-25	4-7	.....
Common	.....	.....	.....	4-12	.....
Last seen	.....	.....	3-27	5-3	11-21
Abundance	Not common	.....	Common.	Common.	Common.

214. [761] *Merula migratoria* (Linn). American Robin.* Fig. 30.

Resident; abundant in all seasons except winter when it is generally rather rare. However, on January 30, 1893, a winter day, 300 Robins were seen by E. M. Kindle. This was probably a band of migrants, and its occurrence then was not unusual. They become common from the middle of February to the middle of March. Some winters they are entirely absent—that of 1900-01 for instance. They have been observed in flocks here as late as April 13, 1903. There is generally a period in fall

when Robins are scarce, followed by a period of abundance before the numbers dwindle down to the usual winter representation. This is caused in all probability by the summer residents of more northern regions, halting here in what to them is a mild climate, after our own summer birds have departed. A similar movement is noticeable among the Bluebirds. The condition of mid-autumn abundance occurred October 22, 1902. Three days later these birds became rarer and flocks were seen migrating at a considerable elevation by day.

Singing began very early in 1903. One was heard singing his spring song, very low as if in rehearsal, January 16, and one burst out in full song January 20. The next song was heard February 24. In other years I have heard an imperfect song as early as February 23, and the complete song March 4, 1902. They continue their songs till late in the year. Perfect songs are heard in August, and on September 1, 1902, a Robin was heard singing with all the vigor if not the perfection of spring. Songs, perhaps slightly imperfect, but not very noticeably so, have been heard as late as October 26, 1902.

They have been observed mated by February 26, 1903. The first nest has been completed as early as March 21, 1903 (P. J. H.). Very little mud was used in the construction of this nest. That this was early in the season as well as in the calendar may be judged by the fact that an inch of snow fell shortly afterwards. The first egg was found March 29, 1903. It was in a nest in a beech tree. The nest was within ten feet of a window in Science Hall (C. G. L.). A full set was not found until April 8, but on April 26 two half-grown young, not accompanied by their parents, were observed. On May 3 two young nearly full grown were seen. Twenty-four days (April 23 to May 17) elapsed between the laying of the third egg and the flight of the young in a nest watched in 1892 (G. Hitze).

One was noticed before daybreak on March 26, 1903, sitting on the ground and singing vigorously. It was observed in the same place the next morning.

When the country is snowbound Robins resort to peculiar methods to obtain a livelihood; one was seen wading about in a shallow spring-fed stream, feeding in the manner of a Sandpiper, February 9, 1902.

MIGRATION RECORD.

Year	1883.	1884.	1885.	1886.	1887.	1892.
Observer	B. W. E.	C. H. E.	C. H. B.	B. W. E. G. G. W.	G. G. W.	E. M. K.
First seen	2-10	2-9	2-14	2-13	1-16	2-1
Next seen	2-13	.....	3-3	2-20	1-17	2-6
Common	2-13	.....	3-7	2-23	2-7	2-6
Last seen	.....	.....	.....	.....	.....	.....
Abundance	Abundant.	.....	Abundant.	Common.	.....	Common.

Year	1893.	1899.	1900.	1901.	1902.	1903.
Observer	E. M. K.	N. B. M.	N. B. M.	V. H. B. W. L. M.	W. L. M.	W. L. M.
First seen	1-28	2-12	2-20	2-19	.....	.....
Next seen	1-29	2-19	3-3	2-27	.....	.....
Common	2-13	3-16	3-9	3-3	3-1	2-27
Last seen	.....	.....	.....	.....	.....	.....
Abundance	Common.	Common.	Common.	Common.	Abundant.	Abundant.

215. [766] *Sialia sialis* (Linn.). Bluebird.* Figs. 31–2.

Resident; abundant in all seasons except winter, moderately common then. Becomes abundant before the middle of March (February 22 to March 16). Seen in pairs February 22, 1884 (C. H. E.). All records of Bluebirds for the winters 1900-01 and 1901-2 were made by groups and show just how the birds were met. Nearly all of these groups are twos or multiples of two, and of them equal numbers were male and female. This is pretty good evidence that many Bluebirds remain paired throughout the year. However, some of the summer residents mate here, and they were seen mating March 1, 1903. Two males were singing madly and flying excitedly about a female, the principal characteristic of whose attitude seemed to be utter indifference to both of her suitors.

Singing February 10, 1903. The first nest was finished March 15, 1903; it was in a fencepost which had rotted in two just above the ground and which swayed on its supporting wires, with every wind. A nest with three eggs was found March 22; and one with four eggs

April 2. On April 4 a nest and six eggs were found in an old Woodpecker's hole (C. G. L.). On April 27, four young Bluebirds 3-4 days old were found and on the 29th seven young, fully feathered and about four inches long, were seen flying about freely with their parents.

On November 30, 1902, Bluebirds were acting as Phœbes are often seen to do; they used a perch near the ground from which they suddenly flew down, picked up an insect or other morsel of food, always returning to the same perch.

MIGRATION RECORD.

Year	1883.	1884.	1885.	1886.	1887.
Observer	B. W. E.	C. H. E.	C. H. B.	B. W. E.	B. W. E.
First seen	1-12	2-2	.....	2-20	1-1
Next seen	.....	2-9	.....	2-21	1-3
Common	.....	2-22	2-28	2-22	.....
Last seen	.....	.....	.....	.....	.....
Abundanee	Abundant.	Common.	.....	Common.	.....

Year	1892.	1900.	1901.	1902.	1903.
Observer	A. B. W.	N. B. M.	W. L. M.	W. L. M.	W. L. M.
First seen	1-28	2-19	2-10	.....	.....
Next seen	2-6	2-22	2-17	.....	.....
Common	.....	.....	3-2	3-16	3-8
Last seen	.....	.....	.....	.....	.....
Abundance	Common.	Rare.	Common.	Abundant.	Abundant.

SUPPLEMENTAL LIST.

1. [51] *Larus argentatus* (Brünn). Herring Gull.

Very probably seen by J. J. Batchelor, April, 1902. See note under *L. philadelphia* in main list.

2. [208] *Rallus elegans* Aud. King Rail.

Rare migrant in Brown County (E. M. K. '94). Will probably be found to have the same rank in avifauna of this county.

3. [226] *Himantopus mexicanus* (Müll.). Black-necked Stilt.

C. H. Bollmann gives a queried record for Monroe County in his list of 1886, and ranks it as rare. It has not otherwise been recorded in the State.

4. [305] *Tympanuchus americanus* (Reich.). Prairie Hen.

Given in C. H. Bollmann's list of 1886 as one of the birds which had to his knowledge been found in the county but which had disappeared.

5. [310] *Meleagris galloparo merriami* Nelson. Wild Turkey.

A rare resident as late as 1886 (C. H. B.), when a few were seen each year (W. S. B.). In 1887 B. W. Evermann said that although he had not observed it, it was still occasionally taken. In 1894 E. M. Kindle wrote that it was almost if not entirely extinct in Brown County. The Wild Turkey is without doubt entirely extinct in this county.

6. [315] *Ectopistes migratorius* (Linn.). Passenger Pigeon.

A rare migrant in 1886 (C. H. B.). B. W. Evermann in 1887 classed it as formerly abundant but then rare. The last date at hand for this county is April 18, 1885, when ten were seen by C. H. Bollmann. It has been observed since that time in Brown County—March 7, 1894 (E. M. K.); 60 were seen April 12, 1895 (V. H. B.).

7. [382] *Conurus carolinensis* (Linn.). Carolina Paroquet.

Given the same position by C. H. Bollmann in his list of 1886 as the Prairie Hen. (See above.) "Judge A. L. Roach of Indianapolis says Parakeets were common in Monroe County in 1828 when his father's family moved there. The family came from western Tennessee, where the bird was abundant and well known. He says they were still there

in 1836. * * * B. W. Evermann learned from the late Louis Bollmann that they were there in 1831. * * * W. B. Seward of Bloomington said that these birds were well known to him from 1840-1850 and were in many places common" (A. W. Butler in "The Auk," Vol. IX, pp. 49-56). "Mr. W. B. Seward informs me of obtaining some five, he thinks, young Paroquets from a farmer's boy in Owen County (adjoining Monroe) in 1845. His impression is they were taken from the inside of a hollow tree, on the borders of White River. This is the farthest north we have any account of their nesting" (Butler, Birds of Indiana, 1897). In Brown County it was formerly abundant along Bean Blossom Creek (E. M. K.).

8. [392] *Campephilus principalis* (Linn.). Ivory-billed Woodpecker.

"Formerly common, now rare" (B. W. E. '87). Recorded by C. H. it was formerly found in Monroe County" (Butler).

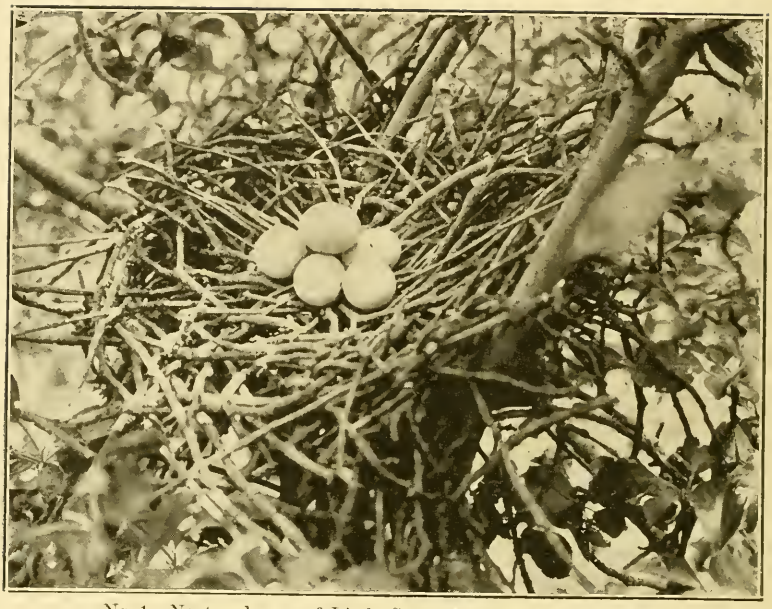
9. [486] *Corvus corax sinuatus* (Wagl.). American Raven.

"Formerly common, now rare" (B. W. E. '87). Recorded by C. H. Bollmann ('86) along with the Prairie Hen and Parakeet as one of the birds which had formerly been found in the county, but which was then extinct.

ADDENDA.

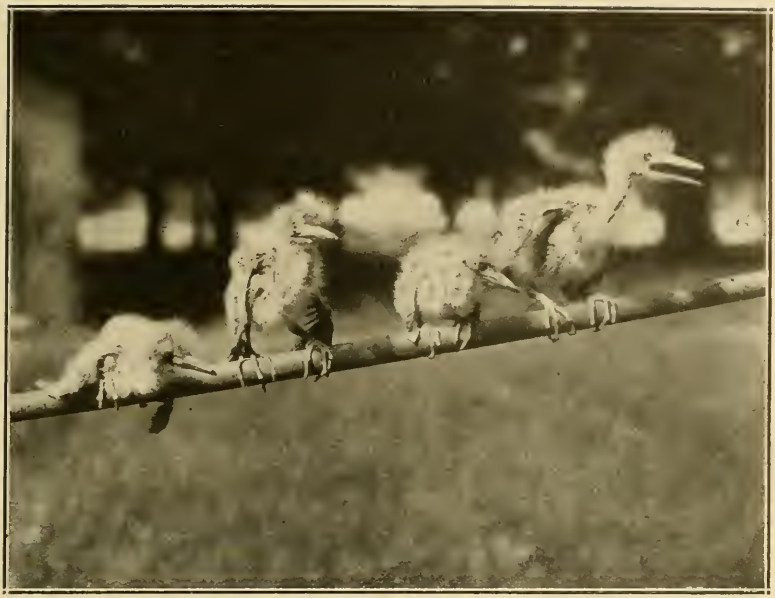
30.5. [212.] *Rallus virginianus* (Linn.). Virginia Rail.

Uncommon migrant. Several were seen and one killed with a club in a yard in town, April 22, 1904.

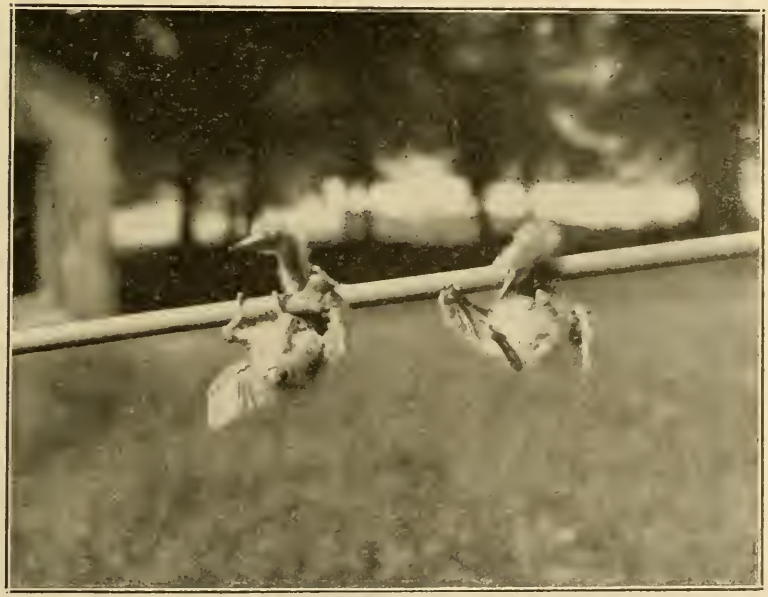


No. 1. Nest and eggs of Little Green Heron in an apple tree.

No. 2. Same nest, with four young and two eggs yet unhatched.

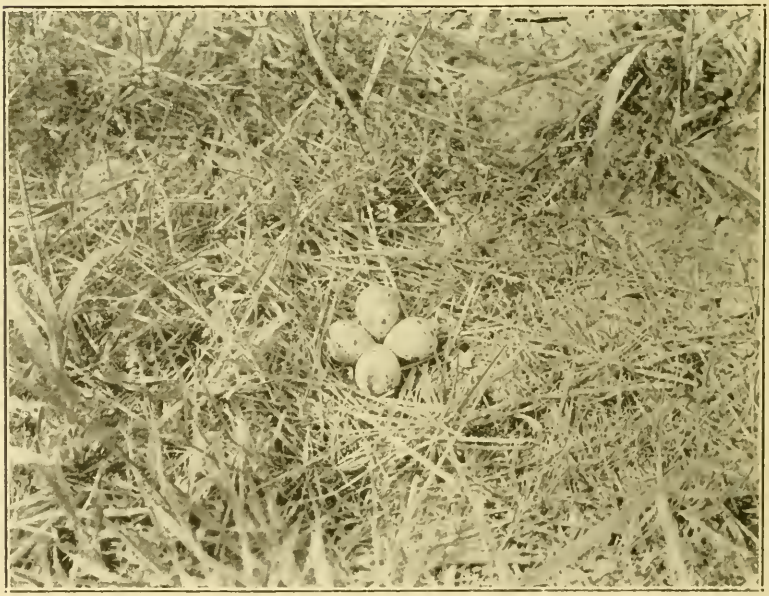


No. 3. Four young of Little Green Heron posing for the camera.



No. 4. Cut of two young Herons, showing the tenacity with which they cling to a stick.

No. 5. Two young Little Green Herons posing.



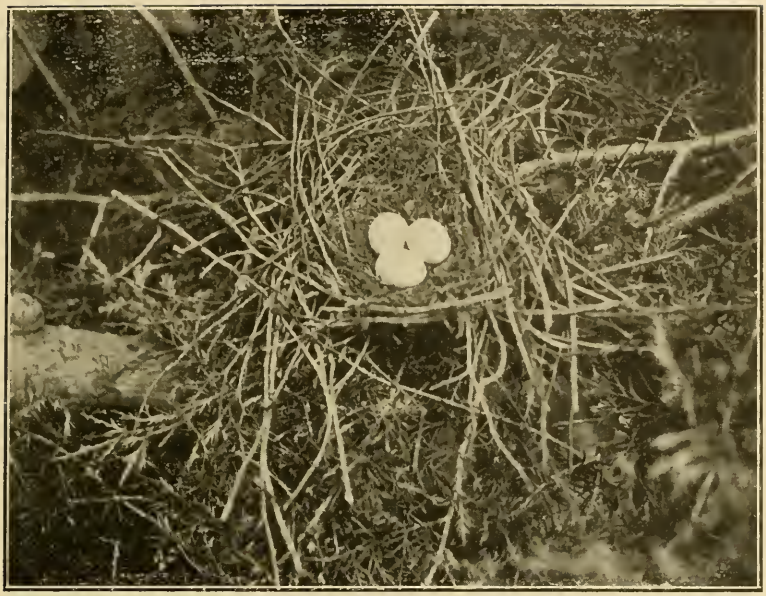
No. 6. Nest of Killdeer on ground.

No. 7. Nest and eggs of Dove on rail fence. Nest is simply a slight addition to old nest of some other bird.

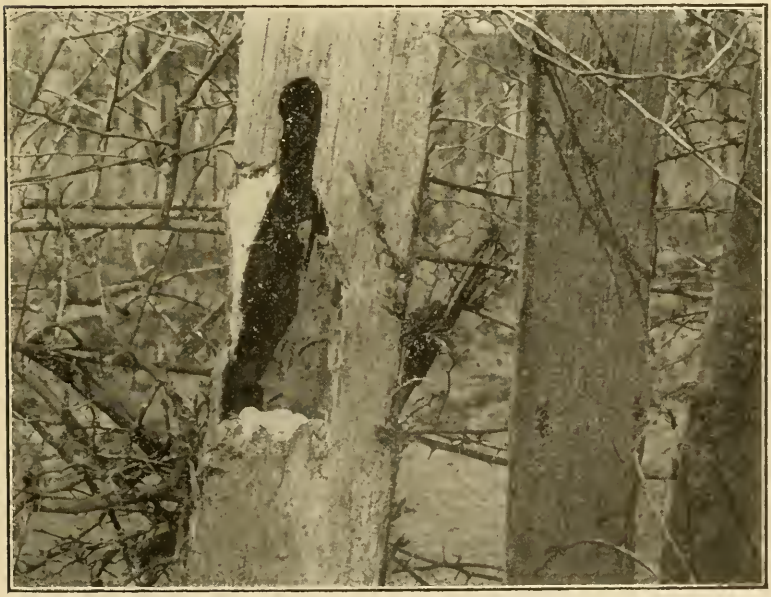
No. 8. Eggs of Dove on ground. No nest whatever.

No. 9. Nest and eggs of Dove on stump.

No. 10. Nest and eggs of Dove in cedar.

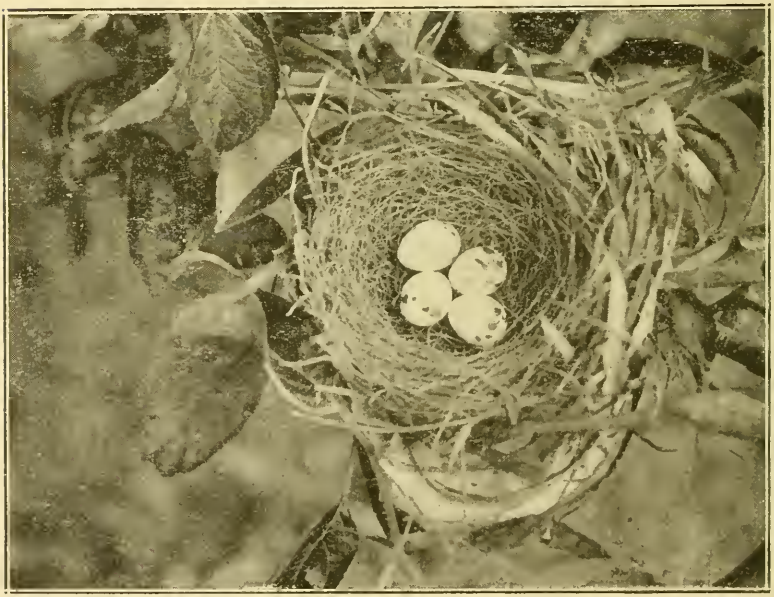


No. 11. Nest and three eggs of Black-billed Cuckoo.



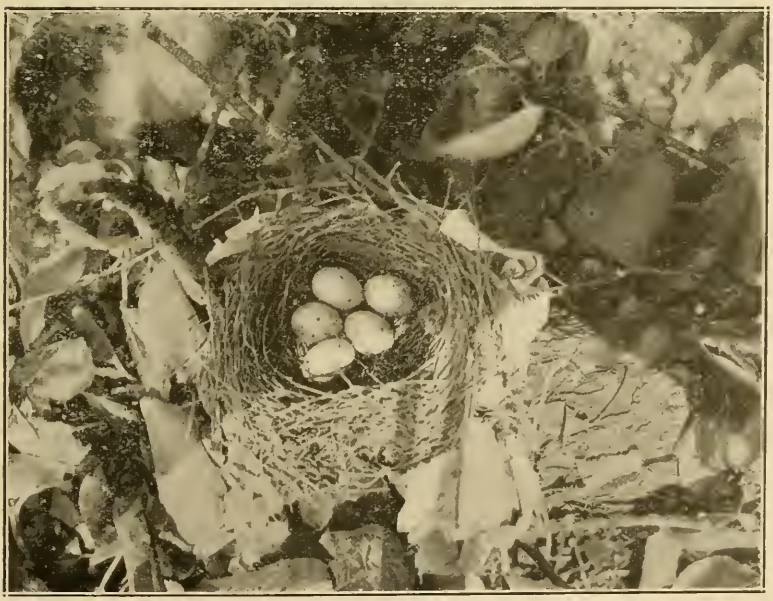
No. 12. Nest and six eggs of Downy Woodpecker in fence post.

No. 13. Nest and five eggs of Flicker in apple tree.

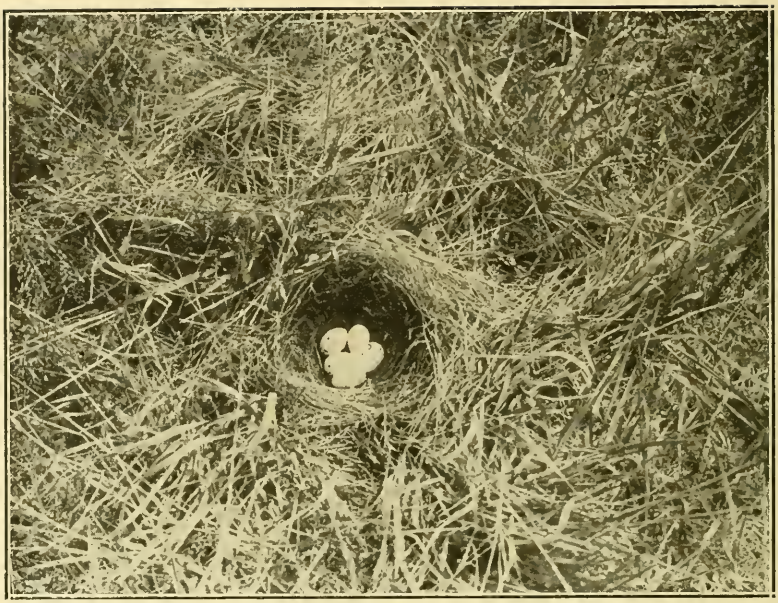


No. 14. Nest and eggs of Kingbird in apple tree.

No. 15. Nest and six eggs of Phœbe on stone abutment of a bridge.

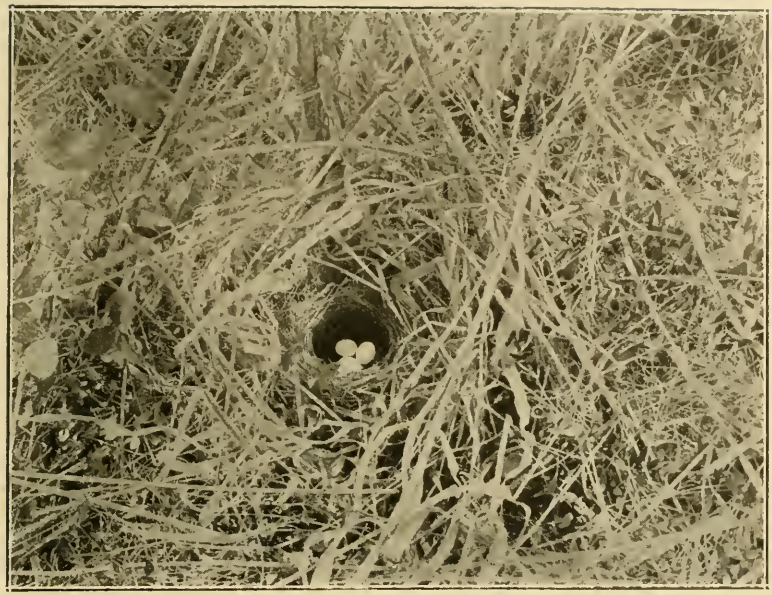


No. 16. Nest and five eggs of Jaybird in apple tree.



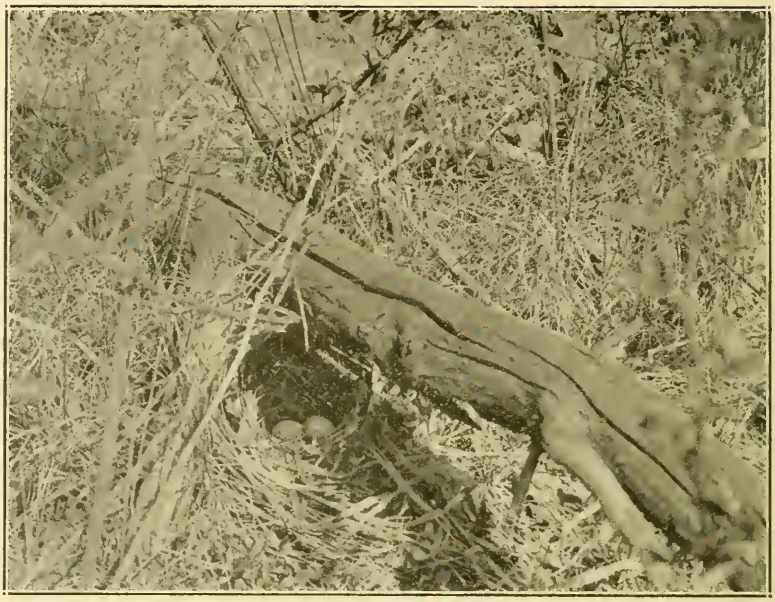
No. 17. Nest of Meadowlark, opened somewhat to show eggs.

No. 18. Nest and three eggs of Chipping Sparrow, with one Cowbird egg, placed in a pear tree.

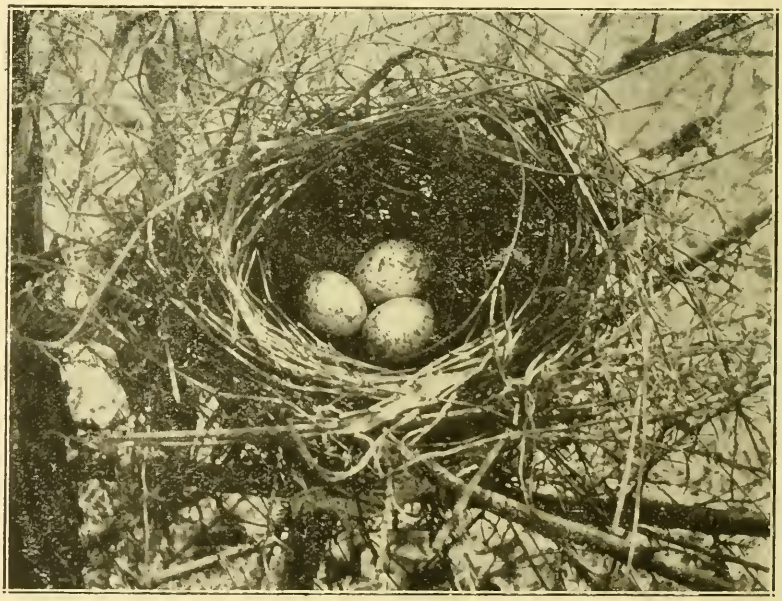


No. 19. Nest and three eggs of Field Sparrow.

No. 20. Nest and four eggs of Song Sparrow.



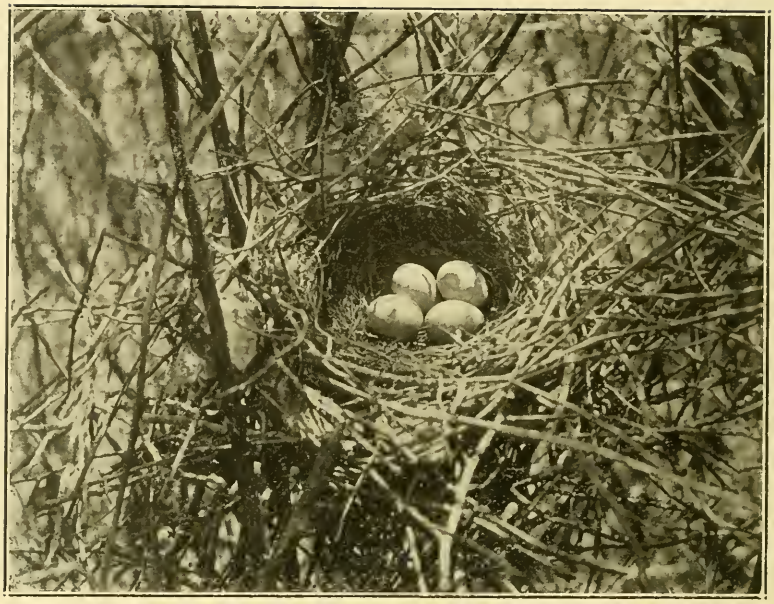
No. 21. Nest and eggs of Chewink. Two of the eggs do not show on account of position of camera.



No. 22. Nest and three eggs of Cardinal in cedar tree.

No. 23. Nest and three eggs of Blue-headed Vireo, with Cowbird egg.

No. 24. Nest and one egg of White-eyed Vireo, with two Cowbird eggs.



No. 25. Nest and four eggs of Brown Thrasher.

No. 26. Nest and four eggs of Brown Thrasher on ground.

No. 27. Nest and four eggs of Blue-gray Gnatcatcher in elm tree.

No. 28. Side view of nest of Blue-gray Gnatcatcher.

No. 29. Nest and six eggs of House Wren in sack hanging on fence. Hole in sack was enlarged to show nest.

No. 30. Nest and eggs of Robin on rail fence. Only one egg shows on account of position of camera.

No. 31. Nest and five eggs of Bluebird.

No. 32. Young of Bluebird.

TABLE.*

This table summarizes the facts recorded in the body of the paper. By means of table it will be easy for anyone to tell at a glance what birds may be expected during any week of the year, and the position of any bird in relation to the entire Calendar. When a bird has only been taken during one or two years this fact is indicated by the date; thus, under 7, the Cormorant has only been recorded in May 3, 1885. The abbreviations a=abundant; r=rare; w=winter; c=common; n=nest with eggs or young, are used and are self explanatory.

	Permanent Resident.	Winter Resident.	Summer Resident.	Regular Migrant.	Occasional Visitor or Migrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1. Horned Grebe				×					11–24								
2. Pied-billed Grebe				×				8–	–29						7–	–30	
3. Loon				×					1–	–11							
4. Bonaparte's Gull					×				1903 16								
5. Forster's Tern					×					1903 13							
6. Common Tern					1886 ×												
7. Double-crested Cormorant					1885 1886 ×					1885 3							
8. American Merganser				×					16–	–14							
9. Hooded Merganser				×				4									
10. Mallard				×a			10–	—	–23								
11. Green-winged Teal				×				4–	–17								
12. Shoveller				×				20–	—	–8							
13. Pintail				×			26–	–4									
14. Wood Duck			?	×				24	—	?	?	?	?	?			
15. Redhead					1903 ×			20									
16. Canvas-back				×					23								
17. American Scaup Duck					×			4									
18. Lesser Scaup Duck				×				9–	—	–8							
19. American Golden-eye				×				1									

20. Buffle-head					1886 1887 ×			5									
21. Surf Scoter					1886 ×												
22. Ruddy Duck					×				1903 24								
23. Blue Goose					1886 ×												
24. Canada Goose				×			17-	—	-12						31-	-24	
25. American Bittern				×r					5-	-13			27-	—	-22		
26. Least Bittern					1902 ×												
27. Great Blue Heron				×r				12-	-30				25				
28. American Egret					1887 ×				10			29					
29. Green Heron			×						10-	—	—	—	—	-22			
30. Whooping Crane					×												
31. Sora					×				15-	-8			×				
32. Yellow Rail					1885 1887 ×												
33. Florida Gallinule					×					1880 10							
34. American Coot					×				12-26								
35. Am. Woodcock			1886 ×		×	×		4-	-19								
36. Wilson's Snipe				×				6-	—	-10				22-	-28		
37. Pectoral Sandpiper				×				15-	—	-9							
38. Least Sandpiper					1887 ×												
39. Semipalmated Sandpiper					×				26-	-3							
40. Greater Yellow-legs					×				26- 1895	-1							
41. Yellow Legs					×				26								
42. Solitary Sandpiper			×r	×					23	—	-9				6		
43. Bartramian Sandpiper					1886 ×												
44. Spotted Sandpiper			×r	×					12	-7	?	?	?				
45. Killdeer		×r	×r			31-	—	—	n	n	—	—	—	—	—	—	r-12
46. Bob-white	×					—	—	—	—	—	—	—	—	—	—	—	—
47. Ruffed Grouse	×r							14-23	7					23			
48. Mourning Dove		×r	×			?	?	8n	n	n	n	n	n	n	—	-9	?
49. Turkey Vulture	×	×r				31-	—	—	—	—	—	—	—	—	—	a-21	
50. Black Vulture					×					1903 16							
51. Swallow-tailed Kite					×								1885 4, 18				

TABLE—Continued.

	Permanent Resident.	Winter Resident.	Summer Resident.	Regular Migrant.	Occasional Visitor or Migrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
52. Marsh Hawk				×r			28–	—	–19								
53. Sharp-shinned Hawk	×r					—	—	—	?	?	?	?	?	?	—	—	—
54. Cooper's Hawk	×					a	—	a	r	—	—	—	—	—	—	—	r
55. American Goshawk					×											1885 22	
56. Red-tailed Hawk	×					—	—	—	n19	—	—	—	—	—	—	—	—
57. Red-shouldered Hawk	×					—	—	—	—	—	—	—	—	—	—	—	—
58. Broad-winged Hawk	×r					—	—	—	a	—	—	—	—	—	a	—	—
59. Am. Rough-legged Hawk					×		1885 21										
60. Golden Eagle		×r				—	—	—	—	15						28	—
61. Bald Eagle					×							1885 29					
62. Pigeon Hawk					×			12–	–28							7	
63. American Sparrow Hawk	×					—	—	n	n	—	—	—	—	—	—	—	—
64. American Osprey				×r				12–	–29								
65. American Long-eared Owl					×	1883 30		1885 19									
66. Short-eared Owl						1886 ×											
67. Barred Owl	×					?	?	1902 24	?	?	?	?	?	?	?	?	?
68. Saw-whet Owl	×r					?	?	?	?	?	?	?	?	1884 20	?	1886 27	
69. Screech Owl	×					—	—	—	—	—	—	—	—	—	—	—	—
70. Great Horned Owl	×					?	?	1903 22	?	?	?	?	?	?	?	?	?
71. Snowy Owl					×	1903 25											
72. Yellow-billed Cuckoo			×						13–	n	n	—	—	–24			
73. Black-billed Cuckoo			×						13–	n	—	—	—	–22			
74. Belted Kingfisher		×r	×			1893 4		5–	—	—	—	—	—	—	—	–9	
75. Hairy Woodpecker	×					—	—	—	—	—	—	—	—	—	—	—	—
76. Downy Woodpecker	×					—	—	—	n	n	—	—	—	—	—	—	—

77.	Yellow-bellied Woodpecker		×r		×		1903 21	—	—	—	-5				15-	—	—	-29
78.	Northern Pileated Wood'ker	×r					r	r	r	r	r	r	r	r	r	r	r	r
79.	Red-headed Woodpecker	×					r	r	r	a	n	a	a	a	a	a	a	r
80.	Red-bellied Woodpecker	×					r	r	a	a	a	a	a	a	a	a	a	r
81.	Northern Flicker	×					—	—	—	n	—	—	—	—	—		—	—
82.	Whip-poor-will			×						21-	—	—	—	—	?	?	?	
83.	Night Hawk			×						28-	—	—	—	—	-21			
84.	Chimney Swift			×a						4-n	n	n	—	—	—	-14		
85.	Ruby-throated Humming-bird			×						29-	n	—	—	—	-26			
86.	Kingbird			×						13-	n	n	—	—	-15			
87.	Crested Flycatcher			×						18-	n	n	—	—	-7			
88.	Phœbe			×					1-n	n	—	—	—	—	—	-17		
89.	Olive-sided Flycatcher					×				1885 30	1885 12							
90.	Wood Pewee			×						26-	—	—	—	—	—	-5		
91.	Yellow-bellied Flycatcher				×					17-	—	—	—	-29				
92.	Green-crested Flycatcher			×						15-	—		—	—	-18			
93.	Traill's Flycatcher			×r							1885 14-	1885 —	1885 —	1885 -27				
94.	Least Flycatcher				×					21-	-19				12-18			
95.	Prairie Horned Lark	×					—	—	—	—	n	—	—	—	—	—	—	—
96.	Blue Jay	×a					—	n	n	n	n	—	—	—	—	—	—	—
97.	Common Crow	×					—	—	n	n	—	—	—	—	—	—	—	—
98.	Bobolink				×					17-	-6			29-	-1			
99.	Cowbird			×a					7-	Eggs —	Eggs —	—	—	—	—	-17		
100.	Red-winged Blackbird			×	×a				4-	—	—	—	—	—	—	—	-16	
101.	Meadowlark		×r	×			r	a	—	n —	n —	—	—	—	—	—	—	r
102.	Orchard Oriole			×						17-	n —	—	—	29				
103.	Baltimore Oriole			×	×					18-	n —	n —	—	—	-2			
104.	Rusty Blackbird				×				8-	—	-16						15-21	
105.	Bronzed Grackle		×r	×a			r	r	a	n —	—	—	—	—	—	—	—	r
106.	Evening Grosbeak					×	1887 20			1887 27, 29, 30								
107.	Purple Finch		×r		×				8-	—	-4							
108.	American Crossbill			×			18-	—	—	—	—	—	14			4-	-5	
109.	White-winged Crossbill					1883 ×	24	6, 10, 12, 23				1886 24						1885 12
110.	Redpoll					×	1883 30			1895 12								1882 —
111.	American Goldfinch	×a					—	—	—	—	—	n	n	n	n	—	—	—
112.	Pine Siskin		×r		×		—	—	—	—	-13					27-	—	—
113.	Snowflake					1886 r, w												
114.	Lapland Longspur					r		2-	-10									
115.	Vesper Sparrow			×a				19-	—	—	—	—	—	—	—	-25		
116.	House Sparrow	×a					—	n	n	n	n	n	n	n	n	n	n	—

TABLE—Continued.

	Permanent Resident.	Winter Resident.	Summer Resident.	Regular Migrant.	Occasional Visitor or Migrant.	January.	February.	March.	April.	May.	June.	July.	August	September.	October.	November.	December.
117. Savanna Sparrow			×r	×				30-	—	n —	n —	—	—	—	—	-6	
118. Grasshopper Sparrow			×						12-	n —	n —	--	—	—	-4		
119. Henslow's Sparrow			×r								n						
120. Lark Sparrow			×a					26-	—	n —	n —	—	-26				
121. White-crowned Sparrow				×					10-	-16					4-25		
122. White-throated Sparrow			×r	×a		1903 29		8-	n —	n -16				24-	—	-22	
123. Tree Sparrow		×a				—	—	—	-19						12-	—	—
124. Chipping Sparrow			×a					16-	n —	n —	—	—	—	—	—	-9	
125. Field Sparrow		× ?	×a				26	—	n —	n —	—	—	—	—	—	-8	
126. Slate-colored Junco		×a				—	—	—	—	-1					6-	—	—
127. Bachman's Sparrow			×	×					n 6-	n -8	—	—	—	?			
128. Song Sparrow	×			×a		—	—	—	n	n	n	—	—		—	—	—
129. Lincoln's Sparrow					×					1885 3-5					1885 10-25		
130. Swamp Sparrow				×				5-	-29						2-	-3	
131. Fox Sparrow		r		×		17	20—	—	—	-16					5-	-28	
132. Towhee	×			×			22—	—	n	n	n	n	—	—	—		?
133. Redbird	×					—	—	—	n	—	—	—	—	—	—	—	—
134. Rose-breasted Grosbeak				×					23-	-16				11-	—	-12	
135. Indigo Bunting			×a						13-	n —	—	—	—	—	-17		
136. Dickcissel			×a						23-	n	n	—	—		-2		
137. Scarlet Tanager			×	×					22	—	—		—	-19			
138. Summer Tanager			×	×a					1-	n	n	—	—	-28			
139. Purple Martin			×					28-	—	—	—	—	—	-10			
140. Cliff Swallow			×	×a					12-	—	—	—	—	-14			
141. Barn Swallow			×a	×a					9-	n	—	—	—	-12			
142. Tree Swallow			1886	×a					5-30	1886	1886	1886	1886				
143. Bank Swallow			×	×a					6-	—	— n	—	—				
144. Rough-winged Swallow			×	×c					18-	n —	—	—	?				
145. Cedar Waxwing			×						?	—	n	—	—	?			
146. Northern Shrike					×		1902 8, 23									18	
147. Migrant Shrike		×	×				16-	—	—	—	— n	—	—	—	—	—	-1
148. Red-eyed Vireo			×a	×a					19-	n —	—	—	—	—	-2		

149.	Philadelphia Vireo			×r	×					28-	—	—	—	—	-28		
150.	Warbling Vireo			×						21-	—	—		—	—	-10	
151.	Yellow-throated Vireo			×?	×					16-	n-13	?	?	?	1	-19	
152.	Blue-headed Vireo				×r					28-	-17				16 28		
153.	White-eyed Vireo			×a						17-	n —	—	—	—	-20		
154.	Black and White Warbler			×r	×					7	—	—	—	—	—	-4	
155.	Prothonotary Warbler					×r				26-	-28						
156.	Worm-eating Warbler			×	×					20-	n —	—	—	-31			
157.	Blue-winged Warbler			×r	×a					19-	—	—	—	—	-28		
158.	Golden-winged Warbler					×				27,28	1886 4						
159.	Nashville Warbler				×r					24-	-11			26-	—	-10	
160.	Orange-crowned Warbler					×					1885 4						
161.	Tennessee Warbler				×					26-	-16			30-	—	-17	
162.	Northern Parula Warbler					×				1885 1886 21-27							
163.	Cape May Warbler				×r					22-	-11				27-	-7	
164.	Yellow Warbler			×a						12-	n —	—	—	24			
165.	Blk.-throated Blue Warbler				×r					30-	-13				1-	-4	
166.	Myrtle Warbler		×		×		—	—	—	—	-13				24-	—	—
167.	Magnolia Warbler				×						5-24			31-	—	-4	
168.	Cerulean Warbler			×r	×					23	-7	r	r	r			
169.	Chestnut-sided Warbler				×					21-	-10			28-	-15		
170.	Bay-breasted Warbler				×r					29-	-13				18-	-10	
171.	Black-poll Warbler				×r					28-	-19				18-	-26	
172.	Blackburnian Warbler				×r					21-	-14			27-	—	-10	
173.	Sycamore Warbler			×	×					12-	—	—	—	—	—	-9	
174.	Blk.-throated Green Warbler				×a					18-	-16				1-	-17	
175.	Pine Warbler				×r					23-26					7-29		
176.	Palm Warbler				×					23-	-13				22-27		
177.	Prairie Warbler				×r					26-	-16						
178.	Oven-bird			×						19-	—	—	—	—	—	-12	
179.	Water Thrush				×				27-	—	-5				14- -18		
180.	Grinnel's Water Thrush					×r				1886 23							
181.	Louisiana Water Thrush			×					×	—	n —	—	—	—	-1		
182.	Kentucky Warbler			×						13-	n —	n —	—	-26			
183.	Connecticut Warbler					×r				1886 27	1886 1887 6-18						
184.	Mourning Warbler					×r					1885 16- -27						
185.	Maryland Yellow-throat			×a						20-	—	n —	—	—	—	-19	
186.	Yellow-breasted Chat			×a						24-	n —	—	—	—	-28		

TABLE—Continued.

	Permanent Resident.	Winter Resident.	Summer Resident.	Regular Migrant.	Occasional Visitor or Migrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
187. Hooded Warbler			×r						20-	n —	n —	—	—	-14			
188. Wilson's Warbler				1885 1886 ×r						8-14			31-	-18			
189. Canadian Warbler				×					27-	-18			26-	-15			
190. American Redstart			×	a					12-	n —	n —	—	—	—	-19		
191. American Pipit				×					1-	-19							
192. Mockingbird			×					24-	n —	—	—	-6	—	—			
193. Catbird			×a						2-	n —	n —	—	—	—	-6		
194. Brown Thrasher			×					16-	n —	n —	n —	—	—	—	-12		
195. Carolina Wren	×					—	—	—	—	—	—	—	—	—	—	—	—
196. Bewick's Wren			×					n6-	n —	—	—	—	—	—	-12		
197. House Wren			×r					9-	n —	— n	—	—	—	-16			
198. Winter Wren		×r				—	—	-3						4-	—	—	—
199. Long-billed Marsh Wren					×r					10, 13				29			
200. Brown Creeper				×		r	r	a	a	-30				27-	a	a	r
201. White-breasted Nuthatch	×					—	—	n	—	—	—	—	—	—	—	—	—
202. Red breasted Nuthatch		×r		×		—	—	—	—	-12				20	—	—	—
203. Tufted Titmouse	×a					—	—	—	n	n			—	—	—	—	—
204. Chickadee		×				—	—	—	—	-15						7	—
205. Carolina Chickadee	×					—	—	—	n	n	—	—	—	—	—	—	—
206. Golden-crowned Kinglet		×r		×a			4-	—	—	-7				21-	—	-28	
207. Ruby-crowned Kinglet				×a				23-	—	-18				21-	-24		
208. Blue-gray Gnatcatcher			×						n5-	n —	—	—	—	-12			
209. Wood Thrush			×						12	n	—	—	—	—	-12		
210. Wilson's Thrush				×r					23-	-16				1-13			
211. Gray-cheeked Thrush				×					10-	-17				2-25			
212. Olive-backed Thrush				×r					28-	-19				1-	-2		
213. Hermit Thrush				×				23-	—	-3					3-	-21	
214. American Robin	×					r	r	n, a	n, a	n, a	n, a	a	a	a	a	a	r
215. Bluebird	×					c	c	n, a	n, a	a	a	a	a	a	a	a	c

*The tables and index were prepared by Charles Henry Frazee and Leonard Haseman from the data contained in Mr. McAtee's paper.

INDEX.

Electromagnetic Induction in Conductors of Different Materials and in Electrolytes.

Arthur L. Foley and Chester A. Evans.

This investigation was undertaken for the purpose of determining whether or not the character of a conductor has any effect upon the electro-motive force generated in it when it is made to cut magnetic lines of force.

Is the e. m. f. generated in a copper wire of given length exactly equal to the e. m. f. generated in a silver wire of the same length when both cut lines of force at the same rate? And is this e. m. f. equal to that generated in a nonconducting tube of length l, filled with an electrolyte, when the electrolyte is made to cut lines of force at the above rate? Electrolytic conduction and metallic conduction appear to be very different processes, why then should one expect metals and electrolytes to give identical results from electromagnetic induction?

It is evident that many difficulties and sources of error will be avoided if the two conductors to be tested can be placed together and made to cut the same field in such a manner that the resultant e. m. f. generated is zero, provided that electromagnetic induction is independent of the substance of the conductor. Also, the direction of the e. m. f. must be constant if a sensitive galvanometer is to be used to detect it.

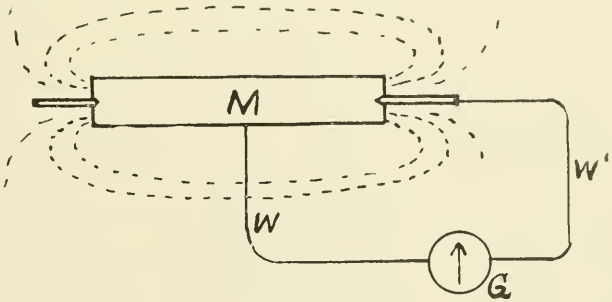


Fig. 1.

Let M (Fig. 1) be a cylindrical magnet mounted to revolve about its axis, and let w and w^1 be wires in contact respectively with the middle of the magnet and the center of the end, and connected, as shown, to a gal-

vanometer, G. Suppose the magnet to be revolved at a high speed. Few lines of force cut w^1, as it is parallel with the axis of the magnet. W is cut by the lines passing from pole to pole and if the pole strength is sufficiently great and the magnet is revolved rapidly, the galvanometer will indicate a current—and therefore an induced e. m. f. If w and w^1 are led from the magnet as in Fig 2, it is evident that the resultant e. m. f. generated is zero, since that generated in w opposes that generated in w^1. But suppose that w is of one metal and w^1 of another, if the e. m. f. generated in each is not the same, the galvanometer, if sufficiently sensitive, will indicate a current. The wire w^1 may be replaced with a tube containing an electrolyte and the electromagnetic induction in the electrolyte measured. To increase the sensitiveness of the apparatus there may be a number of w's and w^1's connected as shown in Fig. 3.

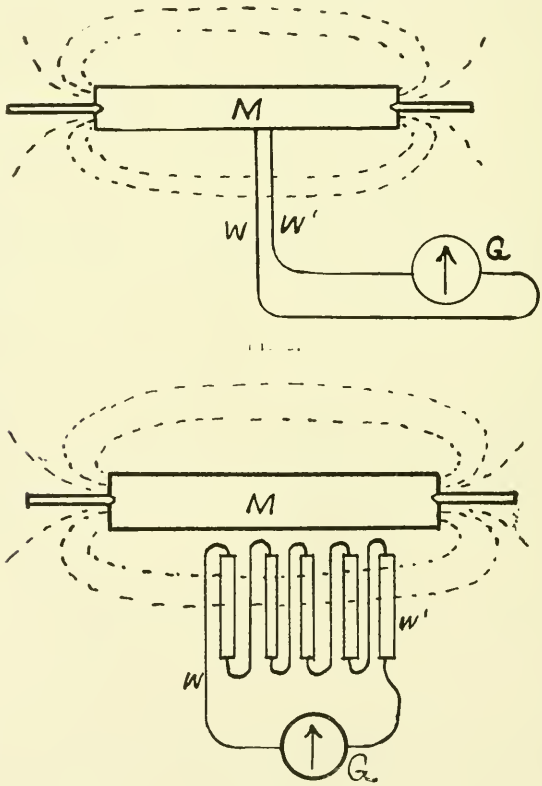


Fig. 3.

Although considerable work has been done, it has been entirely of a preliminary character. With a magnet of pole-strength 415, making 4,000 revolutions per minute, with 100 copper wires (w) and 100 German silver wires (w^1), the junior author of this paper found that no current was indicated by a galvanometer whose constant was 1.1×10^{-9}. The magnet was rotated by an electric motor and the galvanometer was placed on a pier in an adjoining room some thirty feet distant. Work with electrolytes is now in progress.

The senior author is arranging to make the apparatus more sensitive by using an electromagnetic field and a more delicate galvanometer. Results will be given in a future paper.

Interference Fringes About the Path of an Electric Discharge.

Arthur L. Foley and J. H. Haseman.

Some ten years ago the senior author of this paper, while photographing interference fringes under various conditions, noticed that fringes were produced about the path of an electric discharge. Owing to the press of other work further investigation of the subject was postponed. A few weeks since the subject was revived and arrangements were made to continue the investigation.

The apparatus consists of two rectangular wood boxes about twelve feet long, the larger box about eight inches square, the smaller one about six inches square and arranged to telescope in the larger box. Thus the total length of the box can be made anything from twelve to twenty-four feet. The boxes were painted dead black on the inside. The far end of the larger box is provided with a sort of camera attachment and plate holder. The far end of the smaller box is light tight, except for a metal disc, which has several apertures bored through it, the apertures varying in diameter from .01 cm. to .5 cm. By rotating the disc any desired aperture can be brought into position at the center of the end of the box. The aperture was illuminated by the blue end of the spectrum of an electric arc. A piece of ground glass was placed against the outside of the metal disc to insure the spreading out of the light passing through the aperture.

The needle points were placed near the center of the box, which was made about twenty feet long. The points were charged by connecting them to the knobs of a ten-inch plate induction machine driven by an electric motor.

Interference fringes were produced whether the discharge was visible or invisible, continuous or intermittent, and whether between points or small spheres. On some of the plates taken with the needle points 1 cm. apart and with an invisible discharge three dark bands can be seen on either side of the dark central band connecting the two points.

Sufficient work has not been done to warrant an attempt at an explanation of the results obtained, therefore further results will be reserved until others have been obtained that may throw some light on the subject.

Cuscuta Americana L.

Stanley Coulter.

In a study of the genus Cuscuta a peculiar situation in regard to Cuscuta Americana L. arose, which may prove of interest. The history of this species seems evident. The original plant was collected by Sir Hans Sloane in Jamaica and is described in Hist. Jamaica, 1707, vol. 1, p. 201. Gronovius in 1743 determined a specimen collected by John Clayton to be the same as the Sloane plant, to which he definitely referred; Plantæ Virginica, p. 18; 1743. Linnæus, 1753, in Sp. Pl., vol. 1, p. 124, copies the description of Gronovius verbatim and gives the form its binomial name. Linnæus refers specifically to Pl. Virg., p. 18.

It is clear, then, that Sloane's plant in the South Kensington Museum should stand as the type of Cuscuta Americana L. That as a matter of fact our present Cuscuta Americana L. is a very different plant from that of Sir Hans Sloane will perhaps be clear from the discussion which follows. Indeed, Cuscuta Americana L. as at present understood seems to have arisen without a type upon which to rest.

Through the courtesy of the authorities of the South Kensington Museum I was enabled to study the Sloane plant somewhat carefully, with the following results:

Calyx gamosepalous; tube short; lobes coriaceous in center, membranous at edges; diverging at an acute angle; apex abruptly acute; large cells (plainly made out with hand lens) irregularly scattered; membranous part of lobes, as well as inner and outer surface of petals, thinly clothed with velvety trichomes. Lobes of calyx one-half longer than the tube, the tips meeting those of the reflexed lobes of the corolla. Lobes rather spreading, at least not closely appressed to tube of the corolla.

Corolla; tube urceolate, about 2 mm. long; lobes reflexed, obtuse, separating from each other by a narrowly acute angle, about one-half as long as the tube. In many cases margins of petals infolded, which, however, may be due to imperfect drying.

Stamens apparently four, about one-half as long as lobes of the corolla, though exserted on account of the reflexed habit of the lobes.

Styles as long as tube of corolla, widely diverging.

Stigmas decidedly globose-capitate.

Inflorescence in cymose clusters of various sizes; peduncles often branched; pedicels, which are of varying length, bearing a single flower. Peduncles very generally stronger than the stems from which they arise. Pedicels in the majority of instances from 10 to 15 mm. long. Sloane's note that flowers arise from "single side of stalk" seems well taken, though his added statement, "as others of this kind are," needs modification.

Stem, closely appressed to stem of host where haustoria are developed and in such places strengthened and roughened. It also presents a large number of free ends which branch somewhat freely, each branch being subtended by an evident leaf-scale from 1 to 3 mm. long. The free branches have a twisted appearance and twine freely about each other. The plant as a whole is straw colored.

The abundant material permitted the dissection of the flowers, giving the following additional characters:

Flower generally four-parted, in this differing from the majority of American Cuscutas.

Anthers somewhat sagittate, filaments strong.

Scales large, about one-half length of filament; united at base; deeply cleft near top, less deeply at sides, intervening arch not fringed.

Sepals narrowly elliptical, the acumination being really a cuspidation.

Petals delicate in structure with but few large cells; elliptical, obtuse; reflexed fully one-third of their length.

Ovary lenticular, rather sharp-edged. In early anthesis styles are about length of ovary; later they become as long as corolla and very prominent. The styles are somewhat thick, awl-shape, and the globose character of the stigma is apparent from the first.

This is Sloane's Jamaica plant as I was able to make out its characters after an extremely careful study.

The Linnaean description in Sp. Pl. (1753), p. 124, is as follows:

"C. Americana.

Cuscuta floribus pendunculatis.

Cuscuta caule aphyllo volubili repente (Gron. Fl. Virg. p. 18).

Cuscuta inter majorem et minorem media, filamentis longis et floribus late super arbores et campos se extendens. Habitat in Virginia."

This is a verbatim copy of Gronovius' description of "Cuscuta inter majorem et minorem media" in Flora Virginica, Pas Prima, p. 18, 1743.

Gronovius in turn closely followed the description of Sloane in his Hist. Jamaica, vol. 1, p. 201 (1707), t. 128, f. 3, his added characterizations being of very doubtful value.

Through the courtesies of the officials of the Linnæan Society I was able to examine the Cuscutæ in the Linnæan collection. This collection had evidently been examined by Dr. Engelmann in his study of the genus and his penciled annotations were upon the various sheets. There are three sheets, each of which is labeled C. Americana in the well known writing of Linnæus. One of these is evidently Cuscuta Gronovii Willd, and Dr. Engelmann so regarded it, as is shown by his annotation. Another is probably Cuscuta umbellata H. B. K., at least it was so referred by Dr. Engelmann, and whether the reference be correct or not, the plant is certainly *not* the same as that upon the other two sheets. It is on the plant upon the remaining sheet that Dr. Engelmann rests his conception of the Cuscuta Americana of Linnæus. It might be a fair question, in passing, as to why either of the other sheets might not have been selected as the basis of the Linnæan C. Americana.

The plant upon the third sheet, then, is to be taken as representing the notion of Linnæus of the species under consideration. The specimen upon this sheet conforms fairly to Engelmann's description and also to that of Choisy, 1841, although it might be said that Choisy's figures of C. Americana L. in Choisy's Cuscuta, Jan. 21, 1841, No. 51, p. 186 tab. 4, f. 4, could not have been derived from his description of the species in his "Cuscuta enumeratio." The most cursory comparison of the description and drawings will make this fact plain.

The form upon this sheet, however, is not the same as Sloane's plant. A careful study and dissection of the plant gives the following characters:

Calyx 5-parted, polysepalous; lobes oval, acute, diverging from each other at an acute angle, coriaceous throughout, about as long as calyx tube. The calyx is quite large, being scarcely exceeded by the corolla. No evidence of large cells, although under hand lens the texture of the sepal is seen to be coarse, simulating veining.

Corolla 5-parted. Tube at first cylindric, later somewhat urceolate because of increase in size of ovary. Tube scarcely longer than calyx. Lobes, oval, acute, finally reflexed about one-fourth length of tube; in young flowers erect or spreading. Delicate in structure, no evidence of large cells.

Stamens, scarcely exserted, in the majority of cases not at all. Filaments strong, anthers *not* sagittate.

Scales about one-half the length of the petals, united at the base, arch narrow; top of scale deeply fringed, the fimbriations often branching; sides of scales much less deeply fringed, arches not at all. Base of scales plainly bilobate, as is often, though not always the case.

Styles two, parallel, short, subequal, scarcely exserted, in the majority of cases not at all.

Ovary somewhat globose, showing slight tendency toward triangularity, evidently due to development of three seeds. Styles only about one-half the length of ovary; stigmas globose-capitate.

Flowers from 2-4 mm. long and nearly as broad.

Inflorescence: Flowers gathered in clusters of various sizes, though none of the clusters exceed 8 mm. in diameter. Clusters contain from 3-5, up to 10-16 flowers. Flowering branches thickened, rugose, often branched. Pedicels short, single flowered, the flowers in many cases seeming sessile.

Scale leaves small, sub-triangular, acute, membranaceous.

Stem, where closely appressed to host-plant, strong, rugose, dark colored, almost brown. Free stems slender smooth, often branching. Scale leaves, more elongate and less acute than those found on flower branches, occur on free portions of the stem.

The individual flowers have no bracts, although the floral clusters are subtended by two or more membranaceous bracts from 1-2 mm. long and perhaps two-thirds as wide.

It is very evident that the plant in the Linnæan collection is far removed from the Jamaica plant of Sloane in the South Kensington Museum.

Grisebach, in Fl. of British West Indies, London, 1864, includes Americana and makes direct reference to Sloane, t. 128, f. 4, but the description shows that the plant he so refers is not that of Sloane. The following characters (Fl. Brit. West Ind. (1864), p. 476) mark his plant:

1. Pedicels shorter than flowers.
1. Calyx little exceeded by corolla.
3. Calyx lobes short, rounded.
4. Corolla 5-parted, lobes erect.
5. Scales small.

That much confusion has resulted from this uncertainty as to the type feature of Cuscuta Americana L. is evidenced by a study of the various large herbaria.

Thus the C. graveolens H. B. K. (Nov. Gen. et Sp. 3, p. 122, 1818) can scarcely be a synonym of C. Americana L. if the description there given is at all accurate.

In the collections at the Kew gardens, 21809 and 21810, Dr. A. Glazier, Brazil, chiefly from Province of Goyaz, 1896, are neither the C. Americana of Linnæus and Engelmann, nor yet are they Sloane's plant. Herb. Guatemalens, 59, Jan., 1864, Gust. Bernoulli, and Herb. Guatemalens, 1916, Bernoulli and Cairo, with Herb. Mus. Paris 3353, Region de Orizaba, M. Bourgeau, 1865-1866, all mounted on same sheet and labeled C. Americana are C. congesta.

Ex Plantis Guatemalensibus, quas edidit John Donnell Smith, No. 855, C. Americana L. forma floribus majusculis, Coban, Dept. Alta Verapaz. Altitude 4,300 feet, January, 1886. Legit H. von Tuerckheim, is neither C. Americana nor a variety of it; the long slender, acuminate corolla lobes evidently throwing it in quite a different section of the genus.

Such a list might be greatly extended, but enough has been indicated to show into what inextricable confusion we have come because of this absence of a recognized type form for this species.

Personally I am not attempting any decision in the matter; I am simply reciting facts coming under my observation. If Sloane's Jamaica plant is the type of C. Americana L., then the form in the Linnæan collections, so labeled by Linnæus and reaffirmed by our last specialist in the group can not be C. Americana, for it is not the same plant. If the form in the Linnæan collection be taken as the type, what is the name of Sloane's plant? How, also can it be assumed that any other plant than Sloane's was in mind in view of the references of Gronovius and Linnæus to it specifically, references continued as late as 1797, when in Linne Sp. Pl. Willdenow, edn. IV., vol. 1, page 702, we find at the conclusion of the characterization, "Habitat in Virginiæ fructibus et at littora maris in herbis Jamaicæ (v. s.)"? Gmelin, also in his Sys. Veg., 1796, vol. 1, p. 285, refers to Sloane's plant, as does also Vitman in his Summa Plant, 1790, vol. 1, p. 340.

How the riddle shall be read in view of these facts is left to adepts in nomenclature. It is entirely beyond my powers.

On the Nomenclature of Fungi Having Many Fruit-Forms.

J. C. Arthur.

(Abstract.)

The paper begins with a statement of the views of Dr. Magnus and others, who hold that with such forms as the heteroecious rusts the action of the law of priority in the selection of specific names should extend only to names applied to the teleutosporic form. Thus, the common grain rust should be called *Puccinia graminis* Pers., and not *Puccinia poculiformis* (Jacq.) Wettst.

The argument is upheld that this view practically rests upon the inference that the genus Puccinia is a form-genus based upon the teleutosporic stage. A true genus, it is maintained, must of necessity embrace all stages of development and all structural parts of every species under it. The name of the genus, as well as that of the species must, moreover, so far as its nomenclatorial treatment is concerned, be considered as simply appellative, and without regard to its derivation or significance.

These ideas are elucidated with a variety of illustrations. The conclusion is drawn that with clear concepts of this nature there can be no question of the desirability of applying the law of priority to fungi with many fruit-forms, in a manner similar to its use among phanerogams.

The proper name for the common grain rust, according to this method, is *Puccinia poculiformis* (Jacq.) Wettst.

Pollination of Campanula Americana and Other Plants.

Moses N. Elrod.

Campanula Americana L. is markedly proterandrous. In the bud the anthers are in contact with the pilose two-thirds of the style and discharge their pollen introrsely before the corolla opens. As the flower bud opens the filaments wither beyond their more persistent bases. In the meantime the style grows rapidly in length, so that in a few hours it is long-exserted, declined and the pilose, pollen covered end turned upward. No matter whether the flower is on an erect or inclined branch the pilose end always turns upward, while the other portion of the style assumes a horizontal or slightly declined position. One or two days after the bud has opened the hairs on the style begin to wither and drop their charge of pollen. At the same time stigmatic papillæ are exposed and ready for cross-pollination. Nectar is secreted by a fleshy disk surrounding the base of the style, and is protected from rain and the predatory incursion of many insects by the triangular bases of the five stamens.

Honey-bees and the beautiful metallic-green *Agaostemon radiatus* Say are frequent visitors. They readily gain access to the honey by lighting on the petals of the rotate corolla and inserting the tongue between the style and bases of the stamens. Their visits, however, do not promote fertilization, as their movements, in approaching the flower or in collecting honey, never bring them into contact with the pollinated portion of the style nor do they ever touch the stigma.

C. Americana is cross-fertilized by a leaf-cutter bee, *Megachile brevis* Say. It differs from the honey-bee in its structure and the way in which it approaches the honey disk. It is armed with a dense brush of hairs on the under side of the tail, instead of having pollen baskets on the legs; it comes to the flower on the wing, in a direct, unhesitating way, over the upturned stigma, which it frequently touches with the hairs of its tail; it settles on the style with its head directed away from the stigmatic end of that organ, and never comes in contact with the corolla except with its fore feet. While in this position collecting honey the

Note.—I am indebted to Mr. Ashmead, Bureau of Entomology, Department of Agriculture, for identifying the bees named in this paper.

hairs of its tail are in contact with the pilose portion of the style and become pollinated, if the flower has recently come into bloom and the style has not yet shed its hairy coating. But this leaf-cutter is not wholly dependent on its position while collecting honey for a supply of pollen. On several occasions it was seen clinging to the style and transferring pollen to its abdomen with its hind-legs, a maneuver that no other bee seems capable of performing. With the hairs of its tail charged with pollen it is easy to understand how cross-fertilization is effected, as it passes from one flower to another; and so systematic are the movements that they appear to be evolved for the purpose they fulfil. So far as the writer has been able to discover, no other insect than *M. brevis* is of use in fertilizing the tall bellflower. Another leaf-cutter, *Megachile infragilis* Cresson, was often seen collecting honey from *Impatiens aurea*

Figures. CAMPANULA AMERICANA L.
a. Triangular bases of stamens.
b. Pilose end of style covered with pollen and bee collecting honey.
c. Style denuded of hairs, bee about to brush against lobes of stigma.
d. Style denuded of hairs and bee in position on style while collecting honey.

Muhl. and pollen on *Helianthus annuus* L. growing nearby, but was never seen on *C. Americana*.

The tall bellflower, on which the observations described were made, grew in the back yard of a city residence, and was in bloom from July

to November 8, 1904, at which last date forty-seven perfect flowers were counted. Long before November heavy frost had ended all insect visits and the plant had been dependent on self-pollination for fertilization for a month. With frost came some noticeable changes in the mechanism of the flower. The end of the style was not so uniformly bent upward, and the pollen-bearing hairs were much more persistent. During the latter period self-fertilization was effected by the lobes of the stigma bending back until the papillose extremities touched the pollinated hairs. The same movement may have occurred earlier in the season, but if it did it was not so obvious, and many times it would have been useless, as the styles were denuded of their hairy appendages, and the lobes not yet reflected more than usual.

Within the inflated limb of *Pentstemon Pentstemon* (L) Britton the filaments are free, and clustered with the style under the upper lip. One pair of the didynamous filaments is nearly free from the corolla tube, while the other pair and the sterile filament are imbedded in the wall of the tube below the inflation. The bases of the free filaments are dilated, with a concavity on the inner faces in which honey is secreted.

As a result of this arrangement the throat of the corolla is so obstructed by the two free filaments and the style as to prevent any insect from reaching the honey glands, without some special adaptation to overcome the obstruction. To secure honey the visiting insects must be armed with a stout pair of jaws to force an opening between the filaments and style and with a tongue 14 mm. long. These necessary equipments are found in *Anthophora abrupta* Say, a small bumble-bee. For two seasons this bee has been the only insect seen to enter the corolla of a large, cultivated plant, under daily observation while in bloom. Anthophorae never missed putting in an appearance during some part of the day, if the weather was fair, and sometimes as many as half a dozen were seen on the plant at the same time.

Anthophorae abruptae never were seen collecting pollen, but as they forced their bodies into the inflated portion of the flower they were well dusted with it on their hairy backs. This pollen was carried to the next stigma under which they passed, where some of it was left, provided the stigma was ready to receive it. Usually the stigmatic end of the style is pressed against the upper lip of the corolla during the first day of anthesis, after that period it is bent downward and is cross-fertilized

by coming into contact with the pollinated back of a passing Anthophora in search of honey. There does not seem to be any provision for the self-fertilization of *P. Pentstemon.*

The longer of the dimorphic pistils of *Mertensia Virginica* (L) D.C. are of the same length as the stamens and may be self-fertilized by contact with the dehiscing anthers. The shortest of the other form do not reach beyond the end of the narrow tube, and are fertilized by honey-bees. Honey is secreted at the base of a tube 25 mm. long and is further protected by a pubescent ring 2 mm. above the receptacle. No insect was found on the flowers that could reach the honey in a legitimate way, but a big bumble-bee was seen on the corolla making slits in the tube just above the pubescent ring. Through the opening the tongue of the bee was inserted and the honey removed, with ease, as it passed rapidly from one flower to another.

A calendine poppy, *Stylophorum diphyllum* (Mich.) Nutt., under cultivation came into bloom April 23, early in the forenoon. At 3:40 p. m. the petals began closing and by sundown were completely folded over the stamens. Although it was raining the next day the petals under observation again opened in all their golden splendor. It was not clearly evident that the stamens of this plant were proterandrous, though the stigma greatly increased in size after the bud had opened. Usually the flowers did not wither under two days. Small bees were noticed crawling on the flowers, a single honey-bee was seen collecting pollen, and it is probable cross-fertilization was the result of their movements. Flowers protected by a net from insect visitors produced capsules of the normal size, well filled with seeds.

In July it was noticed that while the calendine poppy was producing an abundance of seeds none could be found on the ground under the plant. The seeds of a dehiscing capsule, which were placed in a heap on a small stone, all disappeared by next morning. When it was recalled that ants are known to carry small seeds into their nests they were suspected of carrying them away. This inference seemed probable, as the seeds were provided with a fleshy crest on one edge which an ant could grasp. At last a common black ant, about 6 mm. long, was seen with a seed in its mouth and watched until it disappeared in a round hole. Later an ant was followed to another hole. The mouth to these holes was level with the surface of the ground and not through the usual hillock of sand

of their nesting places. They were located 5 dm. from the stem of the plant, and when opened were found to be about 6 mm. deep. One of them was tunnelled along the edge of a rotten chip and contained seven seeds. The crest of one of the seven seeds was withered while the papillæ of the others were plump. Nothing was seen to indicate that they had been stored for food or that the crest contained anything they cared to eat.

Additions to the Indiana Flora.

Chas. C. Deam.

In addition to the species taken by myself, this list contains fourteen species I received through an exchange with L. M. Umbach, Napersville, Ill., and one from E. B. Williamson, Bluffton, Ind. I have a sheet of all the plants reported in my herbarium. My species have all been verified at the National Museum.

Panicum boreale Nash.

In the swales at Miller, Ind., June 28, 1898, by L. M. Umbach.

Panicum macrocarpa Le Conte.

Wells County, May 31, 1903; Steuben County, June 17, 1903; Dune Park, June 16, 1900, L. M. Umbach. September 4, 1901, by Agnes Chase.

Aristida intermedia Scribn. & Ball.

In moist sands at Miller, Ind., October 2, 1898, by L. M. Umbach.

Elymus glaucus Buckley.

In sand at Pine, Ind., June 29, 1898, by L. M. Umbach.

Eleocharis obtusa Schultes.

Wells County, August 23, 1897; Miller, Ind., July 20, 1898, by L. M. Umbach; Steuben County, July 3, 1904; Noble County, July 21, 1904.

Psilocarya nitens (Vahl.) Wood.

In sloughs at Dune Park, Ind., September 12, 1899, by L. M. Umbach.

Psilocarya scirpoides Torr.

In sloughs at Dune Park, Ind., September 2, 1898, by L. M. Umbach.

Carex oligosperma Michx.

In swales at Miller, Ind., June 24, 1898, by L. M. Umbach.

Carex aquatilis Wahl.

In sloughs at Pine, Ind., May 29, 1897, by L. M. Umbach.

Carex laxiflora varians Railey.

Wells County, May 13, 1903.

Carex festucacea Willd.

In swales at Clarke, Ind., June 4, 1898, by L. M. Umbach

Clintonia boreale (Ait.) Raf.

In swamp at Miller, Ind., May 14, 1898, by L. M. Umbach.

Salix Bebbiana Sarg.

In marsh at Clarke, Ind., May 7, 1898, by L. M. Umbach.

Salix amygdaloides Anders.

In marsh at Lake Station, Ind., May 12, 1900, by L. M. Umbach.

Chenopodium glaucum L.

In ballast at Miller, Ind., August 26, 1898, by L. M. Umbach.

Froelichia Floridana (Nutt.) Moq.

In ballast at Aetna, Ind., July 7, 1900, by L. M. Umbach.

Silene vulgaris (Moench.) Garcke.

In ballast at Pine, Ind., June 17, 1899, by L. M. Umbach.

Heuchera hirsuticollis (Wheelock) Rydb.

Steuben County, July 4, 1904.

Oxalis Brittoniae Small.

Wells County, September 1, 1904; Steuben County, September 9, 1904.

Oxalis grandis Small.

Orange County, May 25, 1901; Franklin County, May 28, 1904.

Ilex Bronxensis Britton.

Wells County, June 11, 1899; Steuben County, July 4, 1904.

Hypericum boreale (Britton) Bicknell.

Wells County, in low border of lakes in Jackson Township, September 6, 1903.

Viola papilionacea Pursh.

Wells County, in woods, May 3, 1903.

Helianthemum majus (L.) B. S. P.

On wooded gravelly hills in Steuben County, August 13, 1903.

Epilobium palustre L.

Wells County, August 18, 1901; Steuben County, August 13, 1903.

Bartonia ionandra Robison.

Steuben County, September 11, 1904.

Apocynum hypericifolium Ait.

Noble County, near Rome City, July 21, 1904.

Apocynum pubescens R. Br.

Kosciusko County, July 28, 1904.

Teucrium occidentale A. Gray.

Steuben County, in swamp near Gage Lake, August 12, 1903; Kosciusko County, in swamp on east side of Winona Lake, July 28, 1904.

Lycopus communis Bicknell.

Wells County, September 2, 1900; Steuben County, August 11, 1903.

Physalis heterophylla Nees.

Wells County, August 22, 1899; Steuben County, September 11, 1904.

Physalis Virginiana intermedia Rydb.

Steuben County, June 17, 1903.

Viburnum cassinoides L.

Steuben County, June 12, 1904, in clearing.

Triosteum arundinaceum Bicknell.

Wells County, May 22, 1898.

Chrysanthemum Balsamita L.

Adams County, September 20, 1903, by E. B. Williamson. Escaped.

Bidens vulgata Greene.

Wells County, September 4, 1904.

Carduus Hillii (Canby) Porter.

Steuben County, June 17, 1903. Only two specimens collected. On wooded hillside one-half mile southeast of Gage Lake.

Additions to the Flora of Marion County, with Notes on Plants Heretofore Unreported from the State of Indiana.

Benj. W. Douglass.

1. *Woodsia obtusa* Torr.
2. *Dulichium arundinaceum* Britton.
3. *Scirpus debilis* Pursh.
4. *Carex lupulina* Muhl.
5. *Carex comosa* Boott.
6. *Trillium sessile* L.
7. *Trillium erectum* L.
8. *Polygonum Virginianum* L.
9. *Allionia nyctaginea* Michx.
10. *Nymphæa advena* Soland.
11. *Nelumbo lutea* Pers.
12. *Caltha palustris* L.
13. *Delphinium trichorne* Michx.
14. *Clematis Viorna* L.
15. *Thalictrum dioicum* L.
16. *Berberis vulgaris* L.
17. *Jeffersonia diphylla* Pers.
18. *Arabis dentata* T-G.
19. *Cleome spinosa* L.
20. *Opulaster opulifolius* Kuntze.
21. *Comarum palustre* L.
22. *Rosa humilis* Marsh.
23. *Amelanchier Canadensis* Medic.
24. *Crataegus Crus-Galli* L.
25. *Robina pseudacacia* L.
26. *Meibomia nudiflora* Kuntze.
27. *Meibomia rigida* Kuntze.
28. *Lespedeza repens* Bart.
29. *Strophostyles helvola* Britton.
30. *Oxalis violaceae* L.
31. *Linum usitatissimum* L.
32. *Ptelea trifoliata* L.
33. *Euphorbia corollata* L.
34. *Euphorbia commutata* Engelm.
35. *Ilex verticillata* Gray.
36. *Vitis æstivalis* Michx.
37. *Hypericum prolificum* L.
38. *Hypericum sphærocarpum* Michx.
39. *Hypericum perforatum* L.
40. *Hypericum maculatum* Walt.
41. *Hypericum mutilum* L.
42. *Triadenum Virginicum* Raf.
43. *Viola tenella* Muhl.
44. *Cubelium concolor* Raf.
45. *Aralia racemosa* L.
46. *Panax quinquefolium* L.
47. *Thaspium barbinode* Nutt.
48. *Conium maculatum* L.
49. *Cicuta maculata* L.
50. *Cornus alternifolia* L.
51. *Nyssa sylvatica* Marsh.
52. *Hypopitys hypopitys* Small.
53. *Steironema quadriflorum* Hitchc.
54. *Diospyros Virginiana* L.
55. *Gentiana Audrewsii* Griseb.
56. *Ipomœa pandurata* Meyer.
57. *Hydrophyllum Virginicum* L.
58. *Hydrophyllum Canadense* L.
59. *Mertensia Virginica* D. C.
60. *Scutellaria cordifolia.*

61. *Koellia flexuosa* MacM.
62. *Koellia Virginiana* MacM.
63. *Lycopus Americanus* Muhl.
64. *Mentha spicata* L.
65. *Physalis Virginiana* Mill.
66. *Collinsia verna* Nutt.
67. *Mimulus ringens* L.
68. *Afzelia macrophylla* Kuntze.
69. *Gerardia tenuifolia* Vahl.
70. *Houstonia cærulea* L.
71. *Houstonia ciliolata* Torr.
72. *Triosteum perfoliatum* L.
73. *Lobelia spicata* Lam.
74. *Nabalus altissimus* Hook.
75. *Vernonia Noreboracensis* Willd.
76. *Solidago Canadensis* L.
77. *Euthamia graminifolia* Nutt.
78. *Antennaria plantaginifolia* Richards.
79. *Gnaphalium obtusifolium* L.
80. *Dysodia papposa* Hitchc.
81. *Erechtites hieracifolia* Raf.
82. *Mesadenia atriplicifolia* Raf.
83. *Senecio aureus* L.

New State Plants.

Tradescantia breviscaulis Raf.

Short stemmed spiderwort. Growing on hillsides near Alliance, Marion County.

Tradescantia bracteata Small.

Long bracted spiderwort. Found in similar localities to the last and associated with it.

Thlaspi arvense L.

Penny Cress. On R. R. near Indianapolis. Rare.

Sisymbrium altissimum L.

On R. R. near Broad Ripple, Marion County. Rare.

Camelina microcarpa Andrz.

Waste fields near Fair Grounds at Indianapolis.

Physostegia parviflora Nutt.

Western Lion's Heart. Along White River at Broad Ripple, Marion County.

Solanum Torreyi A. Grey.

Dry fields, Hancock County. Spreading. Reported to me by Jacob Schramm.

Houstonia tenuifolia Nutt.

Slender leaved Houstonia. Dry hills in northern part of Marion County.

Additions to the List of Gall-Producing Insects Common to Indiana.

Mel T. Cook.

Two years ago the writer presented a list of forty species of gall-producing insects common to Indiana. One year ago an additional list of eleven species was presented to the Academy. It was at first intended to make as complete a list as possible and then to give a more extensive discussion of these very interesting insects and the abnormal growths produced by them. However, a change of residence has made a change of plans necessary.

The following is a list of species which have come to my attention within the past year and previous to my leaving Indiana.

Hemiptera.

52. *Pemphigus vagabundus* Walsh.—*Populus deltoides* Marsh.
53. *Hamamelistis spinosus* Shimer. *Hamamelis Virginiana L.*

Diptera.

54. *Cecidomyia clavula* Beut. *Cornus florida* L
55. *Cecidomyia cerasi-serotinae* O. S. *Prunus serotinae* Ehrh.

Hymenoptera.

56. *Amphibolips prunus* Walsh. *Quercus sp.* .....
57. *Cynips pisum* Fitch. *Quercus alba* L.
58. *Dryophanta radicola* Ashm. *Quercus alba* L.
59. *Neuroterus rileyi* Bassett. *Quercus prinus* L.
60. *Rhodites radicum* O. S. *Rosa carolina* L.
61. *Rhodites dichlocerus* Harris. *Rosa carolina* L.
62. *Rhodites globulus* Beut. *Rosa carolina* L.

Arachnida.

63. *Acarus serotinae* Beut. *Prunus serotina* Ehrh.

Nos. 52, 56 and 60 were sent to me by Mr. F. C. Senour, of New Augusta, Indiana. The others and also specimens of No. 52 were collected by me near Greencastle, Indiana.

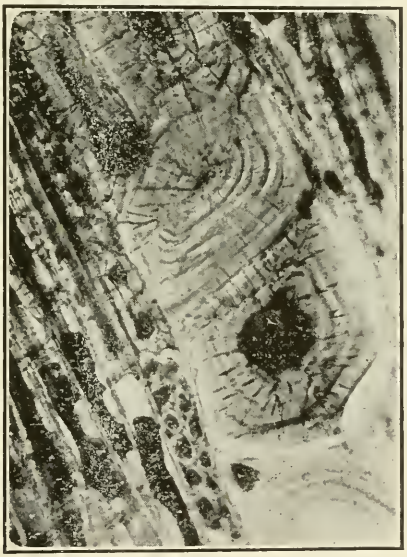
We have now a list of sixty-three species, representing twenty-five genera and five orders of insects, including Arachnida. The host plants represent eleven orders, fourteen families and eighteen genera.

Tyloses in Brosimum Aubletii.

Katherine E. Golden.

The wood of Brosimum Aubletii has been given various common names, as leopard-wood, letter-wood, and snake-wood, on account of the mottled appearance of part of its heartwood. It is a very hard, compact wood, dark brown in color, and has part of the heartwood beautifully mottled with black. The mottling is due to the sclerenchymatous tyloses which fill its tracheæ.

The wood is composed of a mass of fine fibres, nearly round in transverse section, and arranged in fairly regular radial rows. The fibres are flattened tangentially when adjoining either parenchyma cells or

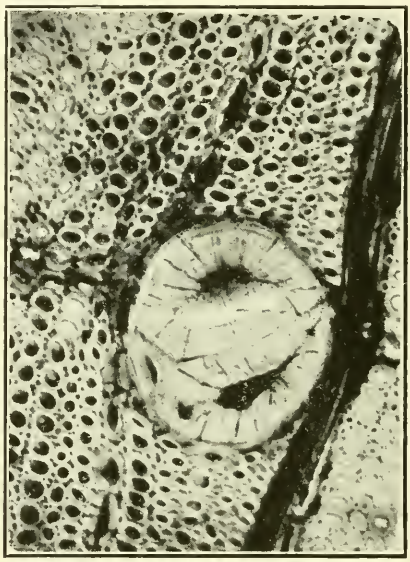


Leopard-wood. Tang. Sect. (x 300)

tracheæ. The tracheæ are scattered promiscuously throughout the fibres, either singly or in groups of two to four. They are finely pitted, and consist of vessels and tracheides. Parenchyma occurs around the tracheæ, sometimes in single rows, sometimes irregularly grouped, also in tangen-

tial lines, and in regular radial rows, having blind ends, as they seem to start and to stop anywhere. The tangential rows branch, the branches running into other rows or joining with the cells around tracheæ. Sometimes the tangential and radial rows are so regular that they give the wood a cross-barred appearance.

The medullary rays consist of very narrow, long cells, the long diameter running in a radial direction. They are from one to four cells wide, the more common number being two. They are from about fifteen to fifty cells in height, though an accurate count could not be made, due to the presence in every ray of larger sclerenchymatous cells. One or more of these sclerenchymatous cells, having fairly thick walls, occur in



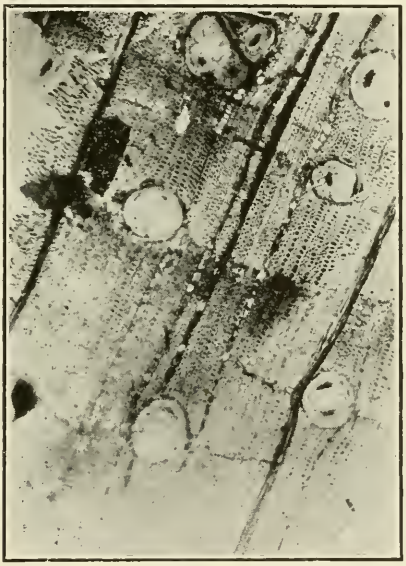
Leopard-wood. Trans. Sect. (x 300)

each ray, either at the end or throughout its height. In all cases a sclerenchyma cell occupies the place of two to four of the regular parenchyma cells and seems to be the result of the merging of a number of the parenchyma cells. They are seen to best advantage in the tangential section.

In a similar way the radial rows of parenchyma, though as regular in their formation as the rays, are easily distinguished from the rays by their greater size and sclerenchymatous walls.

All the elements of the wood, including even the wood fibres, have their lumina filled with a brown to black solid coloring matter. The walls of the elements are not impregnated with the color, and consequently stand out distinctly, so that their peculiarities are easily observed.

The chief peculiarity of Leopard-wood is the presence of sclerenchymatous tyloses. Thyloses or tyloses, as they are more commonly called, are ingrowths of parenchymatous cells into the cavity of the tracheæ. When a trachea is adjoined by parenchyma, the parenchyma retains its protoplasm after the trachea becomes empty; as the parenchyma exerts pressure on the non-resistent walls of the trachea, the parenchyma pushes into the cavity of the trachea through a pit or weak spot, forming a short



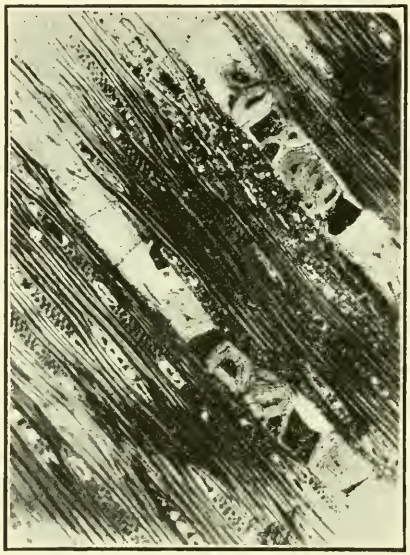
Leopard-wood. Trans. Sect. (x 80)

tube. The tube may be the only one at that part of the trachea, or there may be so many that there is a series of tubes lining the entire cavity. These ingrowths may make no further progress, but the more common method of development is the formation of a wall at the junction of the tracheal wall, cutting off the ingrowths. These ingrowths may then carry on cell division, forming a mass of parenchyma filling the lumen of the trachea. Tyloses form in many Dicotyledons as a regular phenom-

enon, and without the occurrence of any injury to stimulate growth. They form in pitted tracheæ usually, though in some one-year old stems they form in fibrously thickened tracheæ without any perforations.

The walls of the tyloses are delicate at first, but they afterwards thicken somewhat, and their cellulose walls become lignified like the rest of the wood parenchyma.

In Leopard-wood the tyloses have their walls so strongly thickened that the cells resemble the stone cells in pears. Nearly all the tracheæ are filled with them, rarely is there found a portion of a trachea without



Leopard-wood. Tang. Sect. (x 80)

them. The stone cells are irregular in shape, and are packed closely together, usually one being sufficient to fill the lumen transversely, though sometimes two and three are wedged together across the lumen. The walls vary considerably in thickness, some having their lumina entirely obliterated, while in close proximity to them may be others with fairly large lumina. In all of them the thickening of the walls is in well-defined layers, the layers sometimes separating from each other. All the walls are provided with fine canals, radiating from the central lumen, sometimes branched, and in all, the canals of adjoining cells corresponding.

The tyloses give the wood a characteristic appearance under the microscope. This can be seen in the photographs, though much of the beauty is lost with the loss of color.

Boulger (1) in his valuable work on wood mentions the sclerenchymatous tyloses of the Leopard-wood, and in describing the gross structure of the wood, states that the sapwood is yellow, and that the tree has heartwood squaring twenty inches, though only six inches show the characteristic mottling. This would seem to indicate that even if all the heartwood had tyloses form, not all become sclerenchymatous.

Leopard-wood. Rad. Sect. (x 80)

The wood is used in this country in the manufacture of musical instruments, and only the mottled wood is prized. Pieces of the mottled were all that I was able to obtain, so I had no way of determining anything in regard to the tyloses in the sapwood or unmottled heartwood.

The formation of tyloses through the activity of the parenchyma, can be readily understood, but nothing is known as to the cause of this activity in some woods, while in other woods tyloses are never formed. Then again in most woods investigated nothing definite as to time of formation is known. DeBary (2) states that in Robinia pseudacacia tyloses form in

the autumn in the wood formed the previous spring, and that this is true, also, of other woods, but nothing definite as to their occurrence or absence is known. Further investigation is necessary to determine the facts relative to tyloses other than their structure and seemingly haphazard occurrence.

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1. Boulger, G. S. Wood, 1902.
2. DeBary, A. Comparative Anatomy, 1884.

Some Experiments with a Simple Jolly Balance.

Lynn B. McMullen.

In presenting a paper of this kind before the Academy of Science I think it is well to point out that the research work of the high school teacher must be "re"search work indeed—must be research work backward instead of forward. If I might be allowed to read you a parable I should remind you that some fifty, or perhaps sixty, years ago our grandfathers came to Indiana to do research work of a bread-winning character. But those grandparents had brothers, who, through necessity or lack of years, were compelled to stay at home and take care of the real little folks. I take it that the same thing is true of the members of this Academy. Some, usually those of the colleges, are able to do research work. Others, particularly those of the high schools, must expend their energies in the perfecting of details.

Those of us that remember our college course in Physics hold the old Jolly balance, with which we wrestled, in much awe. Certainly no piece of apparatus could be more perverse. The spring being stationary at the top and entirely free at the bottom would take its time in coming to rest and its distance from the meter stick gave parallax an excellent opportunity to do its worst. Further, as the spring stretched the table must be moved, and the table was usually stuck. It is easy to see *now* that the conversion of the Jolly balance from a rogue to a useful citizen depended upon some device for stretching the spring "up" from a stationary bottom instead of "down" from a stationary top. It is the purpose of this paper to explain one such device and to present data showing the accuracy that may be obtained by using it.

The base of the balance is a Sapolio box 6x9x12-in. mounted on leveling screws and weighted with a brick. To the front of the box is screwed an upright standard four feet long. This standard is made by nailing to the face of a piece of poplar ½x2-in. two strips ¼x½-in. leaving a groove between them 1-in. wide and ¼-in. deep in which a meter stick may slide freely. To the upper end of the meter stick is fastened a string which runs over a pulley at the top of the standard. The other end of this string is tied to the end of a large horizontal screw which runs through the side of the box with sufficient friction to hold the meter stick in any desired position. From the top of the meter stick at right angles to it

projects an arm two inches long to the end of which the spring is attached. From the lower end of the spring is suspended an indicator of the form shown in figure 1, with the usual pans below. The shelf shown in figure I upon which the point of the indicator rests when not in use is made of sheet brass and is fastened to the column one foot from the lower end. Tacked to one of the side strips immediately below this shelf so that it projects over the meter stick slightly is a small metal plate

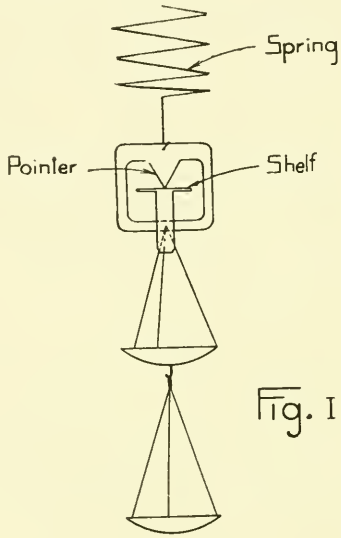


Fig. I

bearing a horizontal scratch. The distance from the top of the meter stick to this scratch can be read with considerable accuracy to the tenth part of a millimeter. Below this shelf slides a table upon which vessels of water, etc., can be placed. To use the apparatus the spring must first be calibrated. Incidentally, Hooke's law may be verified. To do this a reading of the distance from the top of the stick to the scratch is taken when the spring is so adjusted that the pointer barely swings clear of the shelf, no load being in the pans. A load of one gram is then added and the spring is stretched,—by raising the meter stick with the before mentioned cord and screw—until the pointer clears the platform again. The distance from the top of the meter stick to the scratch is again read. The difference between the two readings gives the elongation for a load of one gram. For ordinary work this elongation should be about five

centimeters. With such a spring it is seen that a load of .002 grams will cause an elongation of .1 of a millimeter.

The following tables of data and results obtained by using this simple Jolly balance are self explanatory. They are given not because of any new principle contained in them, but because of the extreme accuracy shown—accuracy seemingly out of all proportion to the care with which the apparatus was constructed.

HOOKE'S LAW AND THE MODULUS OF THE SPRING.

Load.	No Load Reading.	Reading with Load.	Elongation.	E/L.
1 g.	54.96 cm.	60.14 cm.	5.18 cm.	5.18
2	54.96	65.33	10.37	5.18(5)
3	54.96	70.51	15.55	5.18(3)
4	54.96	75.66	20.70	5.17(5)
5	55.00	80.90	25.90	5.18(0)
	Modulus = L/E = .193.		Mean	5.180

DENSITY OF A STEEL BICYCLE BALL.

No Load.	Load.	Elongation.
54.97 cm.	83.95 cm.	28.98 cm.
54.97	83.93	28.96
55.00	83.97	28.97

Mean elongation = 28.97.

Mass = elongation × modulus = 5.591 g.

Diameter by micrometer screw caliper = 1.1115 cm.

Volume .7189 cc.

Density = M/V = 7.78 g. per cc.

PRINCIPLE OF ARCHIMEDES.

Ball in Air.	Ball in Water.	Decrease.
82.98 cm.	79.32 cm.	3.66 cm.
82.99	79.30	3.69
83.00	79.34	3.66

Mean decrease in elongation = 3.67

Loss of weight in water .708 g.

Volume of ball from preceding experiment .718 cc.

Volume of water displaced by the ball .718 cc.

Weight of water displaced by the ball .718 g.

The weight of the water displaced by the ball differs from the loss of weight by 1.4 %. The accuracy may be increased by using aluminum instead of steel.

Specific Gravity of an Irregular Solid.

No Load.	Aluminum in Air.	Aluminum in Water.
54.07 cm.	88.36 cm.	75.70 cm.
54.07	88.38	75.69
54.08	88.38	75.69

Elongation in air 34.31 cm.
Elongation in water 21.62 cm.
Decrease in water 12.69 cm.
Specific gravity of aluminum 2.70.

Specific Gravity of Solids Lighter than Water.

No Load.	Paraffin in Air.	Paraffin and Aluminum in Water.
54.01	67.23	73.39
54.01	67.25	73.37
54.00	67.24	73.38

Elongation due to paraffin in air 13.23 cm.
Elongation due to both in water 19.37 cm.
Elongation due to aluminum in water 21.61 cm.
Elongation due to paraffin in water —2.25 cm.
Loss by paraffin in water 15.48 cm.
Specific gravity of paraffin = .854.

Specific Gravity of Liquids.

No Load in Ether.	Aluminum in Ether.
54.26 cm.	79.01 cm.
54.26	79.00
54.27	79.00

Elongation due to aluminum in air 34.31 cm.
Elongation due to aluminum in ether 24.74 cm.
Decrease in ether 9.57 cm.
Decrease in water 12.69 cm.
Specific gravity of ether .754.

Besides these, two other experiments can be performed in a very satisfactory manner, namely, "The Surface Tension of Water" and "The Distribution of Magnetism in a Bar Magnet."

Newtonian Idea of the Calculus.

Arthur S. Hathaway.

The history of the calculus shows that even a mathematical theory cannot escape the effects of environment. Sir Isaac Newton was for many years the sole possessor of a knowledge of the calculus, and used it with a power which few have been able to equal since his time; yet he has had practically no influence on its present form of development. This was due to Newton's dislike for controversy, so that instead of contending for his ideas, he let them appear only in concise and general form, or even not at all. With the exception of his first two papers on optics, "all of his works were published only after the most persistent solicitations of his friends, and against his own wishes." The criticism which would have aroused an ambitious man to a vigorous defense, had the opposite effect on his disposition. "I was so persecuted," he wrote, "with discussions arising out of my theory of light, that I blamed my own imprudence for parting with so substantial a blessing as my quiet to run after a shadow."

Newton was well versed in the method of fluxions, and the inverse method, that is in differentiation and integration, by the year 1666. In 1669 he circulated a manuscript on the subject among his friends, but refused their solicitations to have it published, and it was not until 1693 that it was communicated to the scientific world by Wallis, in the second volume of his works. During this interval of a quarter of a century, Newton had changed his ideas in important respects, through extensive use of the calculus. He had developed his Theory of Light, discovered the Binomial Theorem, determined the Law of Gravitation, and the Principles of Dynamics, and made important investigations in all departments of mathematical and physical science.

Although the *Principia*, which appeared in 1687, contained no direct information on the calculus, yet its fundamental ideas and principles were involved in every detail of the work. The development of the *Principia* is due to the calculus, but Newton undertook the laborious task of translating everything into the elementary geometrical methods of the time and omitted many results which he had obtained by the calculus, because he could not so interpret them. Many things have been discovered since his time that were afterwards found in his papers

and correspondence, and he left many undemonstrated theorems, whose proofs baffled succeeding mathematicians for 50, 100, and even 200 years.

The *Quadrature of Curves*, published in 1704, and the *Principia*, are the proper sources for Newton's matured ideas on the calculus, and not his earlier manuscript, published by Wallis. The earlier paper adopts the infinitesimal method of neglecting small quantities which is now associated with Leibnitz's calculus, not, however, with the latter's disregard of logic, but in connection with the idea of a limit which is the modern foundation of that method.

Newton states in the *Quadrature of Curves* that "in mathematics the minutest errors are not to be neglected." Also,

"I consider mathematical quantities in this place, not as consisting of very small parts, but as described by continuous motion. Lines are described and thereby generated, not by the apposition of parts, but by the continued motion of points; superficies by the motion of lines; solids by the motion of superficies; angles by the rotation of sides; portions of time by continual flux; and so on in other quantities. These geneses really take place in the nature of things and are daily seen in the motion of bodies."

He then goes on to define fluxions, or as we would now call them, differentials:

"Fluxions are as near as we please, as the increments of fluents, generated in times which are the same and as small as possible, and to speak accurately, they are in the prime ratio of nascent increments; yet they can be expressed by any lines whatever which are proportional to them."

Newton immediately illustrates this definition by the abscissa and ordinate of a curve, whose differentials are shown to be any corresponding increments of abscissa and ordinate along the tangent line. This, and numerous similar illustrations in the *Principia*, show that Newton meant by the ultimate ratio of vanishing quantities, *the limit of the ratio of any finite proportionals to the vanishing quantities.* See, for example, Princ. Bk. 1, Lemma 1, Art. 12. "Ultimate Ratio of Vanishing Quantities." Also, Lemmas 7, 8, 9. Newton did not consider the modern question as to whether or not this ratio was definite, and the answer to that question *is not pertinent to his definition.* In other words, differentials can exist when such ratio is indeterminate. Translated into its exact modern equivalent, his definition is:

Corresponding differentials are, as near as we please, proportionals to corresponding and indefinitely small increments of variables, and to speak accurately, they are corresponding limits of such proportionals.

The power and generality of this definition can only be understood after a careful study of its consequences. It applies whatever the number of independent variables. It is the mathematical foundation of Newton's conception of the state of change of variables, in which corresponding differentials are made to signify corresponding increments. In other words, corresponding increments of *a state of change of variables* are as near as we please, proportionals to corresponding and indefinitely small increments of the variables.

As an illustration of the method, consider $z = xy$, and as usual, let $\triangle x$, $\triangle y$, $\triangle z$, denote any corresponding increments of x, y, z. Then, $\triangle z = x \triangle y + y \triangle x + \triangle x \cdot \triangle y$

Let N be a variable number which becomes indefinitely large in any way whatever (as $N = 1, 2, 3, 4$, and so on indefinitely). Conceive $\triangle x$, $\triangle y$, to diminish as N increases, so that their proportionals, $N \triangle x$, $N \triangle y$, remain finite and approach limits designated by dx, dy ($\triangle x = dx / N + 8 / N^2$, $\triangle y = dy / N + 5 / N^2$, for example). Then if dz denote the limit of the remaining proportional $N \triangle z$, the equation from which it is to be determined is $N \triangle z = x N \triangle y + y N \triangle x + N \triangle x \cdot \triangle y$, which gives, by the theorems of limit, $dz = xdy + ydx$.

Here, the ratio dz / dx is absolutely indeterminate, since it depends upon the values chosen for dx, dy.

Leibnitz rediscovered the calculus in 1676, and immediately published his methods and spread them over Europe. His right to the title of independent discoverer was disputed by the friends of Newton, because when Leibnitz was just turning his attention to mathematics in 1673, he visited London and consulted some manuscripts of Newton. Leibnitz's defense is that he did not see the manuscript on the calculus, and his notes taken at the time, and afterwards discovered, contain only references to Newton's papers on optics. It is fortunate in respect to notation that we have received the calculus from the hands of Leibnitz rather than Newton; but the history of the calculus, from Leibnitz on, revolves about objections to his infinitesimal methods. In order to avoid those methods, Lagrange recast the calculus into practically its present form. He regarded the differentials of the independent variables as their small actual increments, and the differential of a dependent variable as that part of its increment which is of first degree when it is expanded in ascending powers of the

independent increments. In his method, the principle quantities were the differential coefficients, and if z were a function of x, y, he wrote

$$dz = \frac{dz}{dx}\,dx + \frac{dz}{dy}\,dy$$

where dz/dx was a whole symbol for the coefficient of dx in dz, and not the quotient of dz by dx; and similarly for dz/dy.

This idea was not received with favor, partly because it made the calculus depend upon expansions in series, whereas, one important feature of the calculus was the determination of such expansions.

At present, we have a derivative calculus, with a differential notation, in which differentials have significance only in quotient forms; in fact the derivative is Lagrange's differential coefficient, and the two terms are used interchangeably. The student is taught that the quotient form is an inseparable symbol, but the notation, and the calculus itself, eventually require their separation. The explanations which have been devised for such separation of inseparable symbols are sometimes remarkable. The method of rates is simply to define the derivative dy/dx as the rate at which y is changing, and dy, dx, as any quantities whose ratio is dy/dx. This is not the same as Newton's method, who makes dy the amount which y changes in its state of change when x changes by dx, and thence dy/dx is the change of y per unit change of x. It *does* matter whether we make differentials the prime quantities, and thence deduce the significance of their ratios, or whether we make the ratios the prime quantities, and thence deduce differentials. For, two variables can have differentials, with no ratio that is *definite*, i. e., independent of the values of the differentials themselves.

In a calculus in which the derivative is the prime quantity, the differential notation creates numerous *artificial* difficulties which would be eliminated by a proper derivative notation; but this would limit the scope of the calculus and alter many of its time-honored developments. Nor is it necessary to make a change of notation, because the present notation is made completely significant by Newton's definition.

When we consider the weight that attaches to the name of Newton, it would seem that his views on the calculus were worthy of being considered, even today. When we add that he is the original inventor, and that his fundamental idea of the differential is the very one that is needed to give the differential calculus an intelligent and rigorous mathematical basis, it is certainly time that he came into his own.

Conditions for the Deformation of Surfaces Referred to a Conjugate System of Lines.

Burke Smith.

When a surface is subjected to a series of deformations, each form that it assumes during the deformation may be thought of as a separate, distinct surface. We may thus regard a deformation of a surface as a continuous system of surfaces, each representing some form into which the original surface may be deformed. In this paper we consider the problem of determining those surfaces which may be deformed so that a conjugate system of lines will still remain a conjugate system after the deformation is carried out.

We shall suppose that the equations of the surfaces that we consider are given in the form,

$$x = f_1(\mu, \nu), \qquad y = f_2(\mu, \nu), \qquad z = f_3(\mu, \nu),$$

and that the first and second fundamental magnitudes are E, F, G and D, D′, D″, respectively.

If S_2 represents the form that S_1 takes when deformed so that a conjugate system remains a conjugate system, then S_2 is applicable on S_1. But the necessary and sufficient condition that two surfaces should be applicable on each other is that they shall have the same lineal element and the same total curvature.

If the parametric lines, $\mu = \text{const.}$, $\nu = \text{const.}$, on S_1 and S_2 form a conjugate system, then $D' = o$ for both S_1 and S_2. Since S_1 and S_2 must have the same lineal element and the same curvature, we have from the relation,

$$K = \frac{D\,D''}{EG - F^2}$$

that $D_2 = \lambda D_1$ and $D_2'' = \lambda D_1''$ where the subscripts refer to S_1 and S_2 respectively, and λ is a function of μ and ν. To determine λ we make use of the fact that Codazzi's equations must be satisfied for both S_1 and S_2. Bianchi* has thus shown that λ must satisfy the equations,

$$\frac{\delta}{\delta\mu}\left(\frac{1}{\lambda}\right) = -\left\{\begin{matrix}12\\2\end{matrix}\right\}'\left(\frac{1}{\lambda} - \lambda\right)$$

*"Vorlesungen über Differential-Geometrie," p. 336.

(1)
$$\frac{\delta}{\delta v}(\lambda) = -\left\{ {12 \atop 1} \right\}' \left(\lambda - \frac{1}{\lambda} \right)$$

where $\left\{ {12 \atop 1} \right\}'$ and $\left\{ {12 \atop 2} \right\}'$ are the symbols of Christoffel formed with respect to the Gauss sphere. Since now $\frac{\delta^2 \lambda}{\delta u \, \delta v} = \frac{\delta^2 \lambda}{\delta v \, \delta u}$ we have from (1), as the condition of integrability,

$$(2) \quad \lambda^2 \left[\frac{\delta}{\delta v} \left\{ {12 \atop 2} \right\}' - 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' \right] = \left[\frac{\delta}{\delta u} \left\{ {12 \atop 1} \right\}' - 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' \right]$$

Having given the surface S_1, then to every value of λ which satisfies (1) and (2) there corresponds a surface S_2 of the desired type.

There are three possible cases that may occur under (2). Suppose, first, that the surface S_1 is such that

$$(\mathrm{I}) \qquad \frac{\delta}{\delta v} \left\{ {12 \atop 2} \right\}' = 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' = \frac{\delta}{\delta u} \left\{ {12 \atop 2} \right\}'$$

In this case the condition of integrability (2) is satisfied for every value of λ, and since equations (1) are of the first order, there are in this case ∞^1 surfaces S_2 which are applicable on S_1 and such that their parametric lines form a conjugate system. We thus have in this case a continuous system of surfaces, and the above equations are the necessary and sufficient condition that a surface may belong to such a system.

Suppose, next, that S_1 is such that

$$(\mathrm{II}) \qquad \begin{array}{ll} \frac{\delta}{\delta v} \left\{ {12 \atop 2} \right\}' = 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' & \frac{\delta}{\delta v} \left\{ {12 \atop 2} \right\}' \neq 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' \\ & \text{or,} \\ \frac{\delta}{\delta u} \left\{ {12 \atop 1} \right\}' \neq 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' & \frac{\delta}{\delta u} \left\{ {12 \atop 1} \right\}' = 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' \end{array}$$

In this case λ vanishes or is undefined, and the condition of integrability is not satisfied. Consequently there exists no surface S_2 in this case.

Suppose, finally, that

$$(\mathrm{III}) \qquad \begin{array}{l} \frac{\delta}{\delta v} \left\{ {12 \atop 2} \right\}' \neq 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' \\ \frac{\delta}{\delta u} \left\{ {12 \atop 1} \right\}' \neq 2 \left\{ {12 \atop 1} \right\}' \left\{ {12 \atop 2} \right\}' \end{array}$$

We have in this case one, and only one, value for λ^2. If the surface S_1 is such that in addition to (III) being satisfied, (1) are also satisfied, then

there is one, and only one, surface S_2 which represents the result of deforming S_1 so that a conjugate system remains a conjugate system after the deformation.

There are two cases which may occur under (III). Suppose that

$$(\mathrm{III_a}) \qquad \frac{\delta}{\delta v}\left\{\begin{matrix}12\\2\end{matrix}\right\}' = \frac{\delta}{\delta \mu}\left\{\begin{matrix}12\\1\end{matrix}\right\}'$$

Then $\lambda = \pm 1$ and the surface S_2 is such that its second fundamental magnitudes D_2 and D_2'' are either equal to the corresponding magnitudes D_1 and D_1'' of S_1 or they are the negatives of D_1 and D_1''.

But from the equations (*)

$$\frac{\delta x}{\delta \mu} = \frac{D}{eg - f^2}\left(-g\frac{\delta X}{\delta \mu} + f\frac{\delta X}{\delta v}\right)$$

$$\frac{\delta x}{\delta v} = \frac{D''}{eg - f^2}\left(f\frac{\delta X}{\delta \mu} - e\frac{\delta X}{\delta v}\right)$$

Where e, f, g are the fundamental magnitudes of the Gauss' sphere, it is seen that a change in the sign of D and D'' corresponds to a change of sign in the co-ordinates x, y, z of the surface, and therefore the surface S_2 is either identical with S_1 or it is symmetrical to S_1 with respect to a plane or to the origin of co-ordinates.

Suppose next that

$$(\mathrm{III_b}) \qquad \frac{\delta}{\delta v}\left\{\begin{matrix}12\\2\end{matrix}\right\}' \neq \frac{\delta}{\delta \mu}\left\{\begin{matrix}12\\1\end{matrix}\right\}'$$

In this case there is a unique value of $\lambda^2 \neq 1$. S_1 may therefore be deformed so that after the deformation is carried out the lines $\mu =$ const., $v =$ const., form a conjugate system, although they do not form a conjugate system at any time during the deformation. Now, by a theorem of Dini, (**) from relation ($\mathrm{III_b}$) no surface S_0 exists, the spherical images of whose asymptotic lines are the same as the spherical images of a conjugate system of lines on S_1. But from the definition of associate surfaces, there is then no surface to which S_1 is associated, and thus we have the result that when ($\mathrm{III_b}$) is true for any surface S_1 referred to a conjugate system, there exists no surface S_0 to which S_1 is associated.

(*) Bianchi, l. c. p. 134.
(**) Bianchi, l. c. p. 125.

A Family of Warped Surfaces.

C. A. Waldo.

Derivation of the general equation of all warped surfaces having two distinct rectilinear directrices and its application to a few special cases.

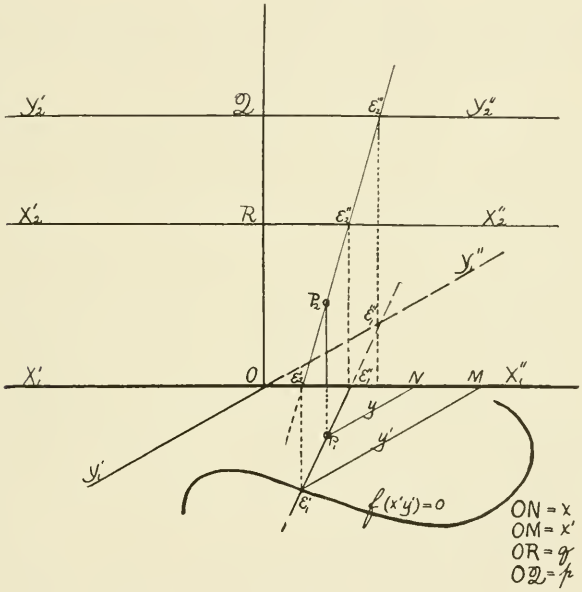


Fig. 1.

Let the surface be defined by the three directrices

$$x = O, \ldots\ldots z = p,$$
$$y = O, \ldots\ldots z = q,$$
$$f\,(x'y') = O, \ \ldots\ldots z = O.$$

The curve $f\,(x'y') = O$ lies in the plane $z = O$, the X and Y axes are parallel to the rectilinear directrices; the Z axis includes the common perpendicular to the rectilinear directrices, unless otherwise specified.

In the diagram Fig. 1, let $X'\,X''$ be one straight line directrix at the distance q above the plane $z = o$, $Y'\,Y''$ the other at p above $z = o$. Their horizontal projections will be the X and Y axes of reference.

Let (x, y, z) be any point P on the warped surface, and $E' E'' E'''$ the rectilinear element containing it.

Let $O M = x'$, $O N = x$, $O R = q$, $O Q = p$.

Then by similarities and projections the following equations exist:

$$\frac{x'}{x} = \frac{E'''_1 E'_1}{E'''_1 P_1} = \frac{E'''_2 E'_2}{E'''_2 P_2} = \frac{p}{p-z}, \quad x' = \frac{p x}{p-z}$$

Similarly, $$y' = \frac{q y}{q-z}$$

Substituting these values of $x' y'$ in $f(x' y') = o$, there results the corresponding functional equation,

$$f\left(\frac{p x}{p-z}, \frac{q y}{q-z}\right) = o,$$

which is the equation in Cartesian co-ordinates X, Y axes general, Z axis perpendicular to X and Y of the warped surfaces as defined above and includes *every* warped surface with two distinct rectilinear directrices. For its application it requires that a section of the surface should be known parallel to the right-line directrices and not including either of them. This general surface is referred directly to the orthogonal projections of two warped lines in space upon a plane parallel to both, and to their common perpendicular. The angle at which the lines intersect is implicitly contained in the equation of the surface. The form of the equation of the surface does not change, therefore, when the surface itself is deformed by changing the angle in space of the right line directrices, provided the form of the equation of the plane curve directrix remains unchanged.

It is also at once evident that the method derives immediately the Cartesian equation of the warped surface determined by the fact that an element cuts a curved directrix, a linear directrix and is parallel to a given plane. This is equivalent to saying that one of our parameters p, q, remains finite while the other becomes indefinitely great.

For simplicity suppose the three axes always at right angles to each other unless otherwise specified.

The Hyperbolic Paraboloid.

(a) Let $f(x' y') = x' - y' = O$.

Then $f\left(\frac{p x}{p-z}, \frac{q x}{q-z}\right) = \frac{p x}{p-z} - \frac{q y}{q-z} = o.$

Let $p = 1$, $q = -1$

Then $x + xz - y + yz = o.$

Rotate the xy axes through $\pi/4$, then the zx axes in the same way, and there results the well known equation,

$$x^2 - z^2 = 2y.$$

(b) Let $f(x'\,y') = x'\,y' - c = o.$

Then $f\left\{\frac{p\,x}{p-z}, \frac{q\,y}{p-z}\right\} = \frac{p\,x}{p-z}\,\frac{q\,y}{q-z} - c = \frac{p\,x}{p-z}\,\frac{y}{1-\frac{z}{q}} - c = o.$

Let $p = 1$ and q become indefinitely great,

Then $xy = c\,(1-z)$.

Rotate the zy axes through $\pi/4$, let $c = 1$ and

$1 - z = Z$,

Then $x^2 - y^2 = 2Z$.

Compare this operation and result with the next.

The Hyperboloid of One Sheet.

Let $f(x'\,y') = x'\,y' - c = o$

as above $\frac{p\,x}{p-z}\,\frac{q\,y}{q-z} = c.$

let $p = 1$, $q = -1$

Then $xy = c\,(1 - z^2)$.

Rotate xy axes through $\pi/4$, let $c = 1/2$.

Then $x^2 - y^2 + z^2 = 1$.

A Cubic Surface with Parabolic Sections.

Let $f(x'\,y') = y'^2 - x' = o.$

Then $f\left\{\frac{p\,x}{p-z}, \frac{q\,y}{q-z}\right\} = \frac{q^2\,y^2}{(q-z)^2} - \frac{p\,x}{p-z} = o.$

a. Let $p = 1$ and $q = -1$. Then

$y^2\,(1-z) = x\,(1+z)^2$, one of the cubical warped surfaces.

b. Let $p = 1$, $q = \infty$, then $y^2\,(1-z) = x$.

c. Let $q = 1$, $p = \infty$, then $y^2 = x\,(1-z)^2$.

Biquadratic Surface with Hyperbolic Sections.

Let $f(x'\,y') = x'^2 - y'^2 - c = o$

Then $f\left\{\frac{px}{p-z}, \frac{qy}{q-z}\right\} = \frac{p^2x^2}{(p-z)^2} - \frac{q^2y^2}{(q-z)^2} - c = o$

a. Let $p = 1$, $q = -1$, $c = 1$

Then $x^2\,(1+z)^2 - y^2\,(1-z)^2 = (1-z^2)^2$

b. Let $p = 1$, $q = \infty$, $c = 1$

Then $x^2 - y^2 (1 - z)^2 = (1 - z)^2$

c. Let $p = \infty$, $q = 1$, $c = 1$

Then $x^2 (1 - z)^2 - y^2 = (1 - z)^2$

Biquadratic Surface with Elliptical Sections.

Let $f(x' y') = x'^2 + y'^2 - c = o$

Then $f\left\{\frac{px}{p-z}, \frac{qy}{q-z}\right\} = \frac{p^2 x^2}{(p-z)^2} + \frac{q^2 y^2}{(q-z)^2} - c = o$

a. Let $p = 1$, $q = -1$, $c = 1$

Then $x^2 (1 + x)^2 + y^2 (1 - z)^2 = (1 - z^2)^2$

Here the volume between rectilinear directrices is exactly that of a sphere of radius one.

b. Let $p = aq$, $c = 1$

Then $\frac{x^2}{\left(1 - \frac{z}{aq}\right)^2} + \frac{y^2}{\left(1 - \frac{z}{q}\right)^2} = 1.$

Circular sections are at $z = o$ and $z = \frac{2\,aq}{1 + a}$.

The planes $z = o$, $z = q$, $z = \frac{2\,aq}{1 + a}$, $z = aq$ divide every transversal harmonically. In particular every element is divided harmonically by the circular sections and the rectilinear directrices.

c. Combining the last two surfaces and letting $p = aq$,

$$\frac{x^2}{\left(1 - \frac{z}{aq}\right)^2} \pm \frac{y^2}{\left(1 - \frac{z}{q}\right)^2} = C$$

Solve for sections parallel to the xy plane and of the same eccentricity:

$m\left(1 - \frac{z}{aq}\right) \pm \left(1 - \frac{z}{q}\right)$ which gives

$z = \frac{aq\,(m - 1)}{m - a}$ and $z = \frac{aq\,(m + 1)}{m + a}$ for similar conic sections.

It is then easily seen that the four planes,

$z = q,$

$z = \frac{aq\,(m - 1)}{m - a}$

$z = aq,$

$z = \frac{aq\,(m + 1)}{m + a},$

divide any transversal harmonically.

d. In the most general form with elliptic sections:

Let $p = 1$, $q = \infty$, $c = 1$.

Then $x^2 + (1 - z)^2 y^2 = (1 - z)^2$, the equation of Wallis's Conco-Cuneus, or the ship carpenter's wedge.

e. Assume case a. The central section at $z = o$ is a circle. Deform the surface by rotating one directrix about the Z axis any angle less than $\pi/2$. The section $z = o$ will now be an ellipse referred to its equi conjugate diameters. The form of the equation of this section will not change; also the form of the equation of the deformed surface will be invariant.

Order of the Resulting Warped Surfaces.

Let $f_n (x\ y)$ represent a homogenous algebraic expression involving x and y and of the nth degree.

In the fundamental demonstration,

1. Let $f(x'\ y') = f_1 (x\ y) - c = o$.

   If x and y are both present, the corresponding warped surface is of the 2d order.

   If x or y is absent, the resulting surface is a plane.

2. Let $f(x'\ y') = f_2 (x\ y) + f_1 (x\ y) - c = o$.

   x^2 and y^2 both present, 4th order.

   x^2 or y^2 absent, other terms present, 3d order.

   x^2 and y^2 both absent, xy present, x and y present or one or both absent, 2d order.

3. Let $f(x'\ y') = f_3 (x\ y) + f_2 (x\ y) + f_1 (x\ y) - c = o$.

   x^3 and y^3 both present, 6th order.

   x^3 or y^3 absent, other terms present, 5th order.

   x^3 and terms involving x^2 absent; or, y^3 and terms involving y^2 absent, 4th order,

   x^3 and y^3 both absent, other terms present, 4th order.

   x^3, y^3, and xy^2 and terms involving y^2 absent, other terms present; or, x^3, y^3, and x^2y and terms involving x^2 absent, other terms present, 3d order.

To deduce the general law of order of the resulting scrolls, construct Fig. 2. Within the squares are present all the powers and combinations that can occur in a complete equation in x, y, of the 5th degree. The numbers at the intersections of the lines show the order of the resulting scroll provided at least two terms remain in our original $f(x', y') = o$, one

of which lies in a square two sides of which converge in the angle in question, or one of the two terms lies in a square bounded above and to the right by one of the lines converging at the angle, the other in a square

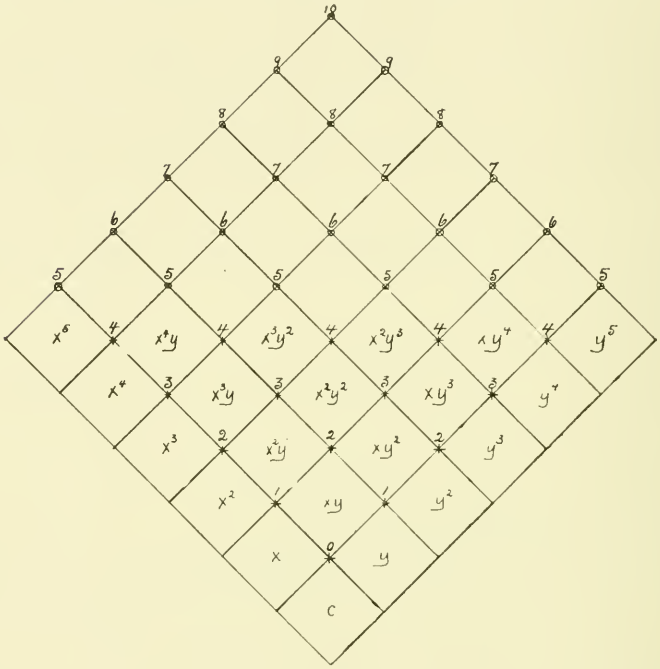


Fig. 2.

bounded above and to the left by the other line making the angle. Thus below one of the points marked 5 is found the term x^3y^2. This term joined with any or all others lying between the lines converging at that particular 5, will yield a scroll of the 5th order.

So also we will have a scroll of the 5th order if we select x^2y^2 on one side and x^3 on the other side of the space bounded by the lines converging at the same point 5.

At the middle point of the whole of Fig. 2 is a vertex marked 4. The following groups can be arranged for the equation of the curvilinear directrix, but in every case the resulting scroll will be of the 4th order.

1. x^2y^2 and c present, xy present or absent,
2. x^2y^2 and c present, and other terms present besides x y,

3. x^2y and xy^2 present, other terms present or absent,

4. x^2y and y^2 present, other terms present or absent (or xy^2 and x^2),

5. x^2 and y^2 present, other terms of lower degree present or absent.

1 and 2 are built from 4th degree terms and the resulting equation is only the 4th.

3, has two 3d degree terms present, scroll 4th.

4, one term 3d degree, other 2d, scroll 4th.

5, built from second degree terms, scroll 4th.

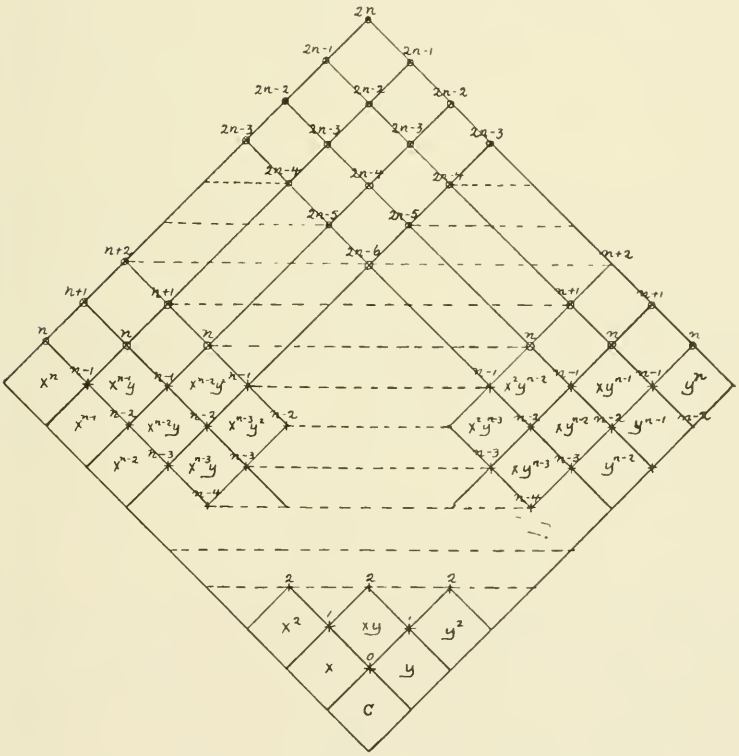


Fig. 3.

Fig. 3, shows at once the order of the resulting scroll when the equation of the curvilinear directrix is marked by the presence or absence of certain specified terms.

Double Generation.

The law of double generation is simply stated. Two straight lines are chosen parallel to the plane of the curvilinear directrix, the three giving rise to a scroll of a certain equation. Suppose two other straight lines can now be found parallel to the plane of the curvilinear directrix and intersecting the first two rectilinear directrices. Suppose the use of the second pair of lines gives exactly the same equation as the first two, then the surface is one of double generation. For example, $x' y' = c$. Substitute $\frac{px}{p-z}$ for x' making $p = 1$ and $\frac{qy}{q-z}$ for y' making $q = -1$. There results $\frac{xy}{(1+z)(1-z)} = c$; now make $p = -1$ and $q = +1$. The same equation results. In fact these are the two generations of the hyperboloid of one sheet.

It then becomes at once apparent that all scrolls are doubly generated whose curvilinear directrix has for its equation a function of the product term (xy), the plane of the curvilinear directrix being parallel to the rectilinear directrices. Thus the first of the five 4th scrolls order mentioned above, viz.: the one having x^2y^2 and c, and perhaps x y terms in the equation of the curvilinear directrix is a scoll of double generation.

It is not at once evident that the property discussed above is coextensive with all the doubly generated warped surfaces in the family under discussion. Such surfaces may also depend upon other properties not yet discovered.

General Observations.

It is evident that the validity of the demonstration does not require the axis of Z to be the common perpendicular between the two rectilinear directrices. If the Z axis connects the two directrices in question and passes through the middle point of their common perpendicular, it follows at once that the demonstration proceeds as before by parallel instead of orthogonal projection.

If we conceive the three axes of reference, under the restrictions just given, to be oblique to each other, we find the resulting equations are still in their simplest forms. In the surfaces of the second order the axes would then be conjugate axes. In surfaces of higher order the axes of reference would play the part of conjugate axes.

It will frequently happen that the equation of a scroll will be sought whose three directrices are given as above, viz., two rectilinear and one plane curvilinear directrix, but the latter in some plane not parallel to the two former lines.

In this case additional means should be given for writing the equation of the surface under the new conditions. It will then be easy to find a section parallel to the two right-line directrices and the problem then is solved by the process discussed in this paper.

A modification of the method here discussed finds the equation of a scroll given by two rectilinear directrices and a plane section of the surface, the section being oblique to a plane parallel to the two given straight lines

An Investigation of N-Rays.

R. R. Ramsey and W. P. Haseman.

This paper is an account of an attempt of the authors to repeat the experiments of R. Blondlot in which he has discovered that there is an invisible radiation given off from an Auer (Welsbach) burner, Nernst lamp and other sources.

Blondlot was investigating the polarization of X-rays (Comptes Rendus, Feb. 23, 1903) and using a feeble spark gap as a detector. He thought he had discovered that the X-rays were polarized in certain planes. In a few days (Comptes Rendus, March 23, 1903) he was convinced that the effects were due to other rays than X-rays. In May of the same year (Comptes Rendus, May 11, 1903) an article by Blondlot appeared, entitled, "Rays from an Auer Burner." An ordinary Welsbach burner (Auer burner) was surrounded with an iron chimney in which a window was cut and closed with an aluminum sheet .1 mm. thick. The radiation from this window was allowed to fall on the little spark gap and the intensity of the light from the spark was seen to increase. By means of a quartz lens Blondlot was able to detect four different wave lengths. The intensity of the spark gap is found to have four maximums as it is moved to and fro along the principal axis of the lens.

A week later (Comptes Rendus, May 25, 1903) Blondlot published an article in which he gave a list of various sources of N-rays and several means of detecting them, the chief ways being the little spark gap; a sheet of silver heated to a very dull redness by a little gas flame; a small phosphorescent screen which has been feebly excited by sunlight or other source.

The intensity or brilliancy of these detectors was found to increase when the radiation falls upon them. In this article Blondlot calls the new rays N-rays, from the town of Nancy, his home.

In a short time afterward Blondlot published an article in which he found that a Nernst lamp with an aluminum window is a good source. He also found that certain substances store up N-rays when they are exposed to N-rays and give off the rays afterward. Among those that store up the rays are quartz, stones and brick. Wood, aluminum, paper,

dry or wet, and paraffin do not store up the rays. He found that one of the essential conditions of a substance that stores up the rays is dryness. It is found that bricks exposed to sunlight become a source for hours afterward.

While experimenting along this line Blondlot discovered an unexpected effect. While viewing a strip of white paper which was feebly illuminated, a brick which had been exposed to sunlight was brought near the eye and the outline of the paper became more distinct. The intensity diminished when the brick was removed. A clock face which seemed a grey patch on the wall became clearly outlined and the hands visible when a brick was brought near the eye. Water intercepts the radiation, in fact, Blondlot used dampened paper as screens in his work. Salt water transmits the rays. An ox eye was transparent and became a secondary source. Hyposulphite of soda in solid or solution is found to be a powerful accumulator. Blondlot has found that compressed glass, wood, etc., emit N-rays and cause the phosphorescent screen to become more luminous. A bent cane near the head caused a clock to become more visible. Unbending the cane caused the clock to disappear. Tempered objects, such as files, knife blades, hammered brass, had the same effect, as also did a knife blade from an ancient tomb. The rays are emitted from nearly every strained object. In fact F. E. Hackett (Roy. Dublin Soc. Trans. 8, 10, pp. 127-138, Sept. 1904), the only English speaking person who is sure he has observed the effect, recommends the use of cork or wood under pressure as a source.

In the early part of the present year Blondlot finds that he has been dealing with two distinct kinds of radiation. N-rays cause the calcium sulphide screen to become more luminous, while the second radiation, or N_1-rays cause the normal intensity to decrease. N-rays cause the normal intensity from the screen to increase, while N_1-rays cause the tangential radiation of the screen to become more luminous.

Photographs have been published which show a greater effect on the plate under the influence of the N-rays than that without. For these photographs, in every case, the light from the little spark gap is used. A. Charpentier has found that the human body is a source of N-rays, the intensity being greater near the nerve centers. The spinal column can be traced by means of the screen. Certain parts of the brain give off the rays abundantly. The intensity being greatly augmented when the brain is active. Charpentier can see himself think. To refute those who

say the phenomenon is one of heat Charpentier has placed frogs on ice and lowered their temperature below that of the screen and shown that the cold frog is still a source.

Charpentier describes experiments in which N-rays are conducted along wire. Two phosphorescent screens are attached on the ends of a wire, length in one case 300 cm. N radiation is allowed to fall on one screen and the screen on the other end is seen to become more luminous. The N-rays are found by Charpentier to have the property of increasing the intensity of certain odors: ammonia, acetic acid, etc.

E. Meyer has found that plants emit N-rays. Certain substances while going into solution become sources. The electrolyte of a Le Clauche cell has been found to be a strong source after the cell has been short-circuited.

One curious fact about N-rays is that up to very recently at least, every successful experimenter has been a Frenchman.

Numerous short articles have appeared explaining the phenomena as one of heat or as one due to psychical phenomena.

Although we so far, like many others, have not been successful, we thought an account of our attempts was worthy of mention.

It was evident after a number of preliminary trials that the eye could not be relied upon to detect the variation in a feebly luminous source of light. The rays are produced by a Welsbach burner shut up in an iron pipe about 50 cm. long, 10 cm. in diameter with walls 1 cm. thick. The pipe is pierced by a window about 5 cm. long and 2 cm. in width

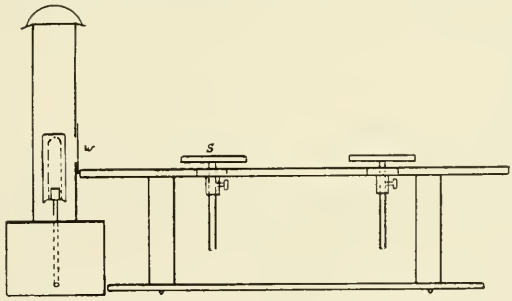


FIG. 1

and closed by some black paper, and a sheet of aluminum 16 mm. thick. The general arrangement of the apparatus is that shown in Fig. I. The

rays are supposed to pass through the window *W* and fall on some feebly luminous object such as a heated platinum wire or a calcium sulphide screen at *S*. Both the platinum wire and the sulphide screen were used and when viewed by the eye through ground glass at various angles and positions relative to the source nothing definite was noticed. The feebly luminous spot at times apparently brightened, then moved around in a circle and went through a series of displacements. This proved that nothing definite can be arrived at by viewing directly with the eye.

The most reliable method of recording the action of a feebly luminous source is photography. With this method, direct and indirect vision is eliminated, as well as the error due to the increased sensitiveness of the eye after being in the dark for some time. A number of photographs were taken, on Seed's regular "gilt edge" plates, with the light from a heated platinum wire, a luminous calcium sulphide screen, and a feeble spark.

The Platinum Wire.

The platinum wire was a very thin strip cut from a piece of foil .03 mm. thick, so that in no place was the wire more than .05 mm. broad. Only one place along it was allowed to be heated and the approximate breadth of this place was .03 mm. The wire was heated by a current approximately .9 amperes from three or five Edison-Lalande batteries. In some of the latter experiments a storage battery was used. The relative position of the different parts of the apparatus is shown in Fig. II.

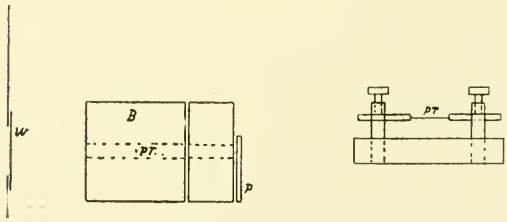
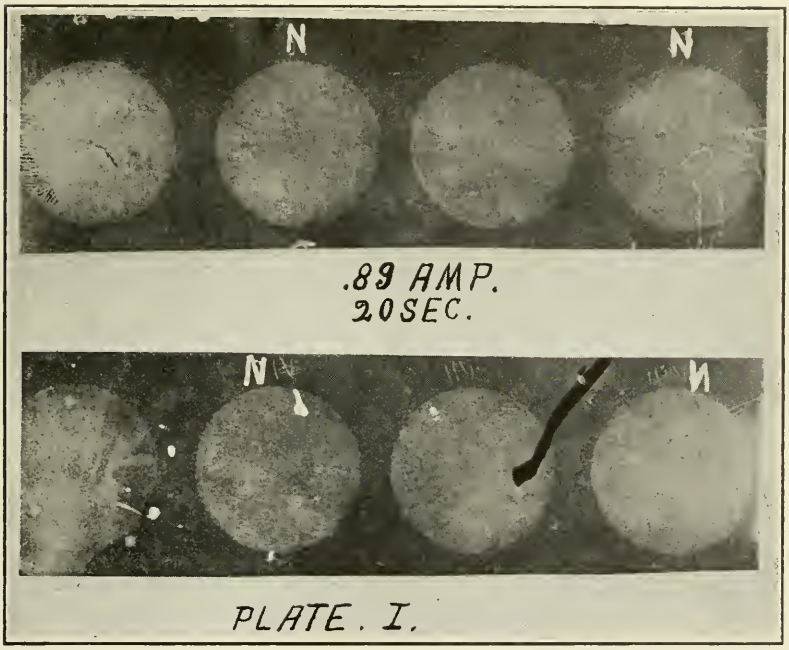


FIG. II.

B is a cardboard box in which is placed the platinum wire. The platinum wire is soldered to two copper wires which are fastened to a

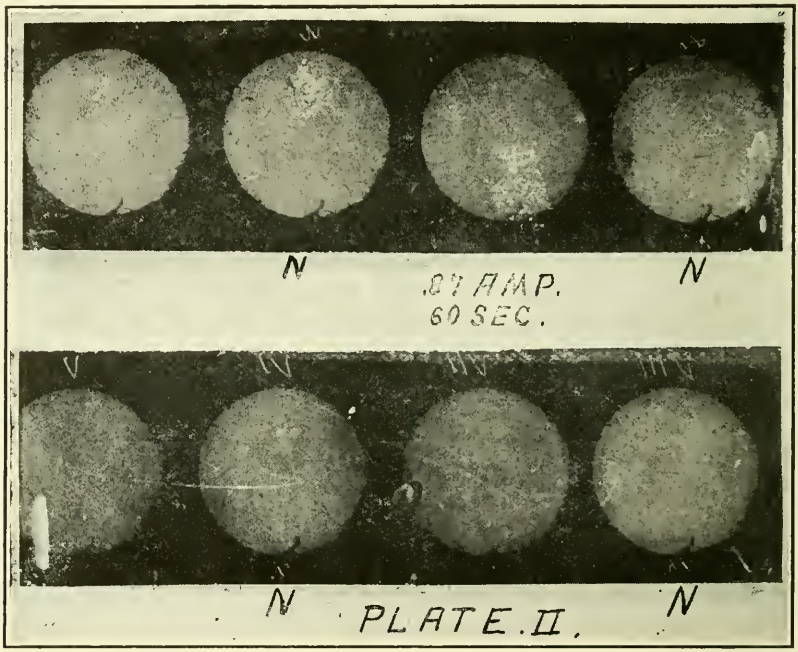
wooden block by two binding posts in order to make connection with the battery. The photographic plate was so mounted back of a block of wood about 25 cm. long, 14 cm. wide and 4 cm. thick with a hole 2½ cm. in diameter that it could be slid past the opening and a number of exposures made upon one plate.



The first two photographs taken with the apparatus just described with the time of exposure and current as indicated. There is very little if any difference between those marked N and the others. Those marked N are exposures without a lead screen inserted between the source and the platinum wire.

Calcium Sulphide.

The calcium sulphide is the luminous sulphide as prepared by E. H. Sargent & Company, Chemists, of Chicago. The sulphide was spread on a cardboard with mucilage and excited by sunlight. A tin can was placed around the iron pipe and aluminum window placed in the tin can. With this arrangement some of the external heating effects were eliminated.



Photographs III and IV were taken with the sulphide screen parallel to the aluminum window so that the rays must fall on the back side of the screen while their effect was photographed from the front side. Photograph III was taken with the sensitive plate about 4 cm. from the screen while IV was less than 1 cm. and in no case was the sulphide screen more than 25 cm. from the source. In III the exposures were alternated so that 2, 4, 6 and 8 were exposed to all radiations that might come from a Welsbach burner and pass through an aluminum window, while 1, 3, 5 and 7 were taken when a lead screen was placed

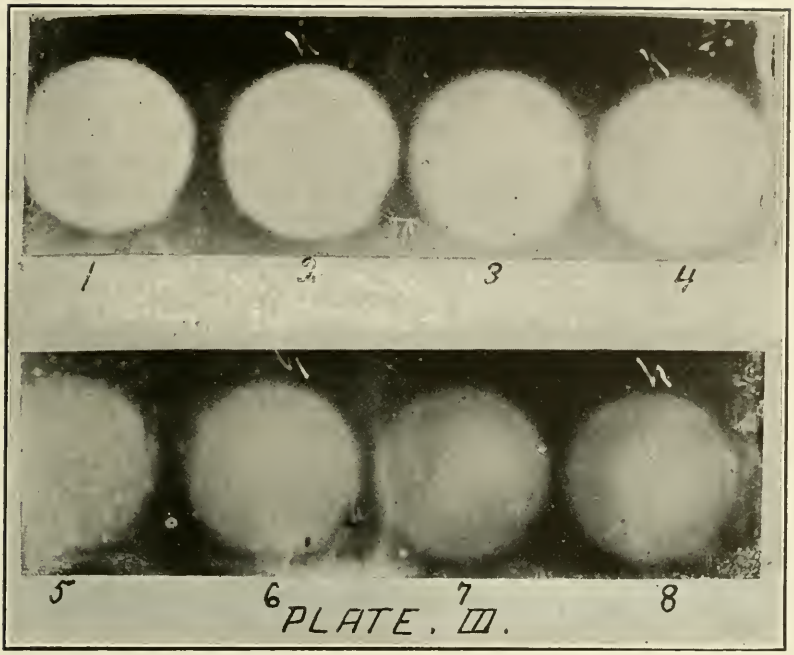


PLATE. III.

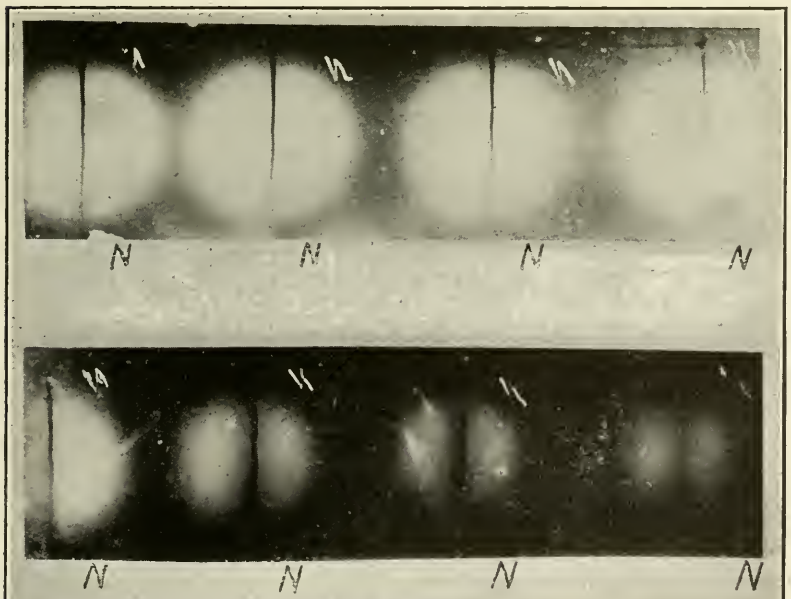


PLATE. IV

between the source and sulphide screen. In the photographs it is seen that there is a gradual decay in the luminous intensity of the screen, and if there is any radiation coming from the burner, in no case is it sufficently intense to overcome the decay or even make the rate noticeably different.

Photograph IV was taken by exposing one-half of the luminous screen to the radiations while at the same time the other half, which was screened from them by lead, was exposed. The arrangement is similar to that shown in Fig. III.

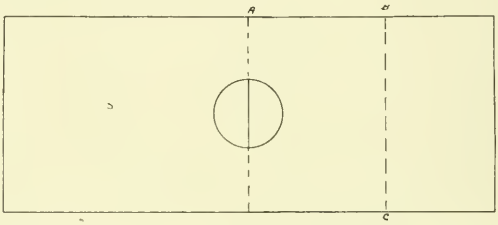


FIG. III

S is a large lead plate 1 mm. thick with a circular opening in the center, on the back of which is fastened the sulphide screen. In the line A D across the opening is a lead strip projecting 2 or 3 mm. foward. A B C D is a small lead plate on the back side of the larger one, covering one-half of the opening. With this arrangement sixteen exposures were taken on one plate and a direct comparison can be made. In the sixteenth

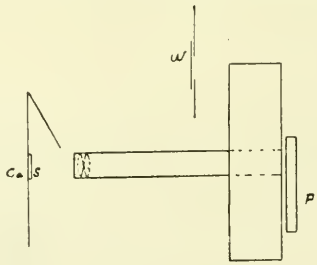
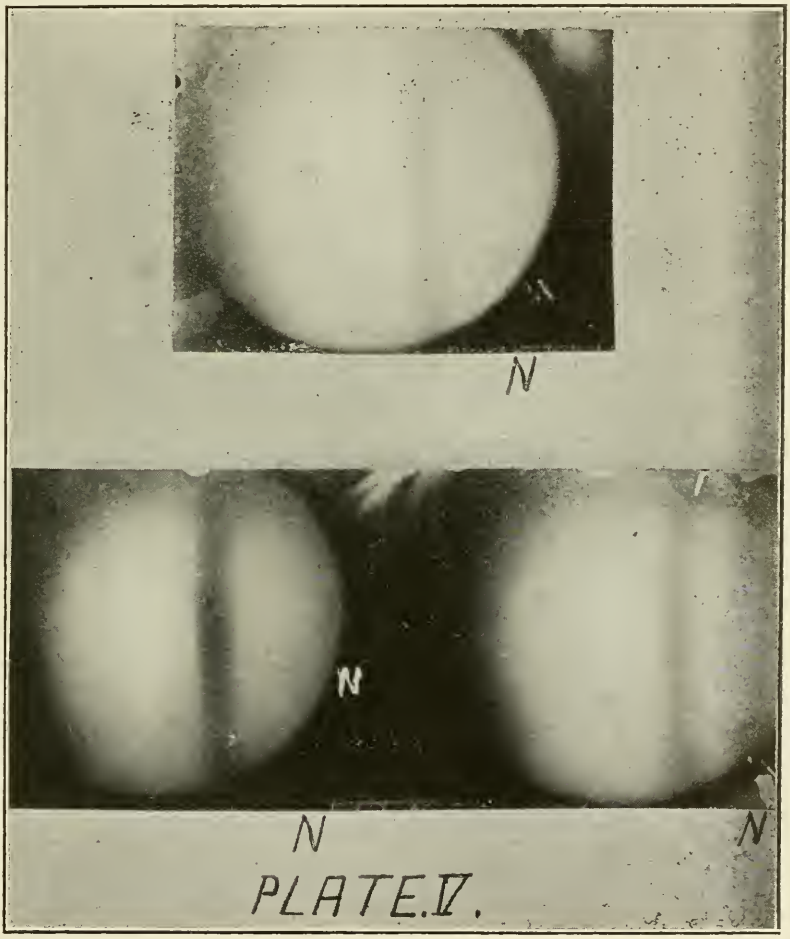


FIG. IV.

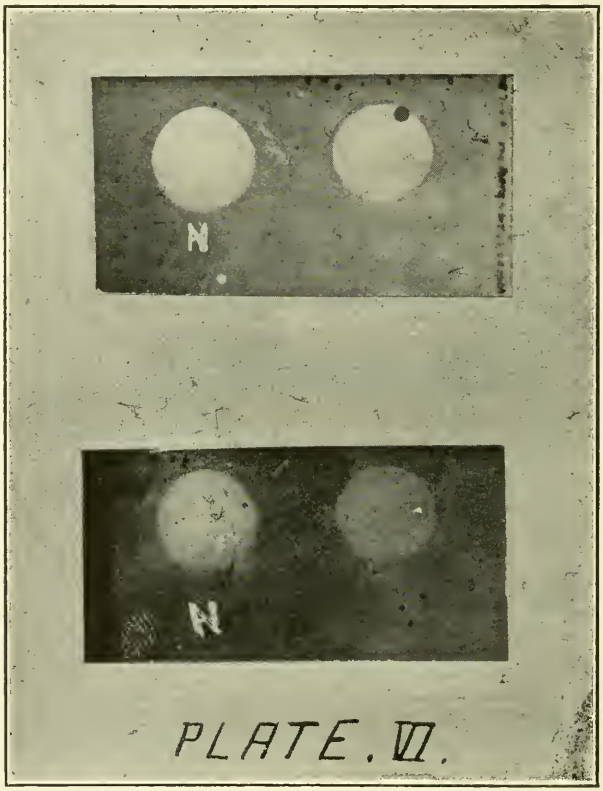
there is not much difference between the half marked N and the half not marked at all.

Photograph V is taken with the aid of convex lenses, focussing the light from the sulphide screen on the plate; by means of a lead plate,



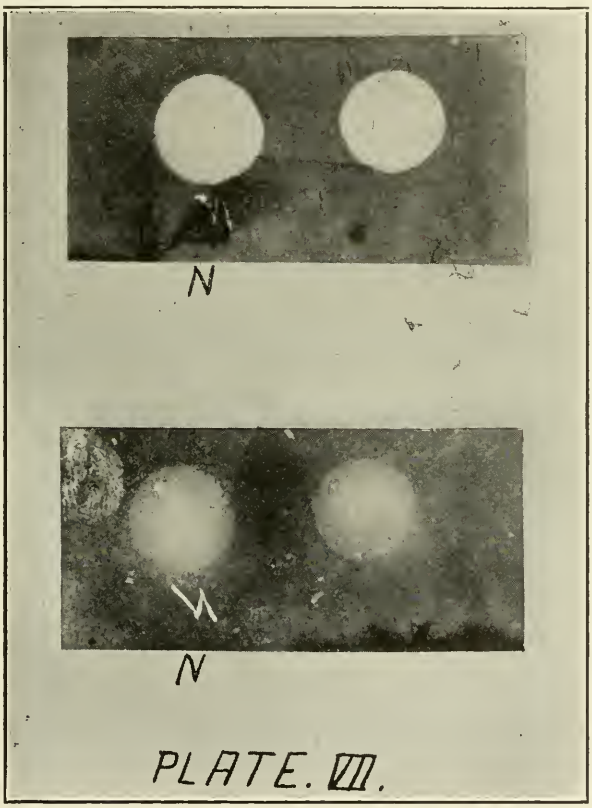
one-half of the luminous screen was screened from the source in such a manner as is shown in Fig. IV. A black strip of paper is pasted across the center of the screen to mark the halves of the luminous sulphide.

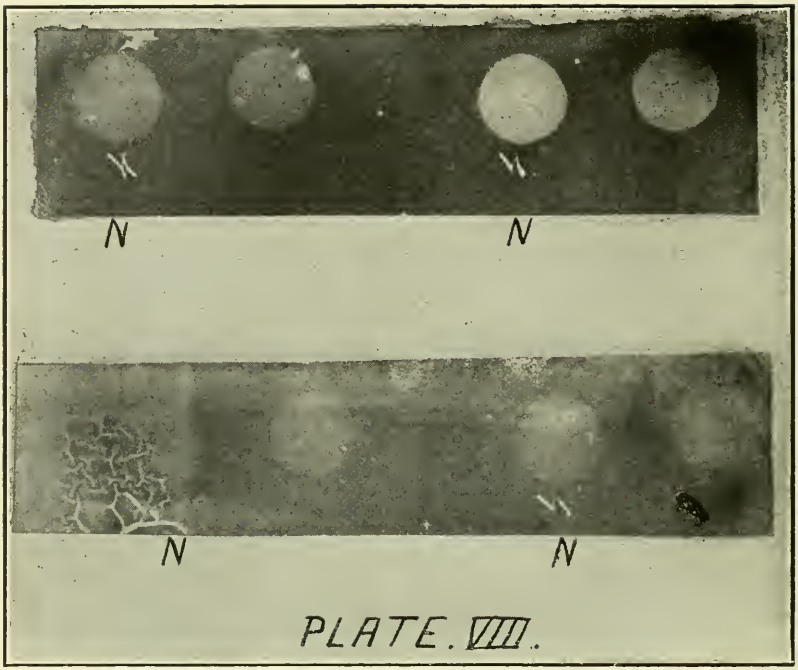
Photograph VI is a trial plate to investigate the effect of various times of exposures. The exposures marked N are seen to be slightly darker on the negative. This seems to indicate that there is a slight effect from the radiations of the Welsbach burner. Photographs VII and VIII



are to show whether or not VI is due to a radiation. VII shows similar results to VI and is taken under similar conditions. It was thought that it might be due to heat, and to prove this a lead plate was placed against the tin can, where it became heated. Exposure VIII is made with the radiation cut off by the lead plate suspended between the source and sulphide screen and shows similar results to VI and VII. The exposures

marked N are the denser on the negative, not because of a radiation falling on the corresponding side of the screen, but because of heat or of initial conditions of luminosity. The arrangement of apparatus for these three photographs is shown in Fig. V.





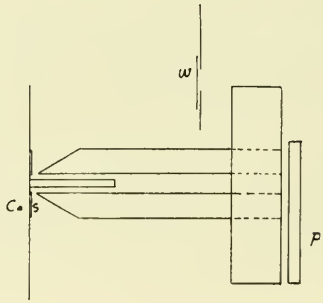


FIG. V.

FEEBLE SPARK.

The apparatus used was as described in Blondlot's work. The results were negative and only two photographs taken, both of which are given in plate IX and X. The intensity of the spark was that given by a

spark between two rounded ends of platinum wire ½ mm. diameter separated a small fraction of a mm. The potential at the spark gap was not

N

PLATE. IX.

N

PLATE. X.

great enough to spark a distance of ¼ mm. While working with this apparatus a phenomenon occurred which shows how easily constant errors may influence the result. The lead screen used to intercept the radiation was suspended by cords to the top of the iron lamp chimney so as

to be easily and noiselessly swung in and out of the path of the radiation from the window. It was noticed that when the lead was interposed the intensity of the spark gap as seen through the ground glass diminished considerably and increased again when taken away. This was what we were looking for. Of course we thought that after weeks of vain effort we were to be rewarded. After changing our apparatus a little the results were just the reverse of what we expected. We also noticed the character of the sound of the vibrator of the induction coil changed in unison with the intensity. A little investigation showed that a slight pressure anywhere on the table would produce the same effect. It seemed that the vibrator was vibrating about a point of nearly unstable equilibrium. A slight change of level of the table caused the vibration to be different and thus cause a different intensity of the spark. The weight of the screen as it was swung to and fro was enough to change the level of the table, which was an ordinary wooden one set solidly on a concrete basement floor.

A three-glower 220 volt Nernst lamp was substituted for the Welsbach lamp. The results were the same as before.

Our results are all negative. After experimenting for some months and appreciating the difficulties and the various psychial phenomena that may enter we are tempted to believe, as some others do, that the various French physicists have been misled. On the other hand, when we consider that the experimenters on this phenomenon have world-wide reputation, we can not think that such men as Blondlot, Charpentier, or Becquenl would rush into print on a subject of which they were not absolutely certain, especialy on one that has been called in question by noted physicists.

It is our intention to remodel our apparatus in certain respects and continue the investigation.

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The Apache Medicine Ceremonies Performed Over the Daughter of C 30.

Albert B. Reagan.

C 30's daughter, near Fort Apache, Arizona, was very sick, so the chief medicine men of the clan, having used every other remedy known to their profession, decided to use the Gunelpieya Disk performances (described in the Indiana Academy of Science for 1903) and the Medicine Ghost Dance as a remedy to make her well. This remedy is the last medical resort known to the Apache Indians. They believe that it will either cure the patient or, if he dies, will prepare him for the Happy Hunting Ground. It belongs to the faith cure side of the Apache medical practice. The Gunelpieya Disk performances are day-time ceremonies, the Medicine Ghost Dance is always performed at night. The former always immediately precedes the latter.

Having decided what to do, the medicine men set about to do it at once.

In a sheltered sunny spot they made a canvas enclosure about thirty feet in diameter. The enclosed area being then leveled, they drew a medicine disk in it some sixteen feet in diameter. This disk they decorated in concentric rings with several symbols of their gods; the sun, rainbows, deer, bird, and gods or Gunelpieya, represented by the figures of men. These they drew on the ground in various colors, the coloring material being prepared as follows: The black from groundup charcoal; the red from pulverized red sandstone; the yellowish-white from crushed limestone; and the green from groundup leaves.

The disk being completed the Gunelpieya cermonies began. The oldest grandmother present, in this case, Chinda by name, came into the canvas enclosure, walked to the center of the disk with cattail flag pollen, sprinkled each of the symbolic figures of the disk with cattail flag pollen, the sacred meal of the Apaches, called by them "Hottendin." She then took a cup partly filled with water and, beginning with the outer rainbow circle, the outer figure of the disk thus drawn, she walked around on each concentric circle, both space and bow, from the rim of the disk to its center, stooping before each sacred object to gather a pinch of dust

from it. This dust she put in the cup which she carried in her hand. Having completed her dust gathering, she prayed for a moment to the four great gods that are holding up the four corners of the earth; then set the cup down in the center of the disk and took her departure.

As soon as grandma commenced to take her leave, the sick girl entered the enclosure and, as she was too weak to walk, they carried her around each concentric circle from the outer rim of the disk to its center, placing her on the sun drawing with her face turned toward the evening sun. At this moment the musicians, who had seated themselves within the canvas enclosure in the space between the canvas and the disk, began to chant in the minor key:

"Kaws′ ah tun′-nee yah′ osh′ kah′
Kaws′ ah tun′-nee yah′ osh kah′
Kaws′ ah tun′-nee yah′ osh kah′
Kaws′ ah tun′-nee yah′ osh kee′ yah′.
Yah′ dethith′-be′-zhe′
Pair-ris′ kee-kay′ ed-dee-teen′
Tsot′ un-tzhon′-nee
Bair′ in-dah′ klee′-dal-ash′
Yah′ ed-dee-teen′ oo′ bair′ tzhon′-nee
Nod′-o-tash′ yo′ e′ hay′ nay′."

Just as the monotonous music had attracted the attention of all, a ghost dancer, called by the Indians "Cheden," came from a nearby thicket and danced into the enclosure. He was nude with the exception of dancing skirt, moccasins and hat, the latter being a square-shouldered ghost hat. This hat had for a support piece a bow-shaped withe which passed, yoke fashion, from the crown of the head to beneath the chin, where the ends of the yoke were tied together with a sinew to keep the hat in place. This withe had a muslin mask stretched over it loosely. To this yoke at the top was fastened a transverse-bar of yucca wood from which several upright pieces projected on which there were peculiarly carved cross pieces and zigzag red lines, indicating lightning. To make the ghost figure more grotesque, the dancer's body was painted in various colors. A ghost god decorated his breast and the red bolt lightning his arms. He held a butcher knife in one hand and a lightning painted wand in the other. On entering he danced around within the enclosure for a considerable time. He then walked around the circle from the east, turning con-

tinually to the right and edging in toward the center of the disk till he reached the patient, approaching her from the rear. He then laid down his knife and wand and dipped his hands in the muddy water in the cup. He then rubbed the sick one's back with the muddied hands. When he had done this he lifted his hands skyward and sent the "sick" away by

The Medicine Dancer. A Pose in the Medicine Dance.

blowing a hissing breath through them. In like manner he placed his hands on the woman's head, on her breast and on her arms. Having completed his task and sent "sick" away, he galloped off into obscurity.

When the "Cheden" had gone, chief medicine man Brigham Young went and took the muddy cup and rubbed the woman in the same manner as the "Cheden" had done before him, except that he daubed her almost all over with the mud, praying continually as he did so. When he had completed his daubing, they carried the sick woman from the enclosure.

Then each one who cared took some of the dust of the gods, that is, gathered a pinch of dust from each of the symbolic figures. This being done, the disk was obliterated. The Gumelpieya ceremonies were thus brought to a close. The next scenes were those of the ghost dance.

At about ten o'clock that night a huge bonfire was kindled in a level open area, around which practically all the Indians of the tribe gathered. Two drummers seated themselves on their blankets a little to the west of the big fire and began to beat the Indian "tomtoms," drums made by stretching a rawhide over the open face of a pot. As soon as the dull drum beats were heard all who desired to sing joined the drummers and began to chant:

To′-kwah tzhoo′-nah nahd′-o-tash′
To′-kwah tzhoo′-nah nahd′-o-tash′
To′-kwah tzhoo′-nah nahd′-o-tash′
To′-kwah tzhoo′-nah nahd′-o-toosh′-she ah′ i′ a′ nah′ ah′
To′-kwah tzhoo′-nah nahd′-o-toosh′-she ah′ i′ a′ nah′ i′.

After the singing had been going on for probably half an hour, the sick girl was carried to the place of meeting and placed on a blanket to the east of the fire. On this she reclined for almost an hour waiting for those who were to perform over her. At last they came, the ghost dancers. There were five of them, four medicine dancers and a clown. The former were "Chedens" and were all attired like the "Cheden" above described with the exception that the hats of two of them had the lath crest pieces arranged in fan shape so as to resemble the spread tail of a turkey, which it was intended to represent. The clown was attired, painted and daubed similarly to the ghost dancers, the crest of his hat, however, was neither square shouldered nor fan-shaped; but instead the lath extended out as horns from each side, a small cross cresting the hat. Besides the difference in the hat, he also had a belt of pine twigs around his waist and a bunch of fir twigs at his back that, in several respects, made him look like Christian in "Pilgrims' Progress" as he started out with his load of sins on his back. The ghost dancers carried lightning painted wands in each hand; the clown carried a thunder stick in one hand and a three-pronged stick in the other. The thunder stick was a piece of lath suspended on a string. The string being twisted, the whirling of the lath gave a sound "all the same thunder," to use the Indian expression. The three-pronged stick resembled the trident of the fabled Neptune. The

clown thus attired and equipped looked much like the pictures of Satan, whom he was intended to represent, except that he was wingless.

These medicine actors approached the congregated people from the southwest, encircled them in a great circle, made circle after circle, each time edging in toward the great fire. As they thus approached they kept

Medicine Man, C 4.

putting their heads near to the ground as if smelling for something, then gobbling and struting like a turkey and waving their hands and wands like a flying bird flops its wings.

At last they entered the sick one's presence and acting as though surprised, they danced backwards and forwards for several yards to the music of the chant:

"Kahs′-ah-tun′ nee yah′ ash kah′
Kahs′-ah-tun′ nee yah′ ash kah′
Kahs′-ah-tun′ nee yah′ ash kah′
Kahs′-ah-tun′ nee yah′ ash kee′ yah′."

Then they approached again only to make a retrograde movement as before. This they did several times in succession. Then they approached and strutted around the little spot that the girl occupied, the clown going through every grimace known to his fraternity. After encircling the patient once, they pranced for a moment while "grandma" sprinkled the sacred meal upon them, blowing her breath in blessing on each one as she sprinkled him. This completed scene one of this act and the men of the gods cantered off into the darkness to go through their religious incantations to drive away the evil spirits, "sick."

The ghost dancers returned and formed in column facing the west, the sick one being changed on her blanket so that she faced them. They danced up to her feet and then retrograded in a backward movement to the spot where they had first formed the column, gobbling and strutting and waving their arms in imitation of a flying turkey. This they repeated seven times. Then the formost dancer, as he made pose after pose often imitating the actions of a mother quail when protecting her brood, left the column and danced to the feet of the dying girl. He reached her presence, strutted around her, laid the crossed wands on her, blew his breath on them, danced backwards for about twelve feet with medicine wands still crossed, parted the wands by a sweeping vigorous movement of the hands in opposite directions, thus sending the evil spirits not into the swine, but to the four winds. He returned to the patient, placed the wands on her breast, then danced backwards and scattered the evil ones as before. He then placed the crossed wands upon her head, and lastly upon her back, each time performing as above described. His work being completed, he galloped off into obscurity to appear in the next scene.

The other medicine dancers in succession went through practically the same performance as the first "Cheden" did. Then the clown came. His performing, in addition to his tumbling and rolling around in the dirt, was about the same as that of those who preceded him, except that he did not strut and gobble like a turkey. His acting completed part one of this scene.

There were three other parts to this scene all of which were similar to the one just described with the exception that the position taken by the actors was different. In part two the sick one faced the southwest, the dancing column the northeast; in part three she faced the northwest, the column the southeast; and in part four she faced the northeast, the

column the southwest. Part four completed this scene and the medicine actors passed out beyond the circle of light.

The next ten scenes were similar to the scene just described, except that when lookers-on went to sleep the Satanic majesty woke them up with his trident and made them dance, there being twenty-seven sleepy ones dancing at one time.

Just as day began to dawn the twelfth and last scene began. The

Chief Brigham Young, of the Apaches.

medicine dancers appeared, were sprinkled with the sacred dust, and began to perform over the sick one as in the previous ten scenes with the exception that they used medicine hoops instead of wands. These hoops were two and one-half feet in diameter, were five in number, were made of willow, and were painted so that the five represented the rainbow in color which they were intended to represent. Besides being painted, each hoop had five eagle feathers suspended from it.

When this scene began the young and middle-aged lookers-on took one more drink of Indian whiskey (they had been drinking it all night), formed around the central fire in a great circle, and danced around from left to right, the women in one half of the circle, the men in the other. The old women danced backward and forward on either side of the fire

Grandma Irrigating.

within the outer dancing circle; and old grandma, Brigham Young, medicine man C 4, and Loco Jim sprinkled the sacred dust and prayed incessantly to the gods. The dancing became more and more vigorous. Every one joined in it. The sound of the peculiar drum, now being beat with greater accent, the loud chanting and the deafening shouts of the dancers filled all the surrounding country with ear-grating sounds. The excitement reached a high tension. The sick one made one supreme effort to rise and join in the dance; but she had not sufficient strength. They lifted her to a standing position, they sprinkled her with the sacred

dust, they rubbed her back with scorched fir twigs, they supported her in a dancing position. She made one more heroic effort to dance and become well. Greater and greater grew the excitement. Loco Jim prayed louder, the shrieks and shouts of the dancers became deafening. The crisis came. In the excitement the sick one forgot her ailments. She danced. She took a medicine god in each hand. She lifted them high above her head. She leaped. She crow-hopped. She posed. She strutted round and round the great fire like a turkey. She called the gods by name. She shrieked, swooned and died.

Words can not describe the scene that followed. Men, yes, Indian men, wept, the women wailed with the hideous coyote yelping wail so characteristic of the Apaches. They all pulled their hair out by handfuls, they rent their apparel and destroyed their property at hand. Then all made a rush to see the corpse. They trampled over each other, and it was with difficulty that they were kept from crowding one another into the great fire. They carried her to the nearest wigwam; stripped, washed and dressed her; beaded her with all the beads of her clan; put wristlets upon wristlets on her wrists; rolled her in her best blanket; took her and her medicine accouterments to the mountain side and buried them beneath a pinyon tree. Then they returned and destroyed everything which belonged to her, both animate and inanimate, together with her father's "tepee," that the things that were hers on earth might be with her in spirit in the land of bliss. Then for thirty days the women wailed and mourned for her at morning, noon and night. Thus were the ceremonies performed over the medicine girl brought to a close.

The Apache Medicine Game.

Albert B. Reagan.

The medicine game is usually played for the benefit of the sick. A medicine man plays to drive "sick" away; an Indian, as the representative of "sick," plays against him. If the representative of the good spirits wins, it is believed that the sick one will get well; if the representative of evil gains the victory, he will die. The medicine man so plays the game that if he believes the patient will die he loses, and if he believes he will get well he wins; he must keep up his reputation as a medicine man. The game is also occasionally played to pass the time away. When played for that purpose four persons usually play, two playing as partners.

In many respects this game resembles the "Setdilth Game," described in the Indiana Academy of Science for 1903. The tally counts are 40 in number, as in that game; but pebbles instead of cobble stones are used. Furthermore, instead of being picked up on the spot, as the cobble stones are, each family carries a "set" with them wherever they go. Like the Setdilth tallies, when used in playing they are arranged in a circle; but in groups of fives instead of tens. A wide space on opposite sides of the circle, designated "water," separates the four west groups from the four east groups. As in the Setdilth game a center or bouncing rock is used. Also as in that game bouncing sticks are used, but the number is four instead of three. The sticks also are very different. The Setdilth sticks are about a foot in length, are the halves of green willows, and are thick and heavy. The Medicine sticks are two feet in length, are dry, seasoned material, are usually yucca lath, and are light and thin. Besides being variously carved, three of them have one face each painted red; the other face unpainted, or painted white. The other stick has one face painted black, the other green. As in the Setdilth game these sticks are struck endwise on the bouncing rock, and are then let fall as chance may direct. In this game, as in the Setdilth game, small sticks are placed between the last rock tally and the next pebble in the direction the player is moving his tally stick to mark the number of points he has gained. Unlike the Setdilth game, 41 points instead of 40 constitute a game-count; the players begin at the south wide space and in order to get

a game they must cross this same space on the return to at least one count on the other side.* Below are the rules of the game.

Rules for Playing.

1. The opponents in the game face each other, both start from the south wide space, and move their counting sticks around the stone circle in opposite directions, each playing as his turn comes.

2. Should the counts of two opponents be such that their counting sticks would occupy the same space, the one who played last takes up his opponent's counting stick and throws it back to the starting point. Its owner must begin the game anew, as all the points he has previously made are lost.

3. Should the counts of any player be such as to place his counting stick in either of the wide spaces, designated "water," he looses all the points he has made, his counting stick is thrown back to the starting place, and he must begin again.

Rules for counting the points, decided by the face of the sticks that are up after they have fallen (the faces according to color will be designated white, black, green, or red).

1. Two white plus one red plus one black, two points.

2. Three red plus one black and all the sticks straight and parallel, 5 points.

3. Three white plus one green, 10 points.

4. Three red plus one green, 13 points.

5. Three white plus one black, 13 points.

6. Three red plus one black, 20 points.

7. Three red, one crossing the other two, plus one black, 26 points.

8. Three white plus one black laying across the others, 39 points.

9. Three red, one crossing the other two, plus one black crossing two red ones (in this game each cross counts 13 points), 52 points.

10. One hundred and sixty-four continuous points or four game-counts constitute a game.

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*The winner of the game-count keeps on playing, retaining the extra points he has gained; his opponents begin anew. They, however, do not lose any game-counts previously gained in the game.

All Saints Day at Jemez, New Mexico.

Albert B. Reagan.

As the Jemez Indians are Catholics, they observe All Saints Day as other Catholics do, but after their own fashion. Whether mass is held in the Jemez church on that day or not, at daybreak the sexton commences to pound the two bells in the belfry of the church alternately with a hammer. This pounding he continues till sun up. The Indians then commence coming one by one to give gifts as prayers for the good of all saints. Some of these gift-carriers have baskets of grain, some baskets of fruit, others baskets of baked bread. On entering the church, each gift-carrier proceeds to the altar, and, having made the cross and said the appropriate Catholic prayer, he places his gift upon the altar and leaves the church at once. On going out of the church he pulls the two bell ropes as often as he chooses, causing the clapperless bells to pound each other into a dull monotonous choppy ringing, thus declaring to the village and to his God that he has deposited his gift. This gift depositing is carried on throughout the entire day. The proceeds, thus obtained, are given to the priest.

The Moccasin Game.

Albert B. Reagan.

The Moccasin game is an Apache nocturnal game. It is played by the men only. The players and spectators gather in a circle around a fire, which serves both for warmth and light. The players divide themselves into two groups, one of these groups occupies the west, the other the east part of the circle, which now assumes the form of an ellipse. Then the sides begin to bet. One side puts up a saddle that it will win the game. The other puts up a horse. So the betting goes on till the members of each side have staked on the game practically all they have. Then the game begins. It is on the same principle as the "chuck luck" game of the English walnut hulls and the pea, except that it is more complicated. It is a straight game of guess.

There are two ways of playing this game. In the one (that used by El Sa Say's band) each side has seven round holes dug in the earth to the depth of about six inches. These holes are filled with leaves or fine bark; and the ground in the immediate vicinity is covered with the same material till the holes are practically hid from view, and instead of a pea a round pebble about the size of an egg is used. In the other style of playing, mounds of earth and variously arranged ridges are used instead of holes; the pebble being used as in the first case. Should mounds of earth be used, linnear marks are made on them to show the possible places that the ball (pebble) may be hid.

In playing the game, if it is the first one of the season, the sides draw by lot to see which will get the pebble, that is, which will get to play first. At all other times the winner in the previous game gets to play first.

The lots having been cast, a member of the lucky side, while he and his game ground are obscured from view with a blanket, puts the mystic* pebble in the bottom of one of the holes; or, in case mounds or ridges of earth are being used, buries it in the dirt beneath one of the linear lines. Then he carefully covers and smoothes everything all over so that the location of the pebble can not be detected at all. This being done, a

* So called "mystic" because each set of players pray over their respective stick and pebble that they will have power to favor them in the game.

member of the opposing clan with divining stick (a small club-like stick) in hand goes over to the other's game ground, so to speak; and, after making six false motions with his stick while he argues and jokes with his opponents to see if he can decide from their actions where the valuable pebble is, he strikes the hole or spot, in case a mound or ridge of earth is used, with vigorous force in which he has decided the stone is. Then there is a lull, a death silence, while he removes the leaves or earth, etc., to see if he has won. If the pebble is not in that place of deposit the players who occupy that ground have won the tally and immediately begin the song of triumph.

Yah e yi,
Yah e yi,
Ain-nee ah,
Ain-nee ah,
Hay hay ah hay ah ah ah a.

The player with the mystic stick goes back to his clan, and the holders of the pebble hide it again. Then another one from the opposing side tries his luck in finding it; but usually with no better success. In this way the game continues for hours. At last a member of the losing side locates the mystic stone, and, amid the shouts and song of triumph of his clan, he takes it to his side of the great ellipse. The other side then begins to guess. This sort of performance is kept up till one side receives the number of tallies previously decided upon to constitute a game. That side consequently wins the game and sweeps in the stakes.

Rules for Playing the Game.

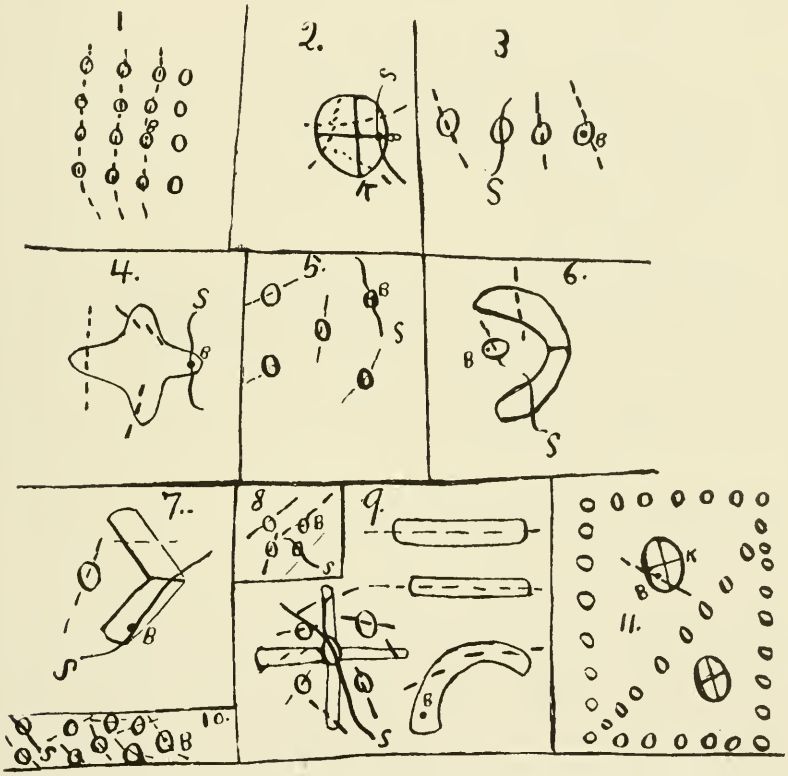
1. If in the preliminary or false motion movement the pebble is uncovered, it counts one tally for the side which has the pebble, that is, for the side which has buried it.

2. If the pebble is located at the final stroke, not the preliminary strokes, of the mystic stick, it counts one tally for the side which has the stick, and that side takes the pebble to its own game field. The other side then begins to guess.

3. If the pebble is not located in the final stroke, nor the preliminary strokes of the mystic stick, it counts one tally for the side which has hid it. And that side retains it and hides it again.

4. There is always one less false motion of the mystic stick than there are possible places for the pebble to be hid; for example, in case there are seven holes in any one of which the stone may be hid, six preliminary strokes of the mystic stick are always made.

5. There are always two tally keepers, one representing each opposing party. At the beginning of the game each of these has a number of



Map showing the various arrangements of the moccasin game field of the dirt type, used in playing one game at the camp of Chief R 6 the night of February 24, 1902.

The broken lines indicate the false or preliminary motions.

K shows lines where the pebble should be hid.

S shows the final stroke. It is represented by a continuous line.

In 1 and 11 the pebble was uncovered in the preliminary motion. In 3, 6, 8 and 10 it was passed over in the preliminary strokes, but not uncovered. In 2, 4, 5 and 7 the pebble was uncovered in the final stroke. And in 9 it was missed both in the preliminary and final strokes. 2, 4, 5 and 7 are the only ones which counted points for the searchers for the pebble. In each of these four cases they got the pebble and took it to their own game field.

bear grass blades, "Indian shoe strings," corresponding to the number of tallies decided upon to constitute the game. When a side loses, the tally keeper of that side gives a blade of grass to his opponent tally keeper. When all the "Indian shoe strings" have passed to the possession of any one side, that side has won the game. It is sun up by that time and all go home, one half paupers, the other half as rich as the Indian generally gets.

Words used in the moccasin game:

Ako. There (used when making a false motion as if to grab the ball).

Don-dee. It is well.

Kod-da. It is ready, the ball is hid.

Tah-al. It is finished.

Oa-kog-go. That is all.

Ah-ko. Here, it is here.

Doh. Play.

Yah-lan-nee. Good-bye, you have lost, you are left, etc.

Ken-not-tah-hah. The moccasin game (so called because originally the pebble was hid in a moccasin).*

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*Taken from the Apaches, their manners, customs, etc., furnished to the Bureau of American Ethnology by the writer.

The "Matachina" Dance.

Albert B. Reagan.

The "matachina" is a peculiar religious ceremonial dance of the Pueblo Indians of New Mexico. It is a religious rite performed in celebration of the birth of Christ. This dance was acted out at the annual feast of the patron saint, Guadalupe, at Canyon de los Jemez, New Mexico, November 12, 1901.

After mass was given at the holy church of Saint Guadalupe, the dancers, some thirty in number, lined up in two rows with the chief of ceremonies at the front and between the rows. All were masked. The chief of ceremonies wore a mask that resembled the head of a donkey very much; and each of the dancers wore a cloth mask. Each of them also wore a circular cap from which there floated to the breeze variously colored ribbons.

When all the performers were in their proper places, the chief of ceremonies began to writhe and to wriggle his body in a laborious manner. This performance was to indicate that with the birth of Christ a furious battle was waged againt sin. As soon as the chief began to perform, the gaudily-attired dancers commenced to move their limbs in a lively manner to the strains of an accordian. They pranced about much in the same way that a baboon trips about in a cage. This spectacular and, at times, grotesque acting was kept up till the sun set. Then the simple-hearted Indians set out for their homes feeling that they had done their duty, that they had been forgiven for their transgressions and that they would begin a new year with unsullied records.

The "Penitenties."

Albert B. Reagan.

At the conquest of New Mexico by the Spaniards, the Pueblo Indians were converted to Christianity. From the first they were very attentive to the teachings of the Catholic priest, but they could not grasp the new creed in its entirety. They were handicapped by the fact that they were not able to read or write. The Bible could not be used as an instrument for their instruction. They had to depend upon the words of the priest only. As a result Christianity, as practiced by the Pueblo Indians today, is greatly "distorted."

The "padres" taught penitence. The Pueblos began in easy stages, but soon corrupted the religion; and now many of the Indians undergo excruciating torture annually to atone for the sins of their respective village. In June of each year there are invariably a number of young Indian men who volunteer their flesh for the elevation of their people. In each village several are selected who lead a procession, composed of nearly every inhabitant of the village. One of these "penitenties," as the Mexicans call them, as late as even the eighties, carried a massive cross in representation of Christ's carrying the cross to the crucifixtion. This one seldom returned alive. In this performance of the "penitenties," the Indians who are not acting as "penitenties" arm themselves with cactus; and each in turn, pricks the "penitenties." The more cruel the nature of the torture, the more nearly have the people of the village been forgiven by the Supreme Being for their sins duriag the year. The flesh bruising part of the ceremony being finished, the suffering subjects, bleeding from head to foot, are carried back to the church, where prolonged and weird ceremonies are conducted. This human offering is followed by the "Matachina Dance," described in a previous paper—a curious ceremony performed in celebration of the birth of Christ.

The Cliff Dwellers of Arizona.

Albert B. Reagan.

The cliff dwellers of Arizona were small of stature, the adult male not being over fifty-two inches in height. Their skulls are brachycephalic (or broader across than lengthwise), like those of the Zunyis, Aztecs and Peruvians. Their skulls have also a little extra bone in the back part of the head, a peculiarity of the Incas, and known as the Inca bone. This bone seems to indicate a close relationship between this mysterious race in Arizona and the semi-civilized races of South America.

The cliff dwellers lived in narrow canyons that afforded water for cooking and drinking purposes, and for irrigating their fields. At the sides of the canyons, under the projecting cliff, they built their adobe houses, so that the cliff protected them both from rain and storm, and from the attacks of an enemy, except at the front.

Besides the cliff home that the cliff dwellers lived in in time of peace, they had caves, natural caves in the rocks, into which they retreated when hard pressed by an enemy. The large cliff cave on the East Fork of White River just east of Fort Apache is an example. At this place a continuous cave, composed of chiseled-out narrow passages, corridors and rooms, runs back along a fissure some 200 feet beneath the surface, it is said, for a distance of four and a half miles.

In case the cliff dwellers could find no cave, they changed their place of habitation, in time of great danger, to the lofty heights above the canyon floor; and there built a village on some projecting ledge. Such a village stands out against the almost perpendicular walls of the Sierra Anches mountains more than a mile in altitude above the floor of Cherry Creek canyon below.

Their dwellings, except of course the caves, were adobe structures. They were built under and against a cliff; and resembled the old Pueblo style of house very much. The second story was set back a little on the floor of the first; and the third story set back a little on the floor of the second; and so on till the "step-front like" house was finished. In each house there was but one door, a hole in the roof of the highest room. From the ground to the top of the first story, and from story to story lad-

ders extended, over which one had to climb to gain entrance to the house. In time of trouble and always at night these ladders were most likely carried to the roof and placed within. The house itself was a fortress.

These dwellers of the cliffs were an agricultural race. They farmed in the little "flats" adjacent to their places of abode, as the remains of their irrigating ditches show, as well as their grain bins. Some of these grain bins were visited by the writer; and were found partly filled with corn cobs and barley heads, from which the barley kernels had been removed by vermin. The barley heads, thus found, seem to indicate that this people knew nothing of the art of threshing grain even with a flail; but in harvesting it they headed it, and stored it away in the head. Then, when they desired to use any of the grain, they threshed it by a hand-rubbing process.

In religion it can at best be stated that the cliff dwellers were sun worshipers, as is shown by the drawings on the vases and urns which they used in their exercises of worship. One of these vases, found by the writer in a Canyon Creek cliff house in Arizona, was jug shaped, except that it did not possess a neck. Around the circular opening at the top were drawn the rays of the sun in red and black. Many more of their vases have similar drawings on them. Further evidence concerning what their religion consisted of, is thus far wanting.

Who these cliff dwellers were, where they came from and what became of them, is a matter of conjecture; and will probably remain so.

The Rosebud Indian Celebration.

Albert B. Reagan.

The Rosebud Indians, like all other Indians, love to feast and make a great display. Feast days are their great days. At the present time but one feast is allowed them each year, that of the 4th of July. This year (1904) the Rosebud Sioux celebrated at two different places, at Cut Meat and at Butte Creek. The author attended the celebration at the latter place. Below are his observations:

Medicine Lodge and War Bonnets.

The morning of the 3d of July the Butte Creek Indians went into camp on the previously prepared celebration ground. This was a circular flat a mile in diameter with an artificial grove and circular arbor in its center. No building of any kind was on it. Nothing only a trader's

stand. Towards evening of that day other Indians began to arrive. A wagon train, carrying the United States flag as a banner, was reported approaching from the south by the Butte Creek Agency wagon road. At once the braves in war paint and feathers made a mimic raid on horse back upon the train, treating it as an immigrant train. The would-be immigrants, on seeing the painted savages charging furiously towards

Eating Puppy Soup.

them from a slight rise of ground, hurriedly unhitched their horses, put them and their families in the rear and made a breastwork of their wagons. Then they waited the onslaught. This came almost immediately. Guns were fired in all directions, and the blood curdling war-whoop filled the air. In fact it looked so much like a real battle that many of the Indian women were scared. For some minutes the sham battle raged, then the wagon train surrendered. The wagons were again hitched to, and the train was taken into camp by the captors.

Nothing further of interest happened till dawn the next morning. Then there was an elaborate parade, followed by religious services con-

ducted by the Reverend Dallis Shaw (Indian). As these services were closing, a giving away scene commenced. Each Indian who desired walked to the center of a congregated circular area, told the people how good he was and exploited the good deeds of his ancestors. Then he walked around the circle handing dollar upon dollar to his friends or "dishing" out groceries to them. This he varied in a few cases by leading

The Parade.

a horse into the circle and turning it loose to be taken by anyone who wished it. Breakfast followed this scene. It consisted, for the most part, of puppy soup and dog stew. It was eaten at the medicine lodge. After breakfast came the Indian brass band parade, then the Omaha Dance in the grove. In this dance several Indians chanted in the minor key, a squaw or two sang soprano, and an Indian beat the drum. The dancers were all men, were painted, daubed and decked with feathers. Each one wore a war-bonnet. And when dancing each crowhopped around somewhat like a baboon trips about in a cage.

While these were acting, the giving away performance, which always accompanies this dance, was going on. The principal things which were being given away were horses. A buxom young squaw would ride a horse into the center of the arbor, and whoever desired the horse would take its halter-rope and lead it away. This performance continued till the United States officials put a stop to it. The remainder of the day was spent in feasting.

The remaining celebration exercises, consisting principally of horse racing and feasting, lasted three more days. Then Uncle Sam's men declared the ceremonies at an end, and the Indians returned to their respective homes.

Notes Upon Some Little Known Members of the Indiana Flora.

(PAPER NUMBER TWO.)

Chas. Piper Smith.

A year ago I gave some notes from my studies in systematic botany, for the summer of 1903, in a paper under the above heading. Certain facts gleaned from my studies the past season, seem to justify me in offering a continuation of that paper. A review of Dr. Coulter's catalogue of the State flora and of all of the subsequent "Additions to the flora ——," etc., in the Academy's "Proceedings," indicates that a few of my recent takes are not reported from the State. Two or three are, however, undoubtedly migrants, though evidently here to stay.

Specimens verifying most of these records have been placed in the herbarium of Mr. Harley H. Bartlett. These are now with him at Harvard University and have been critically examined and compared at the Gray Herbarium. Almost all are also represented in my collection of plant seeds. In accordance with Mr. Bartlett's request, I include a few records which are strictly his own. In reality his name should appear with mine as joint author of this paper.

Avena fatua L. (Marion County.)

A half dozen specimens of this well-marked oat were found by Mr. Bartlett and myself along the "Monon," at the State Fair Grounds, Indianapolis, in July, 1903. About the same number of plants was noted there by myself in August, 1904. An introduction from Europe, it is abundant in California and is not reported east of Minnesota by Britton and Brown.*

Uniola latifolia Michx. (Madison County.)

A small patch found along White River near Anderson. Jefferson County is the only station report by Dr. Coulter.†

Bromus tectorum L. (Tippecanoe and Madison Counties.)

This grass has been recently admitted to the State flora.‡ It is abundant where found at Lafayette and Anderson.

Bromus brizæformis Fisch. and Mey. (Laporte County.)

Found commonly along the Michigan Central R. R. from near Michigan City, Indiana, to New Buffalo, Berrien County, Mich. Said

by Britton and Brown to be "sparingly introduced into Pennsylvania; also from Montana to California. Native of Northern Europe and Asia."

Carex folliculata L. (Laporte County.)

Common in a small tamarack swamp northeast of Michigan City. Carex intumescens Rudge was also taken in a wet wood south of Michigan City.

Carex monile Tuckerman. (Madison County.)

Taken in a small bog along the Big Four Route, southwest of Anderson. Reported only from Gibson County in State catalogue.

Carex trichocarpa Muhl. (Madison County.)

An abundant rank-growing sedge in boggy places along White River, above and below Anderson.

Carex hystricina Muhl. (Madison County.)

Reported only from extreme northern counties. Taken in a low wet place south of Anderson. Noted as scarce.

Carex aquatilis Wahl. (Laporte and Marion Counties.)

Taken by Mr. Bartlett near Indianapolis; by myself south of Michigan City.

Carex costellata Britton. (Laporte and Marion Counties.)

Also taken near Indianapolis by Mr. Bartlett and near Michigan City by the writer.

Carex lanuginosa Michx. (Madison and Delaware Counties.)

Taken by me near both Anderson and Muncie. In the State catalogue Jefferson County is the only definite station given, but the species has been later reported from Kosciusko County by H. W. Clark.§ and is probably well distributed over the State.

Carex gracillima Schwein. (Madison County.)

Taken near Alexandria. Not common.

Carex Davisii Schwein. and Torr. (Marion County.)

Taken by Mr. Bartlett at Indianapolis. Scarce. Steuben County seems to be the only other station on record.

Carex grisea Wahl. (Marion County.)

Taken by H. H. Bartlett near Indianapolis in 1903.

Carex mirabilis perlonga Fernald. (Madison and Delaware Counties.)

Taken near Anderson and Muncie by the writer.

Carex alata ferruginea Fernald. (Marion County.)

Taken near Indianapolis by Mr. Bartlett.

Juncoides campestre bulbosa Wood. (Marion County.)

Taken by Mr. Bartlett near Indianapolis.

Lilium umbellatum Pursh. (Starke County.)

Taken by me in "swampy meadows." This plant is reported in two different places in the Academy's Proceedings for 1901 (pp. 164 and 301). I note it here because of the environment in which I found it.

Atriplex patula L. (Marion County.)

Very common in waste places in Indianapolis, especially along Central Avenue. Recognized in 1903 and omitted from my last paper through mistake. Reported from Steuben County by Bradner; but omitted from the State catalogue (see p. 607 of same) because of lack of verifying material.

Atriplex hastata L. (Madison County.)

Taken at Anderson. First reported from Wells County by C. C. Deam.

Tragopogon pratensis L. (Madison County.)

Common along the C., C., C. & St. L., near the Quartz Works, Anderson. Taken both in bloom and in fruit.

Antennaria fallax Greene. (Marion County.)

Taken by Mr. Bartlett at Indianapolis, river-bluffs opposite Fairview Park.

Mr. Bartlett's work at the Gray Herbarium has led us to change our view concerning one of my records of 1903. An annotation in the herbarium copy of Britton & Brown's "Illustrated Flora," to the effect that the characters and figuring of *Carex Baileyi* Britton do not hold good as regards the material in the herbarium, led Mr. Bartlett to compare the specimens, determined by us as Baileyi, with the herbarium material. As our specimens agree with the typical *Carex lurida* Wahl. (of which Baileyi is there regarded as a sub-species), in spite of Britton's key, etc., I feel it advisable to cancel my records of Carex Baileyi.

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* Illustrated Flora of the Northern States and Canada; I, 173.

† Flowering Plants and Ferns of Indiana, State Geol. Report; 1899, 643.

‡ Additions to the Flora of Indiana; Proc. Ind. Acad. Sci.; 1900, 137.

§ Flora of Eagle Lake and Vicinity; Proc. Ind. Acad. Sci.; 1901, 162.

Physiological Apparatus.

Frank Marion Andrews.

Introduction.

It is frequently the case that much of the apparatus required to carry on work properly in Plant Physiology is so expensive that for any one laboratory to possess all that is needed is quite out of the question. This has led me to plan and have constructed a few very desirable pieces, concerning which this paper makes mention. I am aware of the fact that no lack of contrivances have been made to illustrate some of the principles here set forth. However, for simplicity of construction and perfect adaptation to the purposes for which they were intended, they will certainly be found superior in many ways and useful by any one interested or engaged in physiological work where such apparatus would be involved. It has therefore occurred to me to describe the various pieces of apparatus as concisely as possible and present them, together with the illustrations, in the following brief account:

I. Heating Stage for the Microscope.

This piece of apparatus consists of a rectangular sheet of copper, 60 cm. long, 8 cm. wide and 2 mm. thick. Figure 1 shows a view of the lower side. It will be seen from this view that the copper does not rest directly on the stage of the microscope but is held away from it a distance of 1 cm. This is accomplished by a strong frame of wood B,

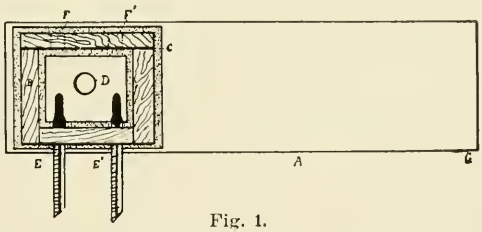

Fig. 1.

7 cm. square and 8 mm. in height. Between the wood and the copper, as an extra preventive against the conduction of heat in long continued experiments, a layer of asbestos 2 mm. thick is interposed at C. The

frame of wood and asbestos is fastened firmly to the copper A by copper screws, which, however, must not reach through the wood B. In the center of the wood and asbestos squares is a circular opening D, 12 mm. in diameter, to allow the light reflected through the stage of the microscope to pass through the slide. Through the side of the wood frame away from the pillar of the microscope, as the heating stage lies in the proper position on the stage of the microscope for observation, are two holes for centigrade thermometers, E and E^1. The temperature at E may be a little less than at E^1, and if this is the case, then an average of the temperatures shown by the thermometers at E and E^1 should be reckoned. It should be ascertained before the experiment that the two thermometers read the same at the same temperature. As they project directly in front during correct observation, the temperature of both is easily seen while experimenting. Since it is not always possible or convenient to carry on experiments with the copper plate of the heating stage directed to the right as would necessarily be the case with the thermometers on the side shown in Figure 1, another arrangement was resorted to. On the side of the wood frame opposite E and E^1 are two similar holes for thermometers, F and F^1, which allows observation while the copper plate of the heating stage is turned to the left or the reverse position to the one in which E and E^1 could be used. It will be seen from the lower view of the heating stage shown in Figure 1 that the bulbs of the thermometers rest against the copper plate inside the asbestos square C, and in this way the heat is readily conveyed to them. One thermometer only might be used, but the use of two is more accurate and therefore advisable. A third position for the heating stage is possible and for various reasons sometimes advisable, in which the copper plate A is directed away from the observer instead of from the left or right. Or it may be turned about on the stage of the microscope through an angle of somewhat more than 180° and still be capable of perfect use at every point. It is held to the stage of the microscope by means of iron clamps, the upper screw of which is provided on its lower end with a small wooden block covered with asbestos. This is necessary since a careless disregard or misuse of subtances that are not poor conductors of heat may readily result in injury to the microscope. Heat may be supplied by a gas or alcohol lamp or other source placed under A at G and the flame increased or moved toward C as is desired.

II. Temperature Box.

This temperature box is made of galvanized iron. It is 25 cm. long, 9 cm. wide and 3 cm. deep, all inside measures. It is held to the stage of the microscope by means of a curved iron clamp hooked over the edge of the box at A. Near the lower side B is a rectangular slit 4 cm. wide and 4 mm. high, extending entirely across the box for the reception of a slide carrying the object for observation. By noticing Fig. 2 it will be

Fig. 2.

seen that the slit, B, is elevated about 2 mm. above the bottom of the box as at C, thus allowing the hot or cold water used to flow under and all around the space occupied by the slide. By this means the temperature may be increased or decreased as desired, in B to the most perfect state of efficiency possible in such a simple contrivance. At D is a cylindrical tube 3 cm. high and 2.5 cm. in diameter for the reception of the objective. In Fig. 2 both the tube D and the side of the box toward the observer are cut partly away to show the interior. The top is provided with a lid. By means of a proper mixture of salt and ice it is possible to reduce the temperature in the slit B, as shown by the thermometers kept constantly in the spaces E and E', to zero centigrade or below. If, however, a high temperature is desired, this may be accomplished by placing a flame under the end of the box F which projects over the stage of the microscope. Or one may arrange a vessel, somewhat higher than the box on the stage of the microscope, and by placing a lamp under this vessel, which is nearly filled with water, easily heat it to any desired temperature as shown by a thermometer. This heated water could then be siphoned into the box A and out again, and in this way the desired temperature in B obtained. The inflow and outflow to A can easily be regulated and made uniform by opening or closing pinch-cocks fastened on the rubber tube. Injury to the microscope is prevented by a sheet of asbestos placed on the stage. This temperature box can be turned either to the right or left or turned and used in any angle of 180° or less.

III. Centrifuge.

This consists of a wooden frame 60 cm. long, 55 cm. wide, and varying in height from 30 cm. at the lowest point at A to 60 cm. at B. Fig. 3 gives a view of the apparatus as seen in vertical median longitudinal

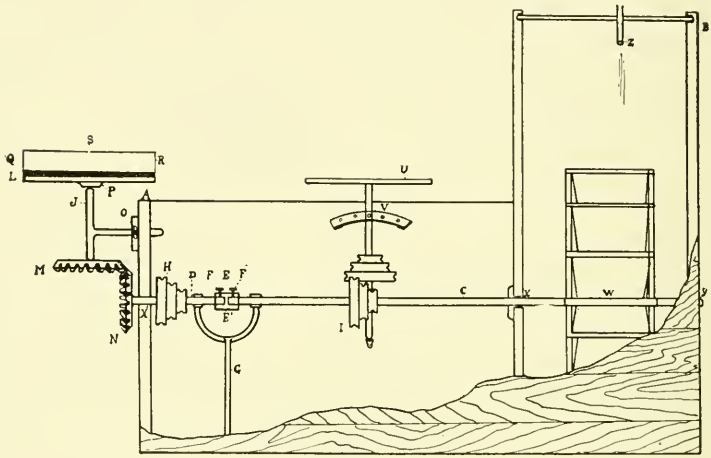

Fig. 3.

section. This apparatus in part resembles the centrifuge figured by Detmer, but is larger and possesses many improvements over his apparatus (Detmer Pflanzenphysiologie Zweite Auflage, 1895, p. 384). The machinery consists of a brass shaft 70 cm. long, in two sections C and D, which at E may be connected or disconnected by tightening or loosening the clamp E^1 by screws F F^1. In this way part or all of the machinery may be run at one time, which is often desirable. The ends of the shaft are held by a support G near E, and on D is a cone-pulley H by means of which it may be driven by other power if so desired, or from which power may be taken for other purposes if the cone-pulley I on C is in use. On the end of the shaft D is a bevel-gear arrangement so that motion is transmitted at right angles to D in the shaft in J which carries the disk L. By exchanging the position of M and N a faster motion of L may be obtained, with no increase in the speed of D. Again by using a still larger cog at N and a smaller cog at M, any speed desired may be had. By a vice versa arrangement of cogs a very slow rotation of L is effected. It is of course to be understood that by varying the size of the cogs M

and N, the distance of J from N must also vary in two obvious directions. This is done by the screw O (Figs. 3 and 4), which holds the support of the shaft carrying L. The shaft carrying the disk is enclosed for the sake of firmness in a sheath J. It is fastened to a disk of iron P. (Figs. 3 and 4), and this is held to the wooden disk of pine L, which is 20 cm. in diameter and 2 cm. thick, by means of screws. Larger disks of wood can, by means of these screws, be substituted for L and therefore the centrifugal force considerably increased aside from the ways of increasing the speed by the cone-pulley and bevel-gear arrangement above referred to. The centrifugal force brought to bear on the objects under investigation may also be increased by being placed near the periphery of the disk L, or decreased by moving them nearer the center of L. The disk of wood must in all cases be first boiled thoroughly in paraffine to prevent swelling. The disk of wood L is covered by a circular sheet of cork Q. This serves for the attachment of seedlings and plant parts to be centrifuged, and to it also are fastened several layers of wet filter paper for keeping the seeds moist. A glass crystallizing disk R, which will exactly fit L, is placed over it and darkened by being painted thickly on the inside with black paint. R is held to L by clamps. In order to water the seedlings when the machine is run for a long time, a hole is bored exactly in the center of the crystallizing disk R as at S, and even while the disk is revolving water may be forced in against the filter paper on the sheet of cork Q, and in this way be carried by absorption to all the seeds on the disk Q. Fig. 3 shows the disk ready to rotate in a horizontal direction. Fig. 4 shows the end view of the frame at A and

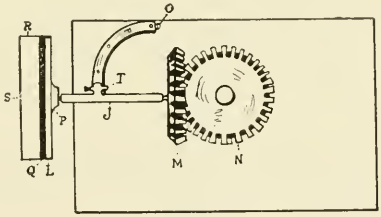

Fig. 4.

indicates how the disk may be rotated not only horizontally but vertically as well, or at any angle between the two by changing the position of the shaft in J by loosening and moving the clamp at T. This machine is also strong enough to carry any small flower pots with growing seedlings,

at any angle and at rapid speeds by using clamps to hold them in position.

As stated by Detmer, seedlings of the proper size when fastened on Q and rotated rapidly curve outwards. I have noticed a curving against the direction of motion in seedlings subjected by a stronger centrifugal machine than this exerting 4,400 gravities.

At U (Fig. 3) is another similarly arranged disk in case it is desired to run two at once at different angles. Here, however, the power is transmitted by a belt and cone pulleys, by means of which different speeds may be obtained. U may also be inclined at an angle by loosening or tightening V. At X, X^1 and Y the shaft is supported in journals. At W is a water wheel 50 cm. in diameter, and by using a very strong stream of water Z, a very high speed and ample power for the experiments here mentioned may be developed. Naturally the speed and power can be easily controlled by the force of the stream of water. By means of the cone-pulleys the machine may be driven by motor or other power.

IV. Apparatus for Growing Plants in Different Colored Lights.

This consists of a wooden box made perfectly tight to prevent the light from entering except at H, Fig. 6. It is 40 cm. long, 25 cm. wide and 25 cm. deep. Of course it is often advisable to use larger sizes of boxes, but the one here mentioned will serve as an illustration. The inside of the box is painted black and is provided with a base for holding

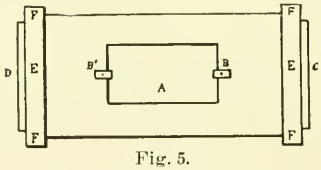

Fig. 5.

flower pots in any position. Each side of the box is provided with a door A, Fig. 5, which by means of the clamps B and B^1 may be removed so that the plant inside may be adjusted in the desired position, as regards the light entering at C or D, and measurements taken. The ends of the box are in the form of caps E (Fig. 5) which lap over the end at F so tightly that no light can enter.

Fig. 6 shows an end view of one of the caps E. In this figure there will be noticed a circular opening H, 15 cm. in diameter in the

center of the cap. Around H is a three-sided wooden frame I, on whose inner edge is a groove J, deep enough to receive one pane of glass. The

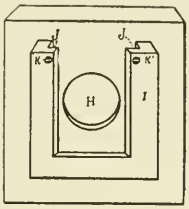

Fig. 6.

pane of glass used is 20 cm. square and must have exactly parallel surfaces. Light of any desired color may enter the box at H by putting in the groove J a glass plate which has been colored in the following way. To a 10 per cent. solution of gelatin add about .25 of a gram of the ordinary "Diamond Dye" of the color desired, while the gelatin is still hot and in solution. Stir well for a few minutes. Now place one of the glass plates in a perfectly horizontal position in a cool place and pour onto it a thin layer of the colored liquid gelatin. Let stand till the gelatin is solid. In this way colored plates of red, orange, green, blue or any other color or shade of color may be obtained. These colors have the additional advantage of being permanent. The screws K and K^1 hold the plates in the correct position in J. By having a number of colored plates any color in the box may be obtained by putting the plate of the desired color in J.

V. Photometer.

A simple form of photometer is shown in Fig. 7. It consists of a wooden base A, 110 cm. long and 25 cm. wide, on which stands a rectangular box B, 81 cm. long, 17.5 cm. wide, and 22 cm. high. This box B is

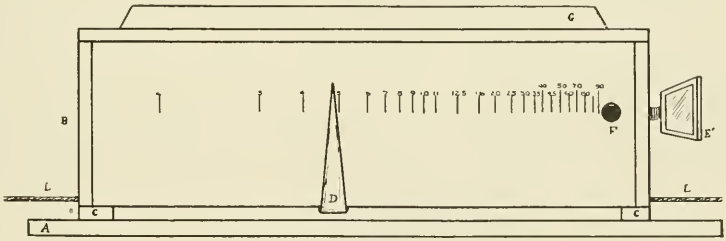

Fig. 7.

raised 1 cm. from A by a block of wood under each of the four corners as at C to allow the to-and-fro motion of the pointer D. The longitudinal opening under G and the base of D give ventilation. The figures on the side of B are accurately placed on the original apparatus and show the intensity of light in Hefner meter units. At E^1 is a mirror and at F a circular opening to a mirror inside. The interior view is shown in Fig. 8. Here A is the wooden base, C the wooden block supporting the box B. L and L^1 are strings by means of which the Hefner-Altneck amyl-acetate lamp is regulated in distances from the membrane K. This membrane consists simply of a circular piece of filter paper covering an opening in the center of the end of the box 7.5 cm. in diameter. In the center of the filter paper is a circular spot about three cm. in diameter, as in the ordinary Bunsen photometer. Each mirror E E^1 is 5 cm. long and 4 cm. wide and is inclined at an angle of about 45° to the filter paper membrane

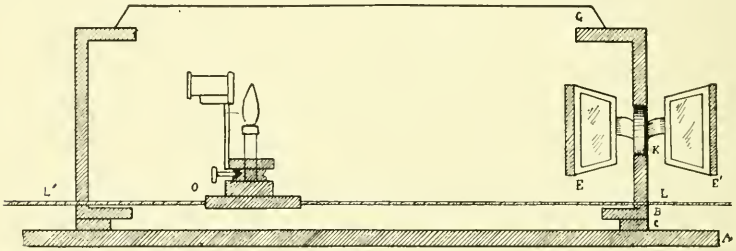

Fig. 8.

by means of the galvanized iron frame which supports it. The V-shaped top G is also composed of galvanized iron. This apparatus will show the intensity of light from 2 to 90 Hefner meter units. When it is desired to test the intensity of light between two and ninety Hefner units, draw the pointer D, opposite which inside the box the Hefner-Altneck amyl-acetate lamp is placed, by the string L towards the filter paper membrane. When the circular spot of paraffine on the filter paper almost disappears, then the light cast on the filter paper screen by the amyl-acetate lamp, and that in the room for example outside are equal. Noticing now the position of the pointer D, we notice that it points to or near some figure on the outside of the box. The number it points to indicates the intensity of light in Hefner meter units.

VI. Rheostat.

This piece of apparatus (Fig. 9) is 35 cm. long, 30 cm. high, and 15 cm. wide. It has a wooden frame A, over which the wire B is tightly stretched, the two sides being connected by the wire Q. The voltage, which, as here used, was a constant one, enters at M through the binding posts E E^1, and from this it passes through the wire B in the direction indicated by the arrow. The wire used was iron number 20 and in all 100 meters

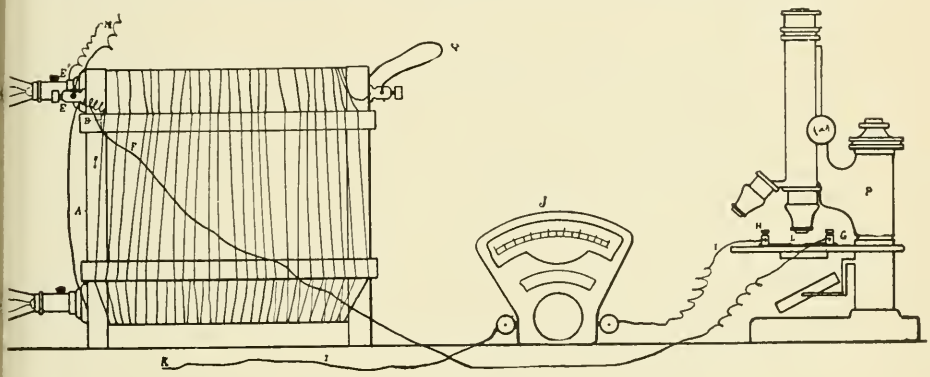

Fig. 9.

were used in making this machine to obtain if needed a high resistance so that by means of shunting any strength of current may be obtained. If an insulated wire F is connected with one post on an electric slide as at G, and the other post of this electric slide is joined to another insulated wire I, about the center of which is interpolated a milli-ampere meter J; then by shunting with the free end K of the wire I to the non-insulated wires B, an electric current if sufficiently strong will pass through a specimen laid on the slide at L under the microscope P. If at first the current at B is not strong enough, the free end of the wire K can be moved from B in the direction of the arrow till a current of the desired strength is obtained. The strength of the current will be registered by the meter J. In the experiment I tried, with 110 volts entering at E E^1, a current of .7 of a milli-ampere was sufficient to cause the movement in the protoplasm in Elodea cells to cease. It began again in 20 minutes. The lamps

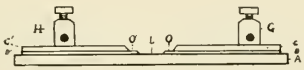

Fig. 10.

may be used in the circuit in series to increase the resistance. Fig. 10 gives a view of a median vertical longitudinal section of the slide. It consists simply of a thick glass slide A, on which is a heavy layer of tin-foil B B^1, and on this a plate of copper C C^1, through which the binding posts G and H are screwed. This not only fastens B B^1 and C C^1 together, but fastens them to the glass slide A. The specimen is laid at L with its ends touching the ends of the tin-foil B B^1, on which the cover glass rests at OO^1.

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