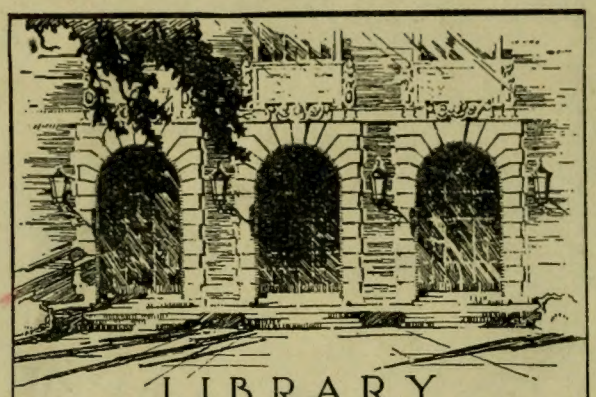
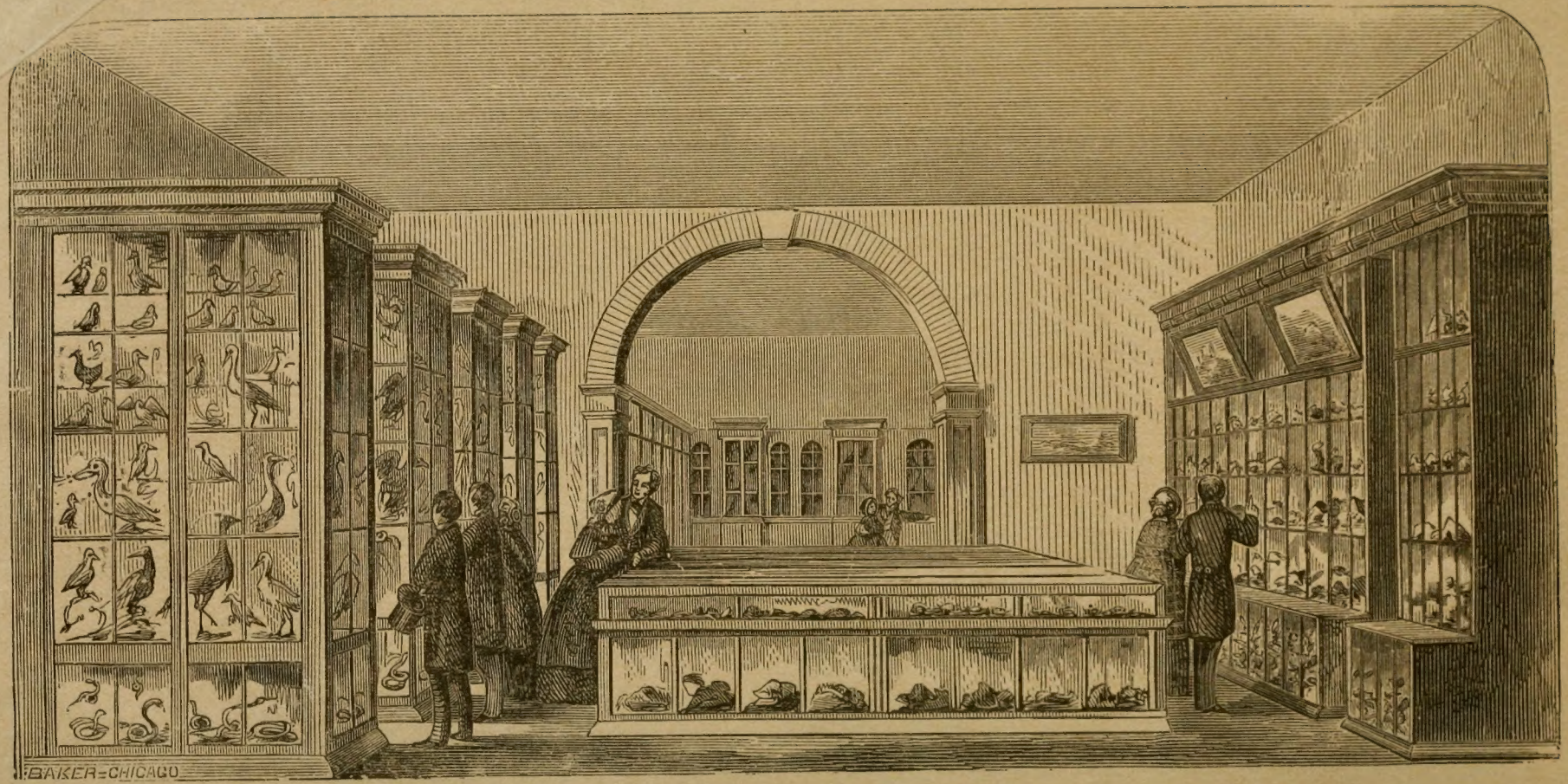




MUSEUM OF THE ILLINOIS NATURAL HISTORY SOCIETY.

Bloomington, Illinois.

VOLUME I. SERIES I.

TRANSACTIONS

OF THE

ILLINOIS NATURAL HISTORY SOCIETY.

EDITED BY C. D. WILBER, SECRETARY,
And Instructor in Natural History and Geology, in the State Normal University, at Bloomington.

SECOND EDITION.

SPRINGFIELD:
BAILHACHE & BAKER, PRINTERS.

1861.

ERRATA.

The attention of the reader is called to the following:

Page 19, fourth line from the bottom, read "form" for "power;" page 20, middle of the page, "form" for "power" again; page 21, fourteen lines from the bottom, read "flame" for "flames," page 22, ten lines from the bottom, supply "of" before "matter;" page 24, eighteen lines from the top, read "three" for "these;" page 25 eighteen lines from the top, read "fountain" for "function;" page 25, two lines from the bottom, read "all-pervading FORCE;" page 26, eleven lines from the top, omit the period and capital S; page 57, read "Mollusca" for "Molusca;" page 57, "Gasteropod" for "Gasterapod;" page 57, "Orthocerata" for "Arthocerata;" page 57, "Leptena" for "Septæna;" page 58, "Murchisonia" for "Marchisonia;" page 65—plate—"Luteum" for "Lutem;" page 107, "Cincticoliis" for "Cincticolles;" page 107, "Erraticus" for "Erratecus," page 109, "Sanguinolentus" "Sanguinolentas;" page 114, "Pensylvanica" for "Pensylvanicica;" page 115, "Sericeus" for "Sericens;" page 115 "Curiosus" for "Coriosus;" page 117, "Similis" for "Rimilis;" page 125, (7), "Blatina" for "Blarini;" page 128, "Magnicandatus" for "Candatus;" page 140, "Dioicum" for "Diæcum;" page 140 "Papavar" for "Paparu;" 141, "Uva-ursi" for "Uva-urse; page 142, "Asclepias" for "Asclipias," page 142, "Arifolium" for "Aurifolinm;" page 142, "Alata" for "Ulata;" page 142 "Pumila" for "Pumilia:" page 182, "Giganteum" for "Gigantum:" page 143, "Chor" for Chorr."

Mr. Walsh's article on "Insects Injurious to Vegetation," is reprinted from the IV volume of the Illinois State Agricultural Society Transactions.

PREFACE.

The first volume of the Society's Transactions is now offered to the public. It has been the aim of the Editor, to present only such articles and papers as are immediately useful and interesting to the citizens and schools of Illinois, with a hope that a zeal for the pursuits and studies of Natural History may spring up among our people, like the seeds of the sower, in the parable, falling upon good soil, and yielding, "some sixty and some an hundred fold."

In order to render the greatest good to all, the subjects have generally been treated in a popular rather than a technical style. It has been said, that he who places a valuable truth or fact within the reach of the million, is doing more for humanity than he who discovers it. And, indeed, if scientific men, or libraries and museums, cannot contribute to the elevation of the masses who are less privileged, their usefulness is questionable. Humboldt, Liebig, Lyell, Davy, Silliman and Agassiz, do not rank less, because they have reduced their observations to the comprehension of ordinary men. Those who teach, in any department, must learn the alphabet common to all, and then all can be educated, whether in Literature, Science or Religion. It is, therefore, unnecessary to apologize for the popular style of the present offering. It should be said, however, in behalf of the authors of the several papers, that they were written in the intervals of their professions or occupations, leaving but little time for study and research. In this country we have but few professional Naturalists; and in this State, only one department of Natural History has ever received public patronage, viz: Geology. The forth-coming Report of the State Geologist will not only encourage these pursuits at home, but will show that the basement of Illinois is worthy of the wonderful garden that rests upon it.

Within the last few years, the advancement of science has been unparalleled. Expeditions to every part of the globe, under government patronage, by societies and individuals, besides a host of observers at home, have furnished a vast array of interesting facts. It is an age of discovery—not of new continents—but of new truths and facts. As a consequence, the public taste is leading irresistibly in the direction of Natural History, to the merited neglect of fiction and romance; and the day is near at hand, when a thorough knowledge of the principles and phenomena of Nature will be considered essential to a liberal education.

In the Great West, furnished ages ago, with its millions of ready-made farms, and where Agriculture is the leading employment, these studies must receive particular and constant attention. Here every portion of Natural History can be made practical and interesting. AGRICULTURE *is* NATURAL HISTORY APPLIED. Geology, Botany and Zoology are its basis, and in proportion as these are understood, will there be success in farming. It is because these sciences are the basis of Agriculture, that men have theoretically considered it practical; it is because it has to a great extent ignored these sciences, its true basis, and become a changeless routine, that it has been practically considered base. When the farmer studies the minerals of which his soil is composed, the plants that spring up around him, the insects that destroy—when he learns to study all the objects which abound on every hill-side, valley and prairie—farming will be a science that will daily awaken thought, a pursuit in which mind can develop, and then it will not only be among the most honorable, but the most honored, of secular professions. Just in proportion as it takes this place, does it rise in dignity, and call men of culture from other pursuits.

C. D. W.

State Normal University, *Bloomington*, Oct. 30, 1861.

CONTENTS.

ILLINOIS NATURAL HISTORY SOCIETY.

SECRETARY'S REPORT.

This Society was organized June 30th, A. D. 1858, and existed simply as an organization until February 22d, A. D. 1861, when it received its charter from the Legislature.

The plan for a Society devoted to the advancement of Science in this State, was discussed at an annual meeting of the Illinois Teachers' Association, held at Decatur, in December, A. D. 1857, on which occasion a meeting was called, to be held at the State Normal University in Bloomington, on the day preceding the annual examination. Said meeting—the proceedings of which are published in a preceding volume of the State Agricultural Transactions—resulted in the organization of this Society.

The demand for this movement seemed to proceed from a want of accurate knowledge in nearly all departments of Natural History in the State; and also, from a desire that all facts and discoveries in a field so vast as Illinois, should be made immediately subservient to the great ends of popular education.

The first year of our operations was occupied in securing the co-operation of naturalists who live in various parts of the State. The plans and objects of the Society were heartily endorsed by them, and each began the work peculiar to his own department, at home. This plan has been pursued until the present time, and many portions of the State have been thoroughly explored.

The results of these surveys and explorations have been placed in the hands of the curator, and during the last year have been arranged in the Museum of the Society, in the Normal University at Bloomington.

These results demonstrate very plainly the wisdom of the movement. Our State is rich in nearly all departments of Natural History, and many new discoveries have been made since our surveys were begun. This is especially true in Botany, Entomology and Geology. Papers descriptive of new species will be published in the the next volume of the Society's Transactions.

It is justly a source of pride, that among our own citizens there are persons competent to carry on this work and give it a permanent character. These individuals have labored with a zeal peculiar to the devotees of science; and it is owing to their energy and self-sacrifice that so much has been accomplished within the past two years.

It is also a source of pride as well as encouragement, that in the annals of similar societies, we do not find an instance of such rapid progress—the example for which, however, had been previously set by the State for which the Society exists.

It is unnecessary to say that many obstacles have been met and overcome, and that many still remain. With what labor or toil the Society has come to its present prosperity, let us not now declare. In nature the forces and energies that control matter, are silent and latent; and it is wise to imitate nature in this as in other respects.

As in the days past, the people still ask "*cui bono?*" which must be answered; and still seek for a sign, which must be given. It requires considerable time to undergo public examination and to meet its approval and co-operation; and it is most gratifying to know that they not only see and approve, but are willing to co-operate for the complete success of our plans and purposes.

The following papers were prepared—most of them—for the last meeting of the Society, and have since been revised for publication in this report. They consist of:

I. Mind, Force and Matter—An Address—By Pres. J. B. Turner, Jacksonville.

II. The Great Tornado of 1860—By James Shaw, Esq., Mt. Carroll, Illinois.

III. Geological Section of Rock River, from Sterling to Oregon—By Dr. Oliver Everett, Dixon.

IV. The Mastodon Giganteus—Its Remains in Illinois—By C. D. Wilber, Bloomington.

V. The Water Lily, (*Nelumbium Luteum*,)—Its Mode of Growth—By Dr. F. Brendel, Peoria.

VI. Taxidermy—By Richard H. Holder, Bloomington.

VII. Birds of Illinois—Catalogue—By Richard H. Holder, Bloomington.

VIII. Natural History in Schools—By A. M. Gow, Dixon.

IX. Object Lessons—By J. H. Blodgett, Amboy.

X. Insects of Illinois, with Catalogue of Coleoptera—By Cyrus Thomas, Murphysboro.

XI. Mammals of Illinois—Catalogue—By Cyrus Thomas.

XII. Plan for a Natural History Survey—By Cyrus Thomas.

XIII Additions to the Flora of Illinois—By Dr. Geo. Vasey, Ringwood, Illinois.

XIV. Museum of the Illinois State Natural History Society.—By C. D. Wilber.

A copy of the charter and constitution of the Society, and the resolutions and reports of committees, together with a list of officers, are also added.

C. D. WILBER, *Secretary.*

Bloomington, *March* 4, 1861.

OFFICERS OF THE SOCIETY.

The following are the Board of Officers of the Society for the ensuing year:

PRESIDENT.

J. B. TURNER, Jacksonville.

VICE-PRESIDENTS.

Dr. OLIVER EVERETT, Dixon; Dr. FREDERICK BRENDEL, Peoria;
Dr. SAMUEL ADAMS, Jacksonville; Hon. A. S. MILLER, Rockford;
Dr. EDMUND ANDREWS, Chicago; D. H. BRUSH, Carbondale;
Hon. NEWTON BATEMAN, Springfield; J. F. JACQUES, Quincy;
Hon. M. L. DUNLAP, Champaign.

SECRETARY.

C. D. WILBER, Bloomington.

TREASURER AND CURATOR.

R. H. HOLDER, Bloomington.

LIBRARIAN.

IRA MOORE, Bloomington.

EXECUTIVE COMMITTEE.

C. D. BRAGDON, C. T. CHASE,
A. M. GOW, Dr. GEO. VASEY,
JAMES BOOTH.

COMMISSIONS.

BOTANY.

Dr. GEO. VASEY, Ringwood, McHenry county;
E. HALL, Athens, Menard county;
M. S. BEBB, Springfield;
Dr. F. BRENDEL, Peoria;
Dr. S. B. MEAD, Augusta.

GEOLOGY AND MINERALOGY.

C. D. WILBER, Bloomington;
J. W. FOSTER, Chicago;
Rev. O. D. W. WHITE, Mt. Carroll
Dr. OLIVER EVERETT, Dixon.

PALÆONTOLOGY.

A. H. WORTHEN, Springfield;
J. P. REYNOLDS, Springfield;
Dr. M. DAVIS, Oswego, Kendall county;
JAMES SHAW, Mt. Carroll.

CONCHOLOGY.

J. W. POWELL, Wheaton;
Dr. LUCIUS CLARK, Rockford;
M. S. BEBB, Springfield;
Dr. E. R. ROE, Bloomington;
E. HALL, Athens.

ENTOMOLOGY.

B. D. WALSH, Rock Island;
CYRUS THOMAS, Murphysboro;
Dr. J. A. SEWALL, Bloomington;
H. W. BOYD, Bloomington;
Dr. WM. Le BARON, Geneva.

HERPETOLOGY.

ROBT. KENNICOTT, West Northfield;
U. D. EDDY, Bloomington;
J. JOHNSON, Vienna.

ICHTHYOLOGY.

Dr. ADAM NICHOLS, Quincy;
Dr. WM. H. GITHENS, Hamilton;
Dr. L. WATSON, Quincy.

MAMMALOGY.

WM. P. GEARHARD, Murphysboro;
CYRUS THOMAS, Murphysboro.

ORNITHOLOGY.

R. H. HOLDER, Bloomington;
Dr. J. W. VELIE, Rock Island;
A. M. GOW, Dixon.

METEOROLOGY.

A. HALL, Athens;
Dr. SAMUEL WILLARD, Bloomington;
Rev. W. W. HARSHA, Dixon;
JAMES SHAW, Mt. Carroll.

DRAWING AND PAINTING—(Natural History.)

J. E. BRYANT, Bloomington.

REPORT OF COMMITTEE ON LIBRARY.

Dr. Roe, of Bloomington, reported the following:

1. That it shall contain all available works on the Natural Sciences, Home and Foreign Surveys, Manuals, Works of Reference in the several departments, Miscellaneous Works, not strictly scientific, Maps and Charts, etc.

2. That the Commissions appointed in the several departments, in the service of this Society, be requested to furnish a list of such books as are needed in this work.

3. That this library be held exclusively for the use of the members, and that the Commissions and Agents of the Society shall be permitted to borrow the books for a short period of time.

4. It shall be the duty of the Librarian to arrange the books of the Society, to make and keep a catalogue of the same, to keep a record of the books drawn from the library as directed by the Society, and report to the Society at its annual meeting.

5. That the Society devote all moneys obtained by donations and memberships to this important object, except so much as are necessary for expenses.

AUXILIARY SOCIETIES.

The following is the Report of the Committee on Auxiliary Societies:

Resolved, That we encourage the formation of Auxiliary Natural History Societies in the counties, schools, colleges and towns of this State, whose object it shall be to develop the Natural History of their localities, and to awaken an interest in the study of Natural Science.

Resolved, That for the purpose of creating and extending the taste for the subject of Natural History, of stimulating those interested in the collection of specimens in the various departments, and of further promoting a system of exchanges, the Illinois Natural History Society offers to Auxiliary Societies the following premiums:

1. For the largest and best collection of *fossils*, illustrating the Geology of any section, an exchange of fossils illustrating the Geology of the State, containing at least double the number of species presented by the competitors.

2. *Botany.*—For the largest and best Botanical collection, illustrating the Flora of any section, an exchange illustrating at least the genera of the State.

3. *Mineralogy.*	At least double the number of varieties.
4. *Conchology.*	Like premiums to be offered.
5. *Entomology.*	
6. *Herpetology.*	
7. *Ichthyology.*	
8. *Ornithology.*	

Resolved, That the competitors for the above premiums shall have their collections on hand at the next meeting, and present them as the property of the Society, and that the Society shall appoint a committee or committees to make the awards above mentioned, and that the premiums be prepared and sent to the Auxiliary Society to which they may be awarded at the earliest opportunity, the Committee being judge in any case whether the collection is worthy of the premium offered.

Resolved, That the officers of Auxiliary Societies be Honorary Members of this Society, who may co-operate with the Society and be entitled to all the privileges of membership, except the right of voting.

JAMES SHAW,
B. D. WALSH, } *Committee.*
A. M. GOW.

RESOLUTIONS.

The Committee on Resolutions, by C. D. Bragdon, Chairman, reported the following resolutions:

WHEREAS the dignity and position of this organization, as well as the utility of its work, depends largely, perhaps primarily, upon the *collection and record of facts*, as well as specimens, illustrating the same; therefore,

Resolved, That we recommend that working members, commissioners, and others co-operating, keep a detailed diary of their observations in their respective departments, and report a condensed summary of the same to the Society, to be placed on file and published in its reports.

Resolved, That it is expedient that we hereafter refuse to hear or accept verbal reports from the different commissions or officers of this Society.

1. *Resolved*, That the Natural History of the country is of sufficient importance to all interests to warrant every effort on the part of educationists, everywhere, to promote its more general study, and the diffusion of a knowledge of it.

2. *Resolved*, That as auxiliary to this work, we recommend the organization of Natural History Societies, and the collection of cabinets, in counties, towns, and public and private schools, to co-operate with this Society; and we hereby pledge to such our co-operation and assistance.

3. *Resolved*, That we recommend, in the education of teachers, a careful attention to their qualification to teach, practically, the Natural Sciences in all our schools.

4. *Resolved*, That we hail with gratification, and commend every effort on the part of authors and publishers to simplify Natural Science, and adapt text books to the needs and capacity of pupils in our common schools.

5. *Resolved*, That the work of the Illinois Natural History Society is so far identical with the industrial interests of the State as to render it not only politic but imperative that the Executive Committee of this Society adopt measures to secure their further co-operation.

6. *Resolved*, That a scientific survey of the State, in all the departments of Natural History, for the purpose of securing a more general knowledge of its agricultural and mineral resources, is a matter of vital importance to the people of Illinois, and worthy legislative action in furnishing means to do it economically and successfully.

7. *Resolved*, That this Society is largely indebted to the railroads of the State, for facilities afforded its working members in the prosecution of their work, and for this recognizance of the practical utility of the work of the Society on the part of these corporations.

8. *Resolved*, That we hereby express our appreciation of the services, and indorsement of the action of Superintendent Wilber, and the *working members*, in their efforts to promote the interests of this Society, and the diffusion of the knowledge of Natural History among the people of the State.

CONSTITUTION.

The following is the Constitution of the Illinois Natural History Society, as amended and adopted at the late session:

ART. I. This Society shall be called the Natural History Society of Illinois.

ART. II. Its field of observation and research shall comprise Geology, Meteorology, Botany, Zoology, Comparative Anatomy, and Vegetable and Animal Physiology.

ART. III. The officers of this Society shall consist of a President, nine Vice-Presidents, Treasurer, Secretary, Librarian, Curator, and Executive Committee, to be elected annually.

ART. IV. It shall be the duty of the President to preside at all regular meetings. In his absence one of the Vice-Presidents shall preside.

ART. V. The Treasurer shall receive all moneys of the Society, such as fees of membership, donations, &c., and disburse the same as directed, upon the written order of the Executive Committee.

ART. VI. The Secretary shall keep a record of all proceedings of the Society; shall file all papers read before the Society; shall visit different portions of this and other States; make collections of specimens; attend to exchanges with various Societies; establish a system of co-operation, and labor to incite a general interest in the study of Natural History.

ART. VII. All specimens shall be labeled, registered and deposited in the Museum of the State Normal University.

ART. VIII. Any resident of the State of Illinois may become a member of this Society on the payment of five dollars, if elected by a majority of the members present at any regular meeting, *provided*, the names of candidates for membership shall, in all cases, be presented on the recommendation of two members of the Society.

ART. IX. Each regular member shall pay an annual assessment of one dollar, after the first year of his membership.

ART. X. The Executive Committee shall consist of five members, to be selected by the Society. This Committee shall take charge of and act upon all matters referred to them by the Society.

ART. XI. The Curator shall receive and take charge of all collections and contributions of specimens, and arrange them in such place as shall be provided by the Society.

ART. XII. All regular meetings of this Society shall be held in the city of Bloomington, on the day preceding the Annual Examination at the Normal University.

ART. XIII. This Constitution may be amended or changed by a two-thirds vote of the members present at any annual meeting of the Society.

CHARTER.

AN ACT TO INCORPORATE THE ILLINOIS NATURAL HISTORY SOCIETY.

SECTION 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly*, That Cyrus Thomas of Jackson county, Benjamin D. Walsh of Rock Island, J. B. Turner of Morgan, Samuel Adams of Morgan, J. W. Powell of DuPage, John P. Reynolds of Sangamon, James Shaw of Carroll, Frederick Brendel of Peoria, Robert Kennicott of Cook, Edmund Andrews of Cook, George Vasey of McHenry, Oliver Everett of Lee, A. M. Gow of Lee, Richard H. Holder of McLean and C. D. Wilber of McLean, and their associates and successors forever, are hereby created a body corporate and politic, under the name and style of the Illinois Natural History Society, and by that name shall have perpetual succession and shall have power to contract and be contracted with, sue and be sued, implead and be impleaded, within all courts of competent jurisdiction; to receive, acquire and hold real and personal property and effects suitable to the carrying out of the objects of said society; to have a common seal and alter the same at their pleasure; to make and adopt such constitution, regulations and by-laws as they may deem requisite and proper for the government of said society, not contrary to the constitution and laws of this State or of the United States, and to alter and amend the same at pleasure; and to have and exercise all powers and privileges usual and incident to the trustees of corporations.

SEC. 2. The object and purpose of said society shall be to conduct and complete a scientific survey of the State of Illinois in all the departments of natural history, and to establish a museum of natural history at the State Normal University, comprising every species of plants, insects, quadrupeds, birds, fishes, shells, minerals and fossils, within our State limits, as far as can be obtained, comprising also such other collections of natural history, from various parts of the world, as may be deemed necessary by said society.

SEC. 3. Said natural history society shall also provide for a library of scientific works, reports of home and foreign surveys, manuals, maps, charts, etc., etc., such as may be useful in determining the fauna and flora of Illinois, and said library shall be kept in the museum of said society at the State Normal University.

SEC. 4. The museum of said natural history society shall be for the use of the members thereof, and for the citizens and schools of Illinois, and shall be accessible to the students of the State Normal University, under such regulations as may be adopted by the trustees of this society, and the board of instruction of said university.

SEC. 5. A full and complete set of specimens in every department of natural history, donated to the society or obtained by exchange, purchase or otherwise, shall forever be and remain in the museum of said society.

SEC. 6. At all stated and other meetings called by the president and five trustees, five trustees shall constitute a quorum: *Provided*, all shall have been notified. The persons named in the first section of this act shall constitute the first board of trustees; and said board shall be divided into three classes of five members, and shall hold their offices for one, two and three years respectively. All vacancies occurring in the board of trustees shall be filled at the regular annual meeting of the members of said society by an election, which shall be by ballot, and shall require a majority of the members present.

SEC. 7. The constitution and by-laws of said society now in operation, so far as they are not inconsistent with this act, shall govern the corporation hereby created,

until regularly altered or repealed by the society, and the present officers of said society shall be the officers of the corporation hereby created until their respective terms of office shall regularly expire or be vacated.

SEC. 8. The property of said corporation, both real and personal, shall forever be and remain free from taxation.

SEC. 9. This act is hereby declared a public act, and shall be in force on and after its passage.

SHELBY M. CULLOM,
Speaker of the House of Representatives.

FRANCIS A. HOFFMAN,
Speaker of the Senate.

APPROVED February 22, 1861:
RICHARD YATES, *Governor.*

POWER, FORCE AND MATTER:

THEIR DIVERSITY, UNITY, SIMPLICITY AND HARMONY, THE BASIS OF ALL SCIENCE AND ALL KNOWLEDGE.

A Discourse delivered at the Anniversary of the Illinois Natural History Society, at Bloomington, June, 1860:

By J. B. Turner, President of the Society.

It is well on all subjects, sometimes to recur to fundamental principles and consider to what final results these would carry us, if unsparingly applied to all objects of research or of thought.—Especially is this appropriate in our investigations of the Laws of Nature; for, by this method alone, can we know whether our assumed principles are true or false, and what we are to expect in their future application to phenomena still unknown, or but imperfectly apprehended and classified under these general axioms or truths

The most rigorous application of our assumed axioms to unknown as well as known phenomena, although in one aspect it may be simply theorizing, inasmuch as it may indicate a probable theory of these phenomena, in another aspect it is only a proper testing of the truth or falsehood of these axioms themselves. In either view, however inappropriate it may seem to the mere pedantic smatterer in science, it cannot be uninteresting to the true philosopher. I have thought, therefore, that it would neither be improper nor unacceptable, on the present occasion, to call the attention of this association to the probable ULTIMATE AND UTTER SIMPLICITY OF NATURE, OF THE WHOLE UNIVERSE OF GOD, as a necessary logical consequence of the fundamental axioms of the Baconian Philosophy.

None can be more fully aware of the difficulty of presenting such a subject, than the members of this association; and none can lament my incompetency to the task more deeply than myself; but with that indulgence which confessed ignorance may always claim from the truly wise, I will endeavor to present an outline

both of my thoughts and of my doubts in a somewhat intelligible form; with less regard to the technical terms and theories of extant science, or the demands of either precision of thought or elegance of style, than to the present necessities of a miscellaneous audience.

What then is the *ultimate axiom* of the Baconian or Modern Philosophy? It is the assumption of the absolute simplicity of the law of causation—or the doctrine that all effects are produced by simple and not by a complex causation.

This doctrine is based on the observation of the entire simplicity of causation, so far as our knowledge has as yet extended, or the extreme unity and simplicity of those causes which, at all points, are found to underlie and produce the boundless phenomenal variety of the Creator's works. And the *philosophic rule*, derived from this, is, never to assume but one cause where that is adequate to the result.

Is this fundamental doctrine and its resultant rule, correct? and, if so, SHALL WE, DARE WE, apply it to all known being and phenomena? But, if not so applicable, it is not, of course, correct, and should be at once abandoned, as untenable; or, at least, should be so far limited and explained, as to indicate, truly, precisely how much we do mean, and what we do not mean, by it. And even if this discourse should have no other use it may provoke thought and incite a more careful scrutiny on this point.

It is self-evident that we know but three generic forms of existence or of being in the Universe of God. To designate these by the old and more common terminology, we should call the first or or lowest in the order, MATTER; the second, the IMPONDERABLE AGENTS, such as light, heat, electricity, etc.; and third, the VOLUNTARY AGENTS, such as men, animals, beasts, birds, etc. The perceived peculiarity of the first, or of MATTER, is, FORM and its ATTENDANTS; that of the second, is simple FORCE, capacity of producing motion, or tendency toward motion, and its attendants; that of the third class, is POWER of thought and of will, in higher or lower degrees; or, POWER of will and its attendants and results; or, perhaps, better, SIMPLE SELF-MOVING POWER. By a shorter terminology, then, I will name these three generic forms of all known being:

MATTER, producing form, and its attendants;

FORCE, producing motion, and its attendants; and

POWER, producing thought and will, and their attendants and results.

I might then, perhaps, here say, that simple MATTER, FORCE and MIND, include all known things; except that it would be straining the usual signification of *mind*, to make it embrace all those lower orders of being, which seem to have some power of thought or of will; and it is not clear, to say the least, that any form of voluntary being, belongs to, or results from, mere MATTER and FORCE; though it may be so. For, though this voluntary princi-

ple, or POWER, of will or of thought, seems to exist in three distinct forms:—in connexion with reason and conscience, as in the case of moral beings; in connexion with intelligence or thought, in greater or less degrees, as in the higher orders of animal life; and, in connexion with bare instinct, in still lower orders—we still, know nothing about it, except that it is a mere POWER, of some sort, manifesting volition or thought and will—just as FORCE is known only as the cause producing motion. But, on the other hand, we can scarce resist the impression, that matter must consist of atoms or elements, though actually known only as the cause of *form* and its attendants. And thus matter, stripped of its phenomenal adjunct of form, presents itself to us as simple ATOMS; and then we have in the world, only ATOMS, FORCES and POWERS—the one producing, (or, perhaps better, merely presenting or resulting in,) all FORM; the next, producing all motion and change of place or form; and the last producing all thought and will—the great Trinity of Universal Science and Nature—the first, the proximate cause of all form; the second, the proximate cause of all motion or change; and the third, the proximate cause of all thought and all will; and, in its highest manifestations, the great first cause of, or rather power producing, all things—all motion—all change—all matter—all everything. The two first of these, matter and force, belong to the realm of the properly natural, or the realm of natural and necessary causation; the last, or POWER of will belongs to the realm or sphere of the supernatural, and lies, at least so far as we know or can see, wholly outside of the realm of necessary causation, and within the realm of voluntary self-determining, self-controlling power—existing, as indeed as do, also, matter and force, under an infinite variety of phenomenal aspects; or, rather, working with infinitely diversified degrees and aspects of power; but ever, still as an original, spontaneous and independent fountain or source of POWER, however small or large; and holding within itself, in its own inherent nature, the cause of its own action; and not, like matter and force, moving only as it is acted upon by some cause from without. But as matter, force, and power or mind, must all alike have an appropriate sphere of action, so also, in each alike, this sphere of action is not the cause of their action. For example:—as matter must have space, as its sphere of action, or it cannot exhibit its phenomena of form; and as force must have matter to act upon, as its sphere or occasion of action, or it cannot produce its phenomena of motion, or of tendency toward motion—so this *power*, this ORIGINAL SELF-DETERMINING and SELF-CONTROLLING POWER of will, or mind, must have its proper sphere or occasion of action, or MATTER to act upon and FORCE to act with, or something to choose and to do, or it cannot exhibit its peculiar phenomenal power. But space is not the cause of power, nor is matter the cause of force, nor are all together the cause of volition or of the action of this POWER of will or mind, but only the instruments or the occasions which render such action possible.

And precisely here, I pause to make my lowest bow to good old Jonathan Edwards and his erudite disciples, and bid them God speed. For it is self-evident that neither matter nor force of any sort, or in any form have any more tendency or even appetency to control mind, or will or POWER, in the true sense of the terms, than space has to control form, or inert matter to control force. And the only answer to the question "what causes this mind, this POWER, to act so and so?" which we can give, is simply this: "God made it, not a form, or a force, but a POWER, in its own nature and sphere capable of such action—just as he made force capable of its own natural action upon matter, and matter capable of assuming form in space." In other words, the natural only, or MATTER and FORCE, are governed by laws of causation; but the supernatural, or mind, will, real POWER, is governed only by the laws of volition or the laws of the SUPERNATURAL—which are neither laws of form or of force or of causation, in any such sense as is ever implied in the realm of the natural.

If now we look over the world of sense, we shall find all its infinitely varied and wondrous phenomena, *at any given moment*, to consist simply of matter, in its various forms and its attendant colors—though color probably belongs to the order of force rather than of matter—and whatever *change*, either of form, or of size, or place, occurs in these atoms of matter—whether from without or from within—whether of growth or of decay—is the result of some FORCE, astronomical, mechanical or chemical, producing or tending toward motion; and these can no more be changed, without force, producing motion, than there can be power without matter. The question, then, here arises—are these two all-producing, all-embracing elements of all being, and all change in the physical world, simple or complex?—each a unit, in itself, or multiform and varied? It is not enough to say that the books give us a great many kinds of matter, and a great variety of forces; for the question is—how do the books know? and on what authority do the books contradict the very axioms, on the basis of which they themselves are professedly written? Is their doctrine of the simplicity of nature, and of causes, to be retained or abandoned? That is the question? If it is to be rigorously retained, then we come, at once, to a view of the utter unity and simplicity of nature, that is most sublime and astounding, and still just what he who knows how simple gravity wheels all suns and spheres and atoms should be prepared to expect—and certainly many of our best writers and thinkers admit the possibility, if not the certainty, of this entire simplicity of matter.

It is generally conceded, then, that matter consists of atoms, or, as they are sometimes called, elements; and it is also quite generally supposed that we know of more than one elemental, or ultimate, or atomic, form of matter. But do we know this? or only assume it, without any ground of confidence, and strictly against all our axioms and analogies, derived from other sources? Some

have supposed that at least two ultimate or atomic forms of matter must exist, or else there could be no combination and no change, producing all the varied phenomena of the material world. But suppose that the ultimate atoms of matter are all one and the same—all, if you please, perfectly regular in their shape, like the eggs of the same bird or fowl or insect; still it is susceptible of mathematical demonstration that the forms into which these ultimate atoms may be piled or congregated, by simply varying the angles of their axis, or their relative distances apart, or both, is absolutely infinite: Thus—take the above mentioned form of matter, which we can most easily conceive of, as an illustration—the egg of a fowl. All can perceive that by varying the angles of their incidence, and their relative distances from each other, the forms in which they may be piled or congregated are absolutely infinite, producing as many forms of piles as there can be forms of matter in the universe of God—however many there may be. I shall soon show how FORCE, or the second great agent in nature, acts upon these atoms of matter, to determine all their relative positions and distances apart, in all their possible aggregations and changes. But one element or phase of this universal force is what we call heat; and the universal effect of this form of force, as it is exerted on all the atoms of matter, well illustrates, at this point, my idea. You take solid ice, and apply the force of heat, and you soon have the yielding fluid, water, from the same identical solid atoms. These same atoms, constituting ice, have now, under the application of this new force—the force of heat—changed both their form and their color, and appear like quite another substance. Apply still more of this new force of heat to this now melted ice, and you have ærial vapor, with the dew, the cloud, the fog, and the rainbow—all still out of your solid ice. Apply more force of heat still, and you have a form of fiery gas out of your inert and sluggish ice, which whirls armies and navies over continents and oceans—grinds granite mountains to powder, and chews up solid iron bars as a horse chews straw. Apply a little more, still, of this new force of heat to your inert ice, and you have an explosion of burning flames, for which we still lack a descriptive name, and, therefore, call it hot steam--hotter than the flame of gunpowder itself, and so uncontrollable, impetuous, and omnipotent, in its action and effects, that the whole solid globe itself connot restrain or control it. Now, no one supposes that the atoms or elements of the gas, the steam, the fog, the water, and the ice, are different; for we know that they are not, but that these same atoms assume entirely new forms and relations, under this new disposing FORCE—or FORCE of HEAT. And precisely similar results follow in the case of all other forms of matter, when subjected to the same force—or force of heat. These very familiar examples show how all possible forms of matter may, at least, be constituted from one and the same kind of ultimate atoms, as easily as from two or more kinds. And until we give up our axiom, as regards the simplicity of causes, it is strict-

ly unphilosophical to suppose that there is, in reality, but one ultimate atomic form of matter; since to attribute more than one simple cause, where one is adequate to the whole result, is, in science, UNPHILOSOPHICAL, if not absurd. But it may be asked—have not chemists demonstrated that there are more elements of matter than one, even in this water itself? I answer no. It is a point that never has been, and, in the nature of things, never can be demonstrated; for we can never declare any form of matter whatever to be simple, till we resolve all matter into its ultimate atoms. Till then, all we can truly say, in any case, is, that we cannot yet declare it compound—that is, cannot yet analyze it into any simpler form than itself. But not knowing and absolutely knowing are two very different things; though, unfortunately, some seem still to consider them the same.

Again—it may be asked—is not your new force, or force of heat, by which you work these vast changes in the case supposed, material, or only another form of matter? I answer—I have no more reason to suppose that heat is matter, in any proper sense of the term—that is, that it consists of atoms, like other matter—than I have to consider mind, soul, and thought, as matter. Matter is, properly speaking, only that which consists of atoms, and necessarily assumes form. Force is that which, without either known atoms or form, necessarily produces motion or change; and these two have absolutely nothing, in common, so far as we know. And as there is no force in mere inert atoms, to produce either motion or change, so there are no atoms in force which can assume form—no more than thought itself can assume physical form or exert physical force—at least so far as we yet know. True, any one has a right to extend the meaning of the term *matter*, so as to embrace what are commonly called the "imponderable agents," which I here call simple FORCE; but, if so, he ought at least to be aware that he, by such definition, pushes the term MATTER wholly out of its usual and well known sense—as truly so as he would the term "*cast iron*," if, by arbitrary definition, he should so extend its meaning as to make it embrace human souls and bodies; for, so far as we know, these imponderable agents—this universal force, (or these forces, if you please)—have not even so much in common with mere matter as cast-iron has in common with human beings; for we know that there is iron in some form in the body—but there is neither form, the essential matter in force—nor motion, the essential of force in matter alone—even in the smallest degree, so far as we know. And by what logic or rhetoric things totally dissimilar should be put under the same name I cannot conceive. Still further—the question is sometimes asked, whether mind itself is matter. We might just as rationally ask if it is pewter or block tin or cast-iron." It can be neither, except by the most arbitrary definition.

Between that POWER, whatever it is, and whatever we may choose to call it, which produces *thought* and *will*, and that FORCE

which produces *motion*, and those ATOMS or *matter* which produce *forms*, there is absolutely not even the slightest resemblance, either in their essence, their modes of action or their uniform effects—so far, at least, as we know or have any reason to believe.

If, therefore, we profess, at all, to class and call different things by different names, we must keep each of these classes, both in name and thought, entirely distinct—at least till we find between them some common idea or element.

Otherwise we might just as well call them by arbitrary definition, all together—all as one "granite," or "plumb pudding," or "wild geese," and cease, at once, from all possible reasoning and inquiry about them. For POWER, producing thought and will—and FORCE, producing motion—and MATTER, producing form, are indeed the only three things, known to us in the whole world of things and of thought, that are, AT ALL POINTS—in essence, function and effect—totally distinct and unlike. Why, then, confound or misname or misconceive them?

It might, with far greater plausibility, be assumed that each atom or particle of matter is, in and of itself, invested with a peculiar force, which impels it to move and act, under all conditions, as it does; that is, that this force, producing all motion and all change, is attached inseparably to the atoms which it moves, so as to become, in all cases, an inherent instead of an external and independent force, acting from within instead of from without upon the particles. But if so, the inert atom is still one thing—the thing of mere place and form; while the inherent force is quite another thing—the thing of all motion, all change, all life and all death, and in thought we must separate them, even if *inseparable in fact.*

But if I have not said enough to show the probability, if not the certainty, of the absolute simplicity of matter, it is still best to consider, at this point, the simplicity of FORCE, or of that which produces all motion and all change. For it is self-evident that there can be no change without motion, and no motion without force or a cause producing it; and as we have, in accordance with general usage, called the cause producing form, MATTER, so now, in obedience to the same usage, we call the cause producing motion or change, FORCE. Is force, then, in the created universe, simple or complex?

"How absurd the question!" says one. "Does not common sense teach us all that force is infinitely complex and various? Do we not all see, with our own eyes, chemical forces, mechanical forces, and astronomical; the force of gravity, electricity, magnetism—of attraction and repulsion; the force of wind, water, steam, and muscle, in all their thousand varied forms? How absurd, then, to speak of force as a simple unit, even granting that matter is but one varied aggregate of simple atoms!"

But stop one moment, my friend. Just now, you was equally sure of multitudinous ultimate forms of matter. You had your oxygens and hydrogens—your nitrogens and carbons—your metals

and gasses—all neatly boxed up and labeled, in your laboratories and books, as an indefinite number of simple forms of matter. We have already, I trust, emptied some of these empyrical vials—or, at least, written, in fair, legible hand, on their labels, "UNKNOWN," though, by every rule acknowledged by either man or God, presumed to be *simple;* and, by the same great law of simplicity and unity, this seemingly multiform FORCE should be confessed a simple unit—at least, till the contrary is proved.

But let us go back, for one moment, and consider again these three phenomena: MIND, FORCE and MATTER. MIND, as the original cause of all things; and FORCE, as the mere right hand of mind or proximate cause of all change; and MATTER, as the element or mere vehicle which, in space, makes all change, all motion, all force, all mind, cognizable to sense. Here is your man with his tea-kettle or boiler, if you please, and his ice. He kindles his fire: for the fire or the heat can no more germinate itself, without some controlling or directing POWER, than the ice can melt itself. Now, we have got just these things together: the man, or an original, self-moved or self-moving POWER; the heat, or a FORCE through which this power—this mind and will of man, may act on matter; and the matter, in the form of ice, on which both MIND and FORCE, and power and causation may act. Here is POWER—self-moved, self-directing power—in the mind and will of the man, or power of ORIGINAL, SPONTANEOUS CAUSATION, or causation assignable to no force from without the man himself—an independent fountain (so to speak) of force, which we will call, for the sake of distinctness, POWER—A POWER—to separate it from all other force as such. Second: we have simple FORCE or PROXIMATE CAUSATION in the form of heat; and third: we have the *ice*, or a form of matter, on which this power of mind or will, or of original causation, can act through, and only through some form of force or some form of proximate causation—in this case, the force of heat. Now, mark: This original, spontaneous power—the power of mind—wills to create or apply the force of heat. The heat yields obedience to this original source of power, and necessarily acts upon the ice according to its own laws of proximate causation, and throws it now into the form of water, now into that of vapor, or dew, or rainbow, or explosive gas—according as the first cause, or power, or directing mind, or will, ordains. Now, this is precisely what, and only what takes place in all forms of motion or of change of life, or of decay and death, in all cases whatever in which we know ALL the elements and causes of such motion or change. There is always, first: a POWER of mind or will of some voluntary being, human or animal—as a power or fountain of causation. Second: some form of FORCE applied or directed by this voluntary agent or power; and, third: the form of matter upon which this force acts. We notice that in this case the force applied is simple heat, and the result is varied in proportion to the intensity of its application. Now, if the power of man, with his limited faculties, by the applica-

tion of the single and simple force of heat, can throw a lump of ice into all these multiform and varied forms, who can doubt the power of God, by the same simple force, under different degrees and aspects, to produce on matter all its varied results?

Again—the Indian or the archer wills to pull his bow-string. This *power* of will sets in motion a FORCE in the muscle of his arm; that force moves the bow-string, and that again moves the bow, and that the arrow—which cleaves the air and causes the death of a sparrow, or a hero, as the case may be. Here, again, is an original power—the power of will—setting in motion a series of forces, animal and natural, determining life and death, or, it may be, the fate of armies and empires. But, as in all other possible cases, here is only, *first*, a self-moving POWER of some voluntary being—*second*, FORCE or forces set in motion or action by such power, and the MATTER on which this original power and its obedient force or forces act. And as we find force the sole cause of motion, or change, or PROXIMATE causation, in all cases fully known to us, we find the will of voluntary beings, the sole functions of original causation—the sole SELF-ORIGINATING POWER. And as there is no tendency, so far as we know, in mere matter to produce motion, so there is no more tendency in mere force to act in any way, except in so far as it is acted upon, or moved by some voluntary *power* or original spontaneous source of causation—under the genera of mind, will, voluntary being, or whatever other name you please to give it; and we have no analogy or well authenticated example whatever of any real or possible change produced without these three concurrent causes of all known change—MATTER yielding to force, of some sort, and FORCE, directed and controlled or set in motion or action by mind, will, POWER or voluntary action of a voluntary being of some sort. Hence, it will appear why I termed MATTER the cause of form, and FORCE the cause of motion or change, and MIND, or power, the great first cause of force, of motion, and of all things—the sole and only fountain of original spontaneous power, at least so far as we as yet know. True, we call this universal force by different names, according to the conditions of its action and the things it acts upon; but in all cases, alike, we know nothing whatever of it, except it is a *simple* FORCE, and have not the least reason to suppose it complex in any case more than in the case of heat supposed; and it would be just as philosophical, in this case of supposed heat, to speak of one force of thawing or melting and another force of expanding, boiling, evaporating, exploding, etc., according as the ice was made to melt, evaporate or explode, as it now is, to speak of the forces of heat, light, electricity, etc.; for we know absolutely nothing of any one of these, except simply that it is A FORCE producing certain results, widely different, indeed, as in the other case, but no more necessarily from different forces; while our ultimate law or rule of causation should impel us to speak of this all-pervading, (as in the case of matter,) as simple—a simple unit—till we have at least some reason to sup-

pose the contrary; especially if in our observations of nature we ever keep finding new facts and hints, which point toward this same simplicity of causation or of force. True, in popular language, it is well enough to speak of "water-falls" and "wind-falls" and "down-falls" of all sorts, and of force of heat, light, electricity, life, death, gravity, polarity, etc, or of a force of thawing, evaporating and exploding, provided we do not philosophically deceive ourselves and others by our terminology; and constantly remember that, as it is one simple force which produces water-falls, and wind-falls, and rain-falls, and one force that melts and evaporates and explodes. So in all other cases, our real knowledge does not extend one item beyond this single idea of *simple force*, producing varied results, in any case whatever; while many items in our knowledge, as well as the constant developments of science, and, above all, the fundamental rule or law of all science—the great rule of simplicity of causation—should compel us to speak of and regard all force, of whatever sort, as a simple unit—simple *force*—producing varied results; which is in fact all we know about it—and we only deceive ourselves when our terminology leads us to think otherwise. But it may be asked—what causes FORCE to move, or MIND OR VOLUNTARY AGENTS to will—to act? All we know is, that it is the essential nature of force to move—that is to act as a FORCE, whenever brought in contact with matter to be moved or to be acted upon. And it is the essential nature of mind or of voluntary beings to will and to act as a self-moving POWER, wherever there are forces, which this power desires thus to set in motion or action—or matter which it desires to act upon. But as the matter does not cause the force which moves it, and is only the necessary occasion, the instrument of its action, so no more does force cause the action of the mind or will, but is only the occasion or instrument which renders its action possible.

In this view of the case MATTER is the mere plaything of force, and FORCE itself is the mere plaything or instrument of supereminent MIND or will. Unless, indeed, contrary to the apparent analogy of all cases of which we can have full knowledge, we resolve all *power* into mere *force*, and consider mind itself only as a higher form of such force, and thus, again, violate a law of lexicography, at least, by including under the same name things which have no perceived analogy—*thought*, *will*—or VOLUNTARY POWER, and involuntary FORCE.

We see, too, in view of this subject, that "personal identity," as well as all forms of material identity, depends not at all on the sameness of the matter of which any particular body is composed; for all matter is, according to this view, a unit; and all forms of mere matter the same; while all variations in matter depend wholly on the variations of force or of force and spirit combined. Hence, the same spirit and the same forces necessarily assume and take to themselves the same material forms, whenever attached to matter at all, and are, therefore, identical, just as gold is always

gold, iron always iron, or any of their alloys, always identical with the same alloy. Hence, Paul's reasoning about the resurrection of the body, in the fifteenth chapter of Corinthians and elsewhere, is, at least, strictly philosophical; and all objections drawn from the constant or total dissipation or recombination of the particular particles of matter in the body, at any one time, either at or before the period of death, are unphilosophical and absurd; or, at the very best, such objections assume what no man knows, or can know, as the basis of their conclusions.

Is, then, FORCE, this proximate cause of all motion, simple or complex—one in kind, acting in various ways, or multiform and complex? Now, motion is simple change of place. It is a simple thing, though endlessly diverse in its directions and changes. Has it a simple cause? The philosophic axiom of the Baconian philosophy can not possibly allow it but one, till it is proved that more than one is needed. And as we now know that most of the apparent forms of matter are merely phenomenal, so we have every reason to suppose that most of the apparent forms of force are merely phenomenal, also. And if there are any facts, revealed by the progress of science, which would drive us from the rigorous application of our philosophic rule of simple causation in solving the phenomena of all form in matter as the result of simple elemental atoms, and of all motion and change as the equal result of simple elemental force, equally one and simple in its nature, I know not what those facts are. Why, then, is it not right to apply our rule and assume and assert its truth till we know to the contrary? Or shall we give up our rule; or hold it as dogmatists do their creeds: as a settled truth, everywhere to be asserted and proclaimed, or at least not contradicted, but nowhere to be either discussed, applied or believed—a bare, dead form of words.

Under this view of the subject, how full of life and inspiration is the study of Natural History, in all its varied departments? How manifold, and yet how sublimely simple, are all the works of God!

Only three simple things, of which to make a universe of being: angels, men, beasts and birds, earth, ocean, air; all solids, liquids, gasses; all forms of beauty and deformity—of life and of death—filling all time and all eternity: MIND, FORCE and MATTER—the great created and uncreated Trinity of the Universe of God—producing all forms, all shapes, all sights, all sounds, all arts, all life, all death, all being, all motion, all change, all everything.

True, we call these three things by various names, as they appear before us in varied forms; but does the name change the thing? So we call water ice when it is frozen, and steam when it is heated. In like manner (it may be, at least,) that we call this all-moving force, as it glances through space, from the bosom of the sun, pure *light*. As it strikes through our atmosphere, or impinges upon the solid matters of our globe, we call it *heat*. As it performs its mysterious and unknown circuits and offices around

and within the earth, (possibly causing both its annual and diurnal motion,) we call it *gravity*, *polarity*, the *centripetal* and *centrifugal* force—*cohesion*, *attraction* and *repulsion*, etc., etc. As it shoots, in fiery masses, from point to point, or from cloud to cloud, or trembles along wires, under oceans or over continents, obedient to the power of mind, (even in man,) we call it electricity. As it runs along the nerves or coils round the brain of men or animals, we call it galvanism, nervous fluid, etc., etc. As it slowly builds or shoots up the myriad forms of crystal, vegetable and animal life in earth, air, and sky, and in the vast and capacious sea, we call it chemical affinity, animal and vegetable growth, life, etc. etc. As it finally drops all things into the charnel house of death, we call it decomposition—decay. And, summarily, we speak of all its acts, in these regards, as composition and *de*composition. As it whirls along in the bosom of a storm, sweeping all things—the air, buildings, fences, trees and animals—in the same giddy whirl along with it, we call it a whirlwind; though we might as well call it a whirl-tree, or a whirl-house, or whirl-barn, or whirl-fence; for it often makes trees, houses, barns and fences whirl as lively as it does the air. While on the ocean, we call a similar phenomena a *water-spout*, and might as well call this a ship-spout, or whale-spout, too, for it takes up a ship or a whale just as easily as it does the water. Finally, when all its earthly offices and duties are done, it seeks to whirl away toward the poles of the earth, and, like the Phœnix, rising from its own ashes, to gleam and corruscate in the Polar sky on its return back to the bosom of the sun, from which it came; and then we call it the "aurora borealis"—"the morning of the north." But it is questionable whether this might not better be called the "evening of the north," for it would seem more natural to suppose that here, at last, the earthly day's work of this *mighty, all-moving force* is brought to its close.

Phenomenally, perhaps, all our varied names are well enough; just as we speak of a water-fall, a stone-fall or a tree-fall—though it is simple gravity, as we admit, that makes them all fall. And what is gravity, or electricity, or attraction, or any other form of force? Why, it is simple force, performing certain things or changes upon matter; and that is, in reality, ALL we know about it.

Simple, mighty, mysterious, all-creating, all-moving, all-destroying force—now gilding a scene; now hatching an egg or sprouting a seed; now wafting a feather or scattering a sporale; and now whirling or exploding a planet or a world—existing everywhere and doing all things—filling all space without occupying space—controlling all form, shape, color and motion, without form, shape, color or motion either—so far as we know; for motion belongs only to matter, not to force—the right hand of God, by which He moves and affects all things—if, indeed, it be at last resolvable into anything but the naked will of God itself; and, if so, it surely must be simple and not complex.

Perhaps we may never be able to solve this great riddle by actual demonstration. But if not, it is still, I contend, more philosophical to hold to the simplicity of nature and the simplicity of causation, and assume that both force and matter are units, rather than to assume, against all our axioms and known rules of evidence, that they are complex and varied. For the case stands really thus: We DO KNOW that some one kind of MATTER, FORCE and POWER does exist as the several causes of FORM, MOTION, and of THOUGHT and WILL. But that *more* than one kind of ultimate matter, force or power does exist we do NOT know; and it is surely more philosophical to ASSUME AND REPORT ONLY WHAT WE DO KNOW than what we do not know. And to draw this line between the actually known and the unknown has been one object of this discourse—that we may see, more clearly, how little we actually do know.

And to trace and note all the varied and complex manifestations, methods, relations and phenomena of that essence of MATTER, which assumes form; and of FORCE, which produces motion; and of POWER, which produces thought and will, makes up the sum total of all human knowledge, both in the natural and material world, under the great law of necessary causation; and in the supernatural and spiritual world, under the laws of free volition. The one the law of MATTER and FORCE—the other the law of SPIRIT and POWER.

This view gives a unity and simplicity to all our philosophic aims and investigations which no other view could; and at certain points tends to shield us from errors, and even from the most gross absurdities, into which the mere book-making and book-reading world have often been inclined to fall.

The absurd confounding of matter or force, or both, with spirit and power, and the great law of *inevitable causation*, which governs the one, with the law of *free volition*, which governs the other—so common in the most learned writers, especially on metaphysics and theology—could scarcely have occurred, if this view of the simplicity of the Creator's works had been, even as a bare possibility, admitted to the mind; for it at once dispels all the fog and dust of such confused and absurd notions, and shows us, at a glance, that a man might as well inquire after the gross weight of a thought, in pounds and ounces, as after the necessary cause of a volition—or after the conscience of a cannon ball, as after the matter of a spirit, or even of a force.

Consistently with this view, there never has been but three great leading modes of human thought in the world—called, in different ages and languages, by different names, and exhibited under somewhat different phases, but each resting, substantially, on the same basis—whether in Germany or Judea—among the millions of China or India—or in the wilds of America. We commonly name these modes of thought MATERIALISM, PANTHEISM and SPIRITUALISM.

The first looks upon the world from the mere material or phenomenal side, and assumes the actual SUPREMECY of MATTER; either

ignoring the very existence of supernatural, supereminent mind, or making it the mere bond-slave or instrument of matter—a "tabula rasa," as they say—a "clean sheet," on which omnipotent matter registers its hourly lessons and decrees.

The second, or Pantheism, looks at the world from the side of mere force, and, regarding mind as a mere form of force, assumes its universal supremacy. And thus, having made mere force the only God, it, of course, finds God everywhere and in all things where this force exists and acts.

The first can see no force outside of matter, and the last can hardly recognize any matter even apart from force; while both, alike, ignore the existence of mind in the highest and most proper sense of that term.

The spiritualists recognize, in some form, a SPIRITUAL POWER, such as I have described, and sometimes spread it over the appropriate realms of matter and force; making spiritual beings the direct and proximate as well as the remote and original cause of many phenomena of force and of matter. Thus each of these modes of thought is based upon some one of the *three great facts in the world;* and from hence have derived their almost incredible vitality and power over the human mind. And from each, alike, we may, as students of nature, derive some valuable instruction, which, as philosophers, we should gratefully accept, rejecting only the attendant error.

To some of the assumptions of our terminology in physics I have already alluded. But let it not be supposed that, even here, things may not be assumed as well as words. Probably, if any one should look over the text books of science, most in vogue with the most learned men, only some forty or fifty years since, he would be utterly amazed at the absurdities and follies which they contain. But do we not still assume that we know things which are not yet quite demonstrated? I confess I have many doubts about even our present attainments, at some points.

In Astronomy, we still talk about having weighed the globes as complacently as a farmer speaks of weighing his pigs. It is often supposed to be mathematically demonstrated, not only that we know their weight, but that they are all solid, and that their gravity is most dense at their centers. But our processes of weighing resemble that of the Indian trader, who put his foot in one end of the scale when he sold shot to the natives. In time, they discovered that it made a material difference whose foot was in the scale. So if we assume that the Earth and all the planets are solid spheres, that is one thing. But if they are, in fact, all hollow spheres, and occupied within only as vast depositories of this omnipresent and all-working force, without atoms or matter, in any form, then we have quite another man's foot in the scale; and our ponderous worlds all turn to mere soap-bubbles, dallied in the hand of that INFINITE POWER that controls all matter and all force, and in whose sight the created universe itself, with all its stupendous forces and

shows, is but a mere bauble—a trinket of a passing day—made for the amusement and development of MIND—self-determining and self-directing mind—a thing infinitely above all mere matter and all mere force—not only an original power, but the only such power; nay, properly speaking, the only power in the universe of God.

Again—it is supposed that the matter of the Sun and many other spheres is more luminous, in proportion to its size, than the matter of our Earth. But where is the proof? If our Northern lights are as bright as represented by Dr. Kane and others—and if the matter of our globe should be increased one million four hundred thousand times—(that is, made equal to the Sun,) and the brilliancy of these lights be proportionally increased, who can say that our Earth would not appear as luminous, (that is, as perfectly enveloped in that force we call light,) to the distant spectator, as the Sun now does to us? True, this may not be so. But I do not think that this and many other points, apparently assumed in the books, have ever yet been demonstrated, or are soon likely to be so; and I apprehend that we shall all, at last, find that the *uniformity* of nature, of both the law of matter and force, as well as their simplicity and unity, is much greater in all the worlds than the books are wont to admit. Who knows that our Earth, just as it now is, would not at once become a sun, simply by increasing its size—that is, simply, by giving a wider field for this force called gravity, electricity, light, Northern lights, etc., to act in, and display itself upon. According to this notion, the Sun is simply, so to speak, a greater galvanic battery than the Earth, requiring, using, giving off, and receiving, more of this force, in its varied forms, only because it is larger and needs more, and perhaps generates more. In this view of the case, there is no proof that the remotest planet in the solar system is any colder than the Sun itself; for, like the Sun, each one may make its own fire, or generate its own heat, by a law compensating for its distance from the centre.

Again—where is the proof that either light or heat is diffused through all space from the Sun, or any other sphere, by universal radiation from the center, like the light of a candle, instead of flowing off toward, and only toward other orbs, in straight lines, as electricity moves toward the matter alone that attracts it. Candles and fires of earth throw their light all around, it may be, because the matter that it seeks, or which attracts it, lies all around. But it is not so with the Sun. And that light and heat or any form of force run needlessly and wastefully through all vacuity, all space, to my mind is an assumption which, with many others of like sort, needs proof. In this view, above suggested, all planets shine in proportion to their size and their own inherent light, and also in proportion to the light attracted to them, or poured in parallel lines upon them, from all other planets; and with us, of course, most of all, from the Sun—so that one side of the Moon gives us

its own light, augmented by the influx from the Sun; and the other side, the same light, augmented only by the stream or influx from the other planets, which is very dim. Now, if the contrary of this suggestion has been proved, surely the proof is not quite as demonstrable as such assumptions in science require; and for one I would like to see the proof of a multitude of similar points assumed made a little plainer before yielding my unquestioning and undoubting assent. That this force of light, whatever it may be, is attracted toward the denser medium, or matter, we have full proof. How much it is so attracted we cannot say.

In Geology, too, we assume that these forces, or this force, exists and acts now in this way, and now in that—at one time the Earth is a bladder, full of water, and anon a bomb-shell, full of fire—one day we trip up Moses' feet, and the next day we set him bolt upright again, on a new pair of exegetical stilts.

In Physiology, we assume that this force, in the production of life, or "vital force," as we call it, acts now on one principle and now on another; and while we agree that all embryos, seeds, and beings, of whatever sort, have, in time past, been created or produced by this force, under the guiding power of God, yet we seem startled if any one suggests that the very same processes, in kind, may be, so far as needed, going on now; and that God has neither gone to sleep, nor this all-creating force become either idle or inactive. Said an eloquent one of old, "Why should it be deemed a thing incredible to you that God should raise the dead." But we seem not to have faith enough to believe that he can make a grain of chess, or clover, or purslain seed, or a new ant's egg, or fly, when he needs one—because it is against the laws of nature, as we say—that is, against the laws of the identical POWER and FORCE, that made all things, and still holds them as they are. But by what logic or law of nature do we infer that that POWER and force which has created all things, may not create still another thing, either the same or different in kind, where it is needed. If Adam was created with all the nameless forms of vermin in and about him, which are now known to live only on the human body, he must have had a merry time of it in his new Paradise, and I do not wonder he rebelled. But if not so created, some living creatures must have been produced since the original creation. And if living things, why not seeds and plants?

In METEOROLOGY, it is generally assumed that tornadoes are caused by a vacuum, or partial vacuum, in the air. Now every fire and candle produces such a partial vacuum; but who ever saw, even on the smallest scale, such motions of the air produced by these vacuums? Is not the balloon or funnel shape of the tornado, also, exactly wrong end up, to suit the purposes of this theory? or, if not—are not the movements of the air upwards almost exactly the opposite to what they should be, on any possible theory of a mere vacuum, and air rushing in to fill it. And where is the evidence that such a vacuum exists at all? The usual fall of the baro-

meter is, of course, no proof. [illegible] any force, forcing the air and all things else upwards, would evidently produce on the barometer the same effect as a vacuum. And if such vacuum, or partial vacuum, is near the earth, why does it not sensibly affect the men and animals thrown into it? But who ever heard of any such testimony. To the best of my knowledge, want of air is quite the last thing any man in a whirlwind thinks of complaining about. The waterspout and whirlwind, or tornado, are usually ascribed to the same cause. But what tendency there can be in a mere vacuum, over the sea, to lift up the water, instead of the yielding air around, and thus create a water-spout, I confess I cannot see, any better than I can see its tendency to create a whale or a rhinoceros. True, if there is a vacuum there, the water might jump up to fill it, instead of the more yielding air all around; and so might the whale; and, indeed, so he would, if he was there. Then, we should have, I suppose, a "whale-spout," or a "*whirl-whale*," instead of a water-spout or a *whirlwind*. Beside, what produces this vacuum? or does it produce itself? Some force, of course, must do it. Why, then, not come right to the truth, at once, and state the simple fact, that this mighty, mysterious, all-moving, all-creating, and all-destroying force, which we see at work everywhere, but know nowhere, in accordance with its own innate laws, in one of its modes of action, whirls air, seas, men, trees, temples and ships, all, ALL ALIKE, aloft, and thus creates a whirlwind, and a "whirl-house," ship, tree, and water, too—a "whirl-everything" that comes within its grasp; for this is simply and strictly ALL we know, as yet, about it.

Is it asked, in any case, where this force comes from? Comes from! Better, far, ask where it does not come from.

Professor Farraday professes to have demonstrated, says the Atlantic Monthly Review, of July, 1860, that one single grain of water contains as much of this elemental force, in the form commonly called electricity, as can be accumulated in eight hundred thousand Leyden jars, each requiring to charge it thirty turns of the large machine at the Royal Institution. If this is so, God, the Infinite Creator, is, surely, not likely to become bankrupt in an ever-present available force, either on sea or land, to make all things, at any moment, either whirl or stand, live or die, as he pleases. Doubtless, his law of volition and action will continue to be, as it ever has been, somewhat fixed and constant; and thus make for us, and for all our intelligences and sciences, that uniformity of phenomena which we are pleased (looking amazing wise all the while) to call the "LAW OF NATURE." But his internal resources of POWER, and his external magazines of FORCE, will not be likely to become soon exhausted, even should whirlwinds, tornadoes and waterspouts be greatly increased, or a new seed now and then sprout and grow, or even a new animal be created; yea, whole globes, systems, and spheres, of new suns, earths, men, animals, and trees.

Then, again, there are the new—what shall I call them?—sciences, arts? truths? facts? or, diabolisms, witchcrafts and humbugs?—phrenology, mesmerism, biology, spiritualism, etc., etc. Well; I well remember the day when we students of old Yale were cautioned against phrenology, as the great antichrist of the times, and the temptation of the devil. Now the necessary position of the clergy in human society, in all ages, makes them so prone to be conservative, that they often have regarded a new thought as a temptation of the devil, (though in our times their love of knowledge is bravely overcoming this weakness of fear,) and I admit it may be so; though I think that, at least, some of the new thoughts that have come into the world under the common fate of being denounced as the children of the devil, have actually sprung from the power of God, wielding according to its fixed laws, that mighty force that moves the world, in all outward manifestations, both of matter and of mind. True, I would regard the old adage, and "give the devil his due;" but to give him everything, that is really worth giving to any body or being, is a little too much. I do not think him worthy of that honor. And as he has NOT succeeded in running away with astronomy, geology, electricity and gravity, in olden time, I am opposed to bequeathing to him any new manifestation whatever, of either POWER, FORCE or MATTER, mind, motion or atoms. Nor do I assume, that we, as yet, understand the full play and interplay, action and reaction, of mind on mind, or power on power, power on force, and force on matter, throughout the whole universe of God, natural and spiritual, so as to be able to say precisely, and most punctiliously, this old thing, which we do understand, is of God, and this new thing, which we do not as yet understand, is of the devil; for I consider it, at least scientifically, if not theologically, possible that God knows and understands several things which we do not, and are not likely to, even in this most enlightened and democratic nineteenth century. At all events, as philosophers, we shall, in this age, as in ages past, learn more by watching and recording facts, than we shall by berating the devil, ever assured that POWER, FORCE and MATTER, working by their own laws, are adequate to all we see and know, without the devil's help, except in his own appropriate work and sphere; and I have never known him to become as yet the father of a new science or the creator of a new fact.

To inquire and examine fearlessly and critically, into these and all other phenomena, is one of the ends of this Association. In what weakness and fear it began its being, and amid what toil, and want, and poverty, it has, thus far, continued to struggle, there are some present who well know. And if its working officers and members have not literally worked for nothing and lived upon nothing, they have come so near it as utterly to spoil the remark as a figure of speech. The report of what they have done, will be presented by the superintendents of the several departments.

But, my friends, why should not this society, with such success as it has already attained, and such talent and such laborers in its behalf, even though homeless and penniless, be in good heart? Is it not the poor, ragged, frugal and hard working boy that ever makes the man? Who now are the two prominent candidates for the highest office in the gift of the civilized world? The one is a poor orphan and the other a poor rail-splitter. So may it be with our Association. Nurtured in poverty and want of all things, it shall yet rise through usefulness to glory; for such is the order of nature and of God. To this end all power and all force tends; and to this law all nature and matter must submit. Go on then, my friends, with thanks for the past and good hope for the future. Who, among us, in that first hour of our weakness—the natal hour of our Association—thought, then, that as much would be actually achieved in ten years, as has already been done in two? and that, too, although the times have been seemingly all against us. It is true that we owe obligations to many friends, both as individuals and as associations; to the hospitable citizens of this place; to the guardians of the Normal School here; and to our great State Associations, Agricultural and Horticultural, now represented here; to the editors of the State, and to many others who cannot be mentioned—for they have all given us a hearty God-speed, and a helping hand, whenever they could. We, also, owe especial thanks to the gentlemanly conductors and guardians of our various railroads, whose generosity and patriotism ever leads them to favor a good cause, quite up to, and sometimes even beyond, the extent of their real ability. Nor should we forget that noble corps of Teachers, the Illinois State Teachers' Association, at one of whose annual meetings the first idea of this Society was suggested, and so many of whom have co-operated and sympathised with it in all its labors and trials.

But the speaker owes to you, on the other hand, an apology, as well as thanks, in leaving again the office, with which you have seen fit to honor him for the two past years, in your hands. I frankly told you in the outset, that I could personally do but little for you; and unexpected events have rendered even that little far less than I intended—so very little in comparison to what others have done, that I could not let this occasion pass without distinctly adverting to it. But that little has been done cheerfully—most cheerfully, and I only now crave your pardon, that it has not been more.

Go on, then, my friends, with good heart and good hope. Use POWER—grasp FORCE—control MATTER—and thus, as thus mortal beings only may, serve man and glorify God.

THE GREAT TORNADO OF 1860.

By James Shaw, of Mt. Carroll.

The great Tornado, of June 3d, 1860, which swept, like the besom of destruction, over the northern counties of our State, deserves more than the passing newspaper notices it received at the time of its occurrence. In magnitude it was the greatest in the history of storms. It originated far off on the prairies of the northwest; traveled in a southeasterly direction until it approached the Mississippi river; then gradually veered round towards the east in a crescent shaped pathway, until it assumed a northeastern course, on which it continued, passing over Lake Michigan and the Peninsular State, till its force was spent, after a five hundred mile race. And here a strange fact might be noted. All the great tornadoes of long continued tracks, of which we have any knowledge, originated near the same spot. Another, near the time of the great Tornado, swept along down to the southward, near the Missouri river, crossed into Illinois in the region of Alton, wheeled round towards the east and north, very similar, though less violent than the one of which we write. In 1844 a terrific whirlwind came down from the prairies of Northwestern Iowa, crossed the Mississippi not far from the crossing place of the June storm of the present year; then pursued almost its exact pathway across Whiteside and Lee counties in our own State.

Not only the vast destruction of life and property in the great Tornado of 1860, but many scientific questions, heretofore but imperfectly understood, demand the attention of the thinking, and turn hither the eyes of the scientific world. An unexplored field opens up at the very first inquiry into the causes and philosophy of these tornadoes. Little is understood of them. They have been chiefly observed within the tropics—on the seas. The yielding waters closed over their pathway. Facts, data, phenomena, could not be collected. The little we did know about them is completely at fault, when we come to explain the long, revolving storms of our mighty prairies of the West. New facts baffle all our science.

Old problems must be resolved. The deep philosophy of storms; the knowledge of "the winds in his circuit;" the forces of electricity, heat, magnetism; the laws of fluids in motion; a keen insight into the mysteries of meteorology—all these, and more, must be well understood before we can solve all the problems attending these terrible storms. The fantastic modes in which the mighty forces of Nature sometimes act puzzle our most learned and scientific men. This was doubly so in the great Tornado of 1860. Was it the *pressure* of the mighty storm wind; was it a display of the electricity of the atmosphere; was it some mightier power that produced results so contradictory and almost omnipotent? Science is now deeply engaged in the investigation of these questions.

She needs in this work facts, data, phenomena. Every one, who has any, should give them to the world. A circumstantial detail of the minutest may prove of much importance. For such a purpose, also, to add a few crude thoughts of my own, this paper is prepared.

The subject cannot be better introduced than by some quotations from a sermon, preached in this village by the Rev. O. D. W. White, a short time after the event it commemorated. He, in company with the writer, visited the Tornado's track, where its greatest power was displayed. Out of good eyes he looked, and treasured their observations in a wisdom loving mind.

After describing the beauty and stillness of the holy Sabbath afternoon, by way of contrast, he proceeded: "There was a change —an appalling change. There came a wind, a rumbling, a rush, a crash, a whirl, a shriek, a wail, followed by a desolation that has sent mourning through the land—whose saddening echoes will be heard for ages to come. More than half a century will have elapsed before the scene will have been erased from the memories of eye witnesses. In the after part of the day the clouds began to congregate as they are wont to do about the western horizon. At first they seemed to have met, like holy angels, for purposes of mercy, to shed the gentle rain upon the thirsty field and water the husbandman's toil. But soon they began to be disturbed and utter tones of anger, and pierce each other with arrows of fiery lightning. And then advancing, as a mighty army sweeping over the battlefield, they commenced their dire work of devastation and death. Everywhere in the course of the angry Tornado trees were uprooted and tossed into the air like feathers. The very land was scooped up like the sands in the desert. Imbedded rocks were torn from their ancient resting places. Fences, barns, houses, cattle, horses, sheep, fowls; with men, women and children, were caught up amid the darkened folds of the whirlwind, to be dashed down again and crushed against the unyielding earth. * * * * The storm has been traced in its track, according to latest accounts, more than two hundred miles west of the Mississippi river. When it was first seen it was advancing in two columns, which were six or eight miles apart. After passing Cedar Rapids, where some

were killed and a number wounded under the ruins of razed buildings, the columns united their forces, as they were about to make a furious charge upon the denser population of Iowa. Mechanicsville, De Witt, Camanche, Albany, Lindon, Como—all beautiful and growing towns—were the principal points of the loss of life and property. The list of mortality is yet imperfect; but it is known that over *one hundred and fifty* souls were precipitated into eternity; and most of them amidst the wildest confusion of warring elements. In some instances whole families were blotted out of existence. In others, children were snatched from their mothers' arms and thrown into the angry vortex Again, others have been left orphans, homeless, clotheless, foodless, and I were about to say friendless; but no; thank God, thousands of kind hearts weep for the orphan ones; who would take them to their homes of pleasure and of plenty. The list of the wounded is also imperfect. But it is keeping within bounds to say that over *two hundred* are now suffering from wounds and bruises—some of whom will recover wholly, while others will be disabled for life. As to the destruction of property, the loss will only be estimated by the million. Many years will have elapsed before the desolated district will recover its wealth, population, and wonted activity. In the course of time the wound may be healed; but the deep pitted cicatrix will be worn by the States of Iowa and Illinois till the time of their latter days.

"To philosophize upon this particular storm would require us to give the history of winds, their causes and courses, both in the tropical and extra-tropical regions. While propriety forbids this it may admit some few remarks. Some of the characteristics of this storm were these: The whirlwind assumed the form of an inverted cone. It had an axis on which it revolved, having one pole—the positive—in the clouds, and the other—the negative—on the earth. It possessed three motions: centrifugal, centripetal, and vertical. By the first it was propelled forward at the rate of sixty miles per hour; by the second, it revolved on its axis at a much greater velocity; while the third kept it dancing up and down in the air something like the boy's kite. Having a zigzag course, it traveled to the northeast, directly under the track of the returning northeast trade winds. Its centripetal motion, like all such winds *north* of the Equator, was from right to left, or contrary to the motion of the hands of a watch. At the same time it was highly charged with electricity, as evinced by electric phenomena, such as picking hens and geese, as electricity only can do; stripping tires from cart wheels and laying them out straight on the ground. When such elements are contending so furiously, it is not strange that everything in their course is destroyed.

"From these well known data the following hypothesis may be given: It was formed by the intersection of two currents of air, namely: the northeast trade winds that had veered around by the north to westward, and the returning winds from the southwest.

These two intersecting motions produced a third and intermediate one, which, with the rotary motion of the earth, gave the storm a northeast direction.

"This Tornado seems to be out of place, or lost, both as to time and latitude. Science has recorded but one Tornado as early as the month of June, and that was a marine one. It occurred in 1831, in the latitude of Trinidad. The season for tornadoes is during August, September and October—seldom earlier or later. Their well known regions are the West Indies, Indian Ocean, and the Chinese Sea. Hence, any recurrence of this calamity is not likely to be suffered soon, if ever."

In addition to these characteristics, the following phenomena or appearances of the storm from this town, some twenty-five miles north of the Tornado's track, at its nearest point are worthy of preservation. Towards sundown of that day an ordinary looking thunder cloud was observed to be passing along the horizon from the southwest towards the east. As it came nearer, the clouds were observed to be in violent agitation. A low, ominous roar, began to be heard, increasing in loudness every moment. A constant rumbling of thunder, accompanied the short crackling sound in the air. The finest electrical display it has ever been my lot to witness was kept up all the time. The whole black mass of moving storm cloud seemed a vast celestial bonfire, so vividly did the lightnings illumine its shadowy edges, and stream through its troubled folds. The Storm Fiend seemed to rage with demoniac fury. The air was in a high state of electrical excitement. White, fleecy clouds floated about the denser mass, whence proceeded the roar. The cumuli and cirri moved slowly about and around the terrible nimbus cloud of the center. Thus the storm approached its nearest point; then died away towards the east, following the steps of the twilight, until stillness and darkness together came, and closed over earth.

The next morning our county was literally strewn over with bits of shingles and light wood, tin cups, pie pans, fragments of papers and letters, and many kinds of light articles. This was true of the whole country over which the Tornado passed. These, and kindred light articles, were scattered for fifty miles on either side of the whirlwind's path. A few days after the storm, as an intelligent farmer of our county was plowing in his fields, an old letter attracted his attention. It was dated in the same county in Pennsylvania from which he had originally emigrated to this country; written by a man whom he knew; about a transaction in which he was interested; and addressed to a friend of his own then living near DeWitt, in Iowa. He immediately left his plow and arrived at DeWitt in time to sympathize in a scene of sorrow and death. The house had been taken up in the arms of the storm and scattered in pieces over the land; and this scrap had floated sixty miles and told the husbandman of his friend's distress.

This phenomenon is easily explained. These articles were caught up in the spiral folds of the hurricane, borne aloft until its whirling motion was spent; then carried off in different directions by the upper currents of the atmosphere. The light ones of course would travel to the greatest distances. Some authorities have denied the *rotary* movement of these tornadoes; but the fact is too well established by the testimony of observers, and by the effects of the whirl, to be gainsayed. I myself observed one later in the season pass over the eastern part of our county. Its force was soon spent, but for a few miles it was exceedingly violent, lifting one barn from its foundation, and injuring everything in its way. The atmosphere was in a high state of electrical excitement. A number of bright looking clouds moved rapidly, like sheep chasing each other, round an invisible center. Indeed, every one who has ever seen one of these storms, has noticed, the very first thing, the revolving motion of all ascending substances. Hurricanes, whirlwinds, tornadoes, waterspouts, typhoons, cyclones, doldrums—all these have an advancing motion as well as a rapid motion of a rotatory kind. So, our recent Illinois tornadoes have had this motion in a violent degree.

To those living in and near the track of the storm, its approach had the appearance of an elephant; the clouds being after the similitude of its body, and the funnel shaped Tornado, looking like a trunk, the lower part of which kept swinging about with an unsteady, swaying motion. This left a zigzag track upon the ground, the reason of which will be noticed hereafter. Citizens of Camanche all say that fleecy clouds were floating in a troubled manner about the air, often breaking and showing glimpses of blue sky beyond. These, at intervals poured down showers of big rain drops, mingled sometimes with hail. A gentle wind blew from the northwest. A terrible roar came from the same direction. While it was yet at a distance a dead calm came over the town. Then a violent east wind sprung up. Then, in a moment, the great Tornado, like the besom of destruction, swept the ill-starred town into ruins. Then a violent west wind followed the broom of the mighty storm.

This fact seems well established as the beginning of our data, viz: that the wind blew violently *towards* the storm as it passed along from every point of the compass. At Camanche, we have already seen, the Tornado was immediately preceded by a strong east wind and followed by a west one. The ferry boat in the river opposite the town was driven by the first of these upon the Iowa shore; there it was whirled about by the Tornado; a few minutes afterwards it was driven upon the Illinois shore and dashed in pieces. In one place I was informed a tree grew, forked near the ground. One of its parts fell in one direction, the other, in the other, from this same cause. Along the northern verge of the track, of greatest force, trees and everything else were blown towards the south, along the southern they were blown towards the

north. Everybody who saw the town afterwards, remembers the chimney blown from a fine residence in the southern part of the town, and stuck endways into the ground, north of the house. These are facts. Near the center of the whirl large locust trees were twisted and wrenched off near the ground. Furniture was shivered into oven wood. In one instance I noticed where the under story of a house had been blown out and destroyed, and the upper one had settled down almost uninjured upon the foundation. Iron seemed to have been most strangely affected. In the dwelling house first alluded to, the stoves were all blown or taken out of the doors and windows, and strangely broken up, while in other respects the house was little injured. All testify as to this strange effect upon iron; though only a few at the time noticed any marked electrical phenomena in connection with it. Some, also, noticed indications of a vacuum, while the hurricane was upon them, such a peculiar sensation in the ears, and an unnatural loudness of the human voice. Many, also, testify that there was a great and unnatural heat in this vortex or vacuum.

Such were the data gathered in Camanche. In Albany and other places I had these observations confirmed. One instance in Albany might be noticed, going to strengthen the supposed inrushing direction of the wind. Two houses were demolished. Articles from the cupboards of each were found in the other's yard, after all was over. As the houses were on an east and west line, the good women folks could see how the dishes went from the western into the eastern yard, but were sorely puzzled as to how those from the eastern house got into the western yard, against the course of the great storm. They had not noticed the previous wind from the east.

In order to preserve all the data possible, it will be proper to insert here some observations in regard to recent Illinois Tornadoes, made by Prof. Turner, at the last meeting of the Illinois State Natural History Society. The first one of which he speaks occurred ten miles south of Jacksonville, in May, 1859:—

"This tornado was one of great force and terror. It not only prostated trees, houses and fences in its path, killing and wounding many persons and animals, but it seemed singularly and unaccountably to break and tear in pieces, to utterly demolish and destroy every thing it touched near the center of its path. Its track covered an area of some ten miles in length, and one-half to three-quarters of a mile wide, as the theater of its greatest fury and power. Houses, men, trees, animals, and even two-horse wagons were whirled aloft high in the air, and literally shivered to pieces. The weaker parts of wagons were not only broken, but the tires were torn off, cut in two and straightened out *straight*, or crumpled into strange shapes and thrown with great fury to the ground; other parts were shivered almost to atoms, and in one instance, even the hub was broken square in two by the violence of the wrench in stripping the tire and other parts from the wheel. Rails

and other timbers were not simply blown away, but literally made into kindling wood, so as to be unfit for any other use. Persons were stripped of their clothes, and even the fowls, in many cases, had all their feathers stripped clean from off them. Most of the fowls treated in this manner, were found dead, as well as the other animals that were in the center of the path of the Tornado, but some of them still lived. The only persons known to the narrator, who were in the very center of the track of the Tornado and escaped alive, were Mr. H. M. Cowell and his hired man. Mr. Cowell is a plain, uneducated farmer, of honest and unpretending character, and a man who has no philosophical or metaphysical theories of any sort to repel or defend; indeed, he never read a book of any sort in his life, and, in the opinion of the narrator, is wholly unable to read or write, though a man of good character and good sense. This was stated by the narrator to show the kind of man whose account was to be taken of the appearances inside of the Tornado.

"At the time of the appearance of the tornado cloud in the southwest, at five o'clock, P. M., May 26, 1859, Mr. Cowell was plowing in the field, at some distance from his house, with an old steady pair of farm horses. He saw the frightful, balloon-shaped cloud approaching directly toward him very rapidly from the southwest, while a steady wind was then blowing directly against the cloud from the northeast. The advancing cloud was of a distinct balloon or funnel shape, and then appeared to him from his position, peculiarly bright and luminous, not at all black or dark in any of its parts, except at its base or bottom. The top part of the cloud particularly appeared to be in terrific agitation, much like the foam on the top of a large boiling cauldron. Greatly alarmed at the threatening and singular appearance, he at once attempted to drive his horses and plow to the house, which was about a quarter of a mile distant. In doing this his course in the field lay for some distance in the same line with that of the approaching storm; that is, to the northeast. He had not proceeded far before there seemed a lull in the northeast wind and a dead calm. The horses suddenly took fright, and refusing to advance, commenced rearing and plunging in their traces. Their manes and tails and all their hair "stood right out straight" as he expressed it, and they only jumped up and down without advancing. The iron on the harness, traces and plow, in his language, "seemed all covered with fire." He felt a violent pulling of his own hair, which left "his head sore for some days," and the hair itself rigid and inflexible. He tried to unhitch the traces, but something seemed to prevent him; he felt a violent twitching of his hands; but finally succeeded, and mounting upon one horse he succeeded in making him advance, though his fright and his rearing and plunging and the peculiar appearance of his mane and tail continued till he got out of the direct line of the storm which was for some minutes. He then turned from and out of the line of the

storm toward the house. Then this appearance wholly subsided, and he turned to the stable, put his horses in, and ran towards his house. He had got almost to the house before the wind began to blow. Then it almost instantly hurled house and all away with it. But as the cloud passed over, as soon as he came within it, its whole appearance was changed. Instead of being bright, it was pitch dark, so dark that he could see nothing at all until he came to the center, when it was light again, making the impression on his mind that the dark part of the cloud was a mere shell, like the outside section of a tunnel. Mr. Cowell distinctly states that while he was, for those few moments, riding in the direct path of the storm, the light was so brilliant that he could not endure it with his eyes open, and for the most part kept them shut; while the cloud behind in the horizon, still appeared as before, yet there was no wind, no thunder, and no noise whatever, except the murmuring sound of the advancing tempest, which of itself was not audible at first. He thinks he thus rode in the direct path of the storm about fifty yards before he turned to go to the house. As he departed from the center of the whirl, he experienced these phenomena less and less sensibly, and before he reached the stable there was nothing of it.

"Mr Cowell's hired man, Mr. Alex. Campbell, who was at work in another part of the field not far distant, in passing also to the house, went directly across the track of the storm, which Mr. Cowell had crossed obliquely. He was also as much frightened at the light and the shocks he experienced, and shut his eyes as much as he could, and ran and soon passed through it.

"Mr. Cowell states that others experienced similar effects who were near, though not in the center of the whirl.

"When the terrific whirl struck the house, which was a little at one side, as supposed, of the exact center of the storm, it swept everything before it, even tearing up the brick foundation of the chimney for a foot below the surface of the earth; stripping all the feathers off from some of the hens and turkeys, as perfectly clean as if picked for the table. Some, though badly plucked, and made entirely blind, still lived. But no thunder at all was noticed, and no great noise whatever was heard while in the center of the dark cloud, though the roar to those a little distance without was terrific.

"The narrator stated that one John Ray reported that the Vernon church, surrounded by an Osage orange hedge, was taken up. with its brick foundation, and all together set over the hedge, which was not bruised by the passage of the house, and not a brick of the foundation was left inside the yard. The house was set down again, and left quite whole.

"The narrator said that Dr. Ford, of New York, reported other instances of tornadoes, in which persons had their clothing entirely stripped from their backs.

"How much, said Prof. Turner, of all these strange and almost incredible reports was due to alarm, or mistake, or misapprehension, he had no means of knowing. He only reported the substance of the facts as reported to him, and quite a little pamphlet might be filled with details, equally incredible, reported by persons of undoubted veracity, the above being only given as samples of the strange facts that are so reported.

"But in May, 1860, a whirlwind of less note passed over the so-called Hillsboro farm, the residence of Prof. Turner himself, tearing down the fences, tearing the roofs completely from the larger buildings, sweeping away the smaller ones, etc., etc. He had carefully and accurately examined this ground during all the time the superintendence of the needed repairs was going on. And he especially noticed that the old rotten glass windows in the brick house, on the windward side as well as on all sides, *were left perfectly whole and sound in their places*, not one being blown out or broken, although the sash of some five or six of them was so rotten that a child could have pushed them inward with its thumb and finger; while the doors of the house and barn, all stout and strong, were blown inward with such violence as even to tear off heavy iron hinges, and to tear out heavy pieces of oak timber, and the entire L of the house and roof and gables, were swept away from the same building and the same exposure.

"Prof. Turner said that on no theory he had ever before admitted, could he account for this very singular fact as well as the facts reported by Mr. Cowell and others. And he would inquire if ever any one had heard of the windows of a house in tolerable repair being blown in by a tornado, while the building was left standing; or if it was common, as in this case, to tear the strong parts of the house, and leave the weak and even rotten windows and wood on such, unharmed? If so, what was the cause? He asked: Did it not appear self evident that mere *pressure* of any sort would burst in the frail windows of a house far sooner than any other part of it? And yet the reverse had certainly occurred in the instance narrated by him, and coming within his own experience."

These are all the data I have been able to gather in regard to *Recent Tornadoes in Illinois*. Even these need confirmation. No two persons can be found after a tornado who will agree in all things. Terror takes away the power of correct observation. Illusions deceive the eye.

Science, before she can establish her deductions, must have more data—better established facts. Observers over the prairies of the Northwest must gather these in the coming years.

A few crude speculations, however, will here be offered in regard to the scientific questions presented. If new data demand it, they can be corrected. How do the winds form themselves into a whirl? Can their *pressure* and *mechanical force* produce all the physical results observable after such a storm as the one under con-

sideration? Is electricity the cause, or are its phenomena only the accompaniments intensified of a thunder storm, displayed in a tornado? Can electricity, by direct transference of the fluid, or by induction, as in the pith-balls of school room experiments, account for such mighty and fearful displays of power?

Some philosophers and geographers explain all rotary storms to be the result of the meeting of two winds at an angle and their turning upon a center. If a cloud happen to be between these two winds, near the place of meeting, it would be rapidly turned round. Condensation and the electrical phenomena of a thunder-storm, if added, would give all the forces at work in a tornado. Such are the causes shadowed in the first quotation above, and also set down in our text books in geography and philosophy. This hypothesis, however, is exploded by more recent developments in Meteorology and Atmospheric Electricity.

In studying the philosophy of winds, it is a good thing to read the lessons of analogy in its laws of fluids in motion in the rivers and seas. The *air ocean* has much in common with the *earth ocean*. Both have mysterious movements — tides, currents, ærial and ocean streams, eddies, mælstroms, whirlpools, waterspouts—hurricanes, tornadoes, whirlwinds—these have a family resemblance. At the confluence of two streams of water, even in a little brook, whirlpools are formed. The meeting of adverse ocean streams would present similar phenomena. These would travel but a short distance. The like might take place at the meeting of two adverse winds. But the whirl would be gentle—its path would be short. In the Indian Ocean and Chinese Seas, and in intertropical countries generally, where there is much disturbance of the air currents on account of the fierce contest between the Trades and Monsoons, hurricanes, cyclones, doldrums, and waterspouts, are of frequent occurrence and of short duration—averaging but a few miles in length.

But if this be the true theory, why not have tornadoes and whirlwinds in the winter and spring? Certainly the winds are then fiercer and contrarier than at any other season of the year. Yet, instead of frequent rotary movements of the atmosphere, no one ever saw them at all in the winter or early springtime.

In addition to air in motion, heat and electricity both must be present in active manifestation. Some scientists consider one, some the other, as the great cause of tornadoes and all kindred storms. The fact—if it be a fact—that such storms whirl in one direction—to wit: contrary to the hands of a watch—in the Northern hemisphere, and in a contrary direction in the Southern and opposite hemispheres, seems to argue that the earth's revolution upon its axis also has a modifying influence.

Suppose that the air of some locality becomes heated from any cause. Of course the heated air would rise into the higher regions of the atmosphere. Currents of other air would flow in from all sides to supply its place. Becoming heated, they, too, would rise;

and, according to a well known law of motion, would receive a rotary movement, with a partial vacuum in the center; just as in water flowing through a funnel. If a handful of down be scattered near the top of the chimney of a lighted kerosene lamp, this may be illustrated on a small scale. The uprising current of hot air will carry all the particles which come into it upward, and gradually communicate to them a gyrating movement. Those outside of the current will flow in, and rise as the others before them. And thus a whirlwind in miniature will be observable, as long as the cause continues. A large brush pile, or a house on fire, will afford a similar illustration, with the sparks and smoke and whitecaps flying about. In all these cases there is, perhaps, a partial vacuum in the center—the resultant of this kind of motion. Waterspouts are mere shells, being hollow in the center.

It seems a fact that the dew point and point of saturation lie lower comparatively over the mighty prairies of the Northwest. During the warm weather of summer, therefore, this lower and thin stratum of moist air, lying beneath the dew point, will be pressed down by the strata of dry air above. Radiation from the earth and other causes will tend to heat the moist stratum reposing on the earth's surface. This will produce a destruction of the atmospheric equilibrium. Currents will flow towards the point of greatest heat, as above shown. As this lower, moist atmosphere rises into the cooler and dryer regions above, it will have its moisture rapidly condensed into clouds, or down-pouring rain. If electrical action now be added the tornado forces are complete.

Thus, the Great Tornado of 1860 originated somewhere in the country of the Upper Missouri river. The Northwest winds bore it along, gently at first, but as the accumulation of momentum made it rage fiercer and rise higher into the air, it was caught by the returning trade winds from the Southwest, carried round towards the Northeast, its greatest curvature in its earth marked path being where it crossed the Mississippi; which was also the place where it displayed its greatest force—the whole motion not being unlike a comet sweeping around its perihelion. This explains the action of the Tornado upon the ferry-boat and dishes at Albany, the cause of the trees being blown inwards on both sides of the storm's path, the East and West wind in rapid succession before and after its passage, and the strange position of things after it was all over. The key to the explanation of its zigzag motion is also found here. Rev. Mr. Harsha, of Dixon, prepared an accurate and beautiful map of the Tornado's track across Clinton county, in Iowa, and Whiteside and Lee counties, in Illinois. The lesson of the map is very instructive. It teaches, that wherever the tornado changed from a direct line of advance, it was owing to some local obstruction, which cut off, or weakened, the inblowing air current from the side towards which the storm rushed. Thus, it always left a direct path to hug along under a hill, or by the edge of a grove. When the obstruction was passed, the direct course of

advance was again resumed. Observers all agree in saying that the top of the terrible, funnel-shaped cloud advanced in a straight line, but that the lower part described this crooked path, as we have seen, by obstructions to the currents of air rushing in. Mr. Harsha did much for the cause of science, and of humanity, too, in his study of the great Tornado, of which we speak. His labor of love in relieving the suffering will be remembered side by side with his labor of science in preparing a very instructive map of a part of its pathway. I am indebted to him for many suggestive thoughts, as well as for the privilege of studying the map of which I have spoken.

The peculiar state of the dew and saturation points being nearly the same over the prairies of the Northwest—in other words, the strata of upper and dry, cool atmosphere, and of lower, surface, moist atmosphere, extending from the country of Nebraska to the great lakes of the Northeast, gave the Tornado a field for its long and terrific course. It scooped up, over that five hundred miles of sorrow and death, from the warmer atmosphere below the dew point, the wind for its raging whirl, the moisture to be condensed into rain and hail, and the very electricity which made it so much more dreadful.

This explanation of the causes of tornadoes seems to be the result of the more recent study into the philosophy of storms. Not only tornadoes, but even ordinary thunder storms, are carried on, probably, in the same way—by lower moist air rising and being condensed in a much milder manner.

Professor Henry, of the Smithsonian Institution, adopts substantially this hypothesis, after a careful study of the views of Loomis, Espy, Dr. Hare, Redfield, and others, who have observed and written upon storms; and also after a comparison of a great amount of facts and data in possession of the Institution, of which he is Secretary.

The electrical phenomena attendant upon these efforts of the atmosphere to restore its broken equilibrium, next claim our attention. Dr. Hare thinks electricity the cause of the tornado, and all such natural phenomena. This scientist attributes the violent upward motion of the air to a peculiar electrical state of the atmosphere, in which, while the air is highly positive, the earth is negative, and the bodies carried up are repelled by the earth and attracted by the cloud. Whether this is the true explanation or not, every one can see the great disturbance of the electrical equilibrium that must take place in a tornado. As a rule, the electricity of the atmosphere is positive; that of the earth, negative. The same is true during a thunder storm. The greatest electricians of this and other countries have demonstrated this by many and laborious experiments. As a tornado passes over the landscape, sucking up and condensing the surface strata of moist atmosphere, with all its electricity and latent heat, the ground under the cloud must be constantly exhausted and the cloud constantly and greatly surcharged. Hence, there will be constant discharges back to the

earth from the cloud. The equilibrium is constantly destroyed; nature constantly seeks to restore it. Powerful attractions, repulsions and inductions will take place almost with every stroke of lightning. Tornadoes and many other influences, carry electricity up into the air. The air being a non-conductor, or rather, being imbued with imperfect insulating powers, the attempts of the electricity to flow back again to the earth and restore the disturbed equilibrium between the ground and the clouds, are attended with various electrical phenomena. The tremulous and many-tinted undulations of the Aurora Borealis over the Arctic skies, is doubtless nothing but electricity creeping back through poor conductors to the earth home, whence it had been enticed into the region of clouds. The fierce, unchained lightning, stabbing the earth as with the dagger of a god, is the same thing greatly intensified. The ravages of the tornado—with its "terrific and appalling grandeur; now pausing fitfully, as if to select with malignant caprice the objects of its unsparing violence; now descending to earth, and again drawing itself up, with its deep, loud and sullen roar; its mysterious darkness; its apparent, self-moving, resistless revolutions, carrying upward branches of trees, beams of houses, and large objects of every description; its impetuous downward rush to the earth, and then again up to the sky; its sublime altitude, sometimes erect, and at other times inclined; its reeling and sweeping movements"—these may be the result of electricity suddenly accumulated, and bursting as suddenly out, before it has had time to discharge itself by more peaceful channels. Thus, Lieut. Jansen calls tornadoes "the circulating channels of electricity hidden in a deep night;" and some authorities consider waterspouts as solely due to the same cause.

Mysterious, all-pervading wonder, before whose phenomena science so often must stand dumb! Philosophers and scientists tell us its powerful agency works unseen on the relations of the parts and properties of all bodies, effecting changes in their constitution and character so wonderful and minute that it may be considered the chief agent of Nature, prime minister of Omnipotence, the vicegerent of creative power. We also know that the lambent flame of the aurora; the laws of crystalization, health, vegetation; the great convulsions of nature, as earthquakes, whirlwinds, waterspouts, tornadoes, thunder-storms, and many other phenomena, are accompanied with and often depend upon electricity, or some of its magnetic or galvanic forces. Indeed, this imponderable source of all power and thought may be nothing but the exertions of the Divine Mind, as He rules the universe of mind and matter and force.

We think, however, that Mr. Espy has well nigh settled the question that electricity is not so much the cause as the consequence of a tornado or thunder-storm. But, whether cause or consequence, we can see how intense electrical action must be. Even the mechanical force of electricity, especially of lightning, is great

and often inexplicable. Professor Lovering states that pavements have been torn up; hair and hoofs carried into trees; a hat transported to the roof; the bark of trees detached below; leaves crisped on the under side; and sods turned up, by this force. The *modus operandi* of this force is as follows: Particles of air, suddenly electrified, fly asunder with a great explosive force, as do the pithballs attached to the prime conductor and electrified. A stroke of lightning will suddenly imbue the air within a tree or rock with this more than gunpowder explosiveness; and they will be blown into fragments. The air thus acting may lift a church; or acting among the non-conducting feathers of a chicken, or goose, may throw them far from the body of the fowl; or may jerk the tire from a wagon wheel and straighten it along the ground. All the phenomena spoken of by Professor Turner, and all observed in the great Tornado, may also thus be explained. But if this were not enough, the great force of the wind, together with the violent inductions, attractions, repulsions, above alluded to, would give a catalogue of forces, whose effects would be multiform, indeed.

A kite flown into the clouds and acted on by induction, will have all its electricity driven into the lower part of the string, from whence it may be drawn off in sparks. So a tornado cloud, extending high into the air, and acted on by induction, will have its lower extremity terrifically charged with electricity. Every flash to the earth will momentarily reverse the electrical condition of the cloud and the ground under it. Thus, mighty and conflicting forces will work out their designs on the grandest scale. "The tiny twinkle of Omnipotence" will be indeed seen and felt.

Every one remembers the strange theory of some philosopher a few years ago, who proposed to produce rain by kindling great fires over an extensive tract of country. At the time he was considered a crack-brained fanatic. But he had in his possession the true secret of storms. If he could have heated up a stratum of air, and charged it with moisture, he not only would have had a thunder storm, but even might have had a tornado upon his hands.

The summary we arrive at is this: The rarifaction of the atmosphere in summer produces an unsettled state of the air in which the winds are liable to break loose from their controlling forces. A local heating causes a rush of winds to the place of disturbance. They meet in the center and rise; generally with a whirling, gyratory motion. They will only take place at a peculiar state of the dew point and point of saturation in the atmosphere. The whirling vortex or vacuum will advance with the course of the wind in which it may happen to be. The low stratum of moist air lying below the dew point will be sucked in and carried into the upper atmosphere. The friction of the ascending moist air will produce fearful quantities of electricity. Rapid condensation will produce rain and hail; evolve more electricity; and free great quantities of latent heat. The electricity of the clouds and earth will act by induction and mechanically. And thus, the tornado will be self-

sustaining, so long as the conditions of the atmosphere are favorable.

Many years may possibly elapse before the atmosphere will be able to furnish the materials for so long and violent a storm. Meantime, it is earnestly to be hoped, that patient and exact observations will be made during the coming summer, wherever a tornado or thunder storm occurs. Among the facts to be noticed, the condition of the dew point before the storm ought to be carefully known. The clouds ought to be closely scanned, to obtain their electrical conditions and the force and direction of the wind currents. Observations on the tornado's direction, and whether the motion round the vortex is whirling, or upward; whether low lands, streams, groves, and hills influence its direction; luminousness, and width, and shape of tornado cloud; condition of the atmosphere before and after its passage; in short, every phenomena attendant upon it, from the minutest to the grandest, ought to be carefully observed. Especially, accurate surveys of the path of the storm, after its passage, noting accurately the direction in which trees and other objects are blown, should be made and preserved. Any and all such information, sent to the writer of this article, will be thankfully received, and used to the best of his ability. In this way we may be able to add some contributions to the sum of human knowledge.

Since writing the above some new facts in regard to our subject have been developed. Persons living near Lyndon, who were caught within the storm, assert that an intense coldness prevailed near the center. This is easily explainable from what has been before stated. The centrifugal force of the uprising, whirling currents would produce a vacuum within, down which, at times, the upper and colder atmosphere would rush, mingled with rain and hail from the rapidly condensing cloud above. In this way a central spot would sometimes be very cold, notwithstanding it might be surrounded with rarified and heated air.

T. B. Butler has written a book upon the "Philosophy of the Weather," in which he attacks, and in his own mind demolishes all the existing theories, and almost every conclusion arrived at by the most eminent meteorologists. He makes a perfect Zouave charge upon them all, sparing nothing, and builds up no new theories where he has torn down all the old ones. So far as he undertakes any explanation at all, it is that electricity is the cause of all meteorological phenomena. The earth, he argues, is a great magnet, surrounded with magnetic currents in the form of circles and curves, just as the currents of a strong magnet arrange the iron filing round it. These electric currents act upon the oxygen of the atmosphere and carry it along, producing the circulation of the atmosphere. In a tornado, according to this doctrine, a continuous current or stream of electricity exists between the earth and the storm cloud; that these streams flow in from either side of the advancing storm, having polarity, and making a "law of cur-

vature;" in short, "that currents of electricity alone could produce the sudden vacuum by removing the air above." His book is valuable for the many facts and indefatigable labor in its pages, but utterly fails to establish the supposition that magnetism and electricity account for all weather phenomena. The very arguments adduced, every fact brought forward to overthrow the theories of Espy, Redfield, and others, goes to establish them. As for instance, he denies that the wind blows from all points towards the center of a storm; but admits that it flows in from either side in a curved path. Very well. Now suppose a storm stands still and the wind blows towards the center all round. This is what he expects to see made out. But give that storm a rapid onward motion and things will be slightly disarranged. Add to this the air rushing down in the middle and up the sides, and a great complexity of motions will take place. Almost every objection urged against the theory, even the curved path of the inflowing lateral air currents are capable of a mathematical demonstration by the laws of motion and in accordance with the theories of Espy and Redfield. The former of these supposes the gyratory motion of the tornado; the latter the aspiratory, or that the air currents flow in and up without any whirl. We think the true theory is a combination of both these, as advanced in a former part of this paper. In other words, the air flows in from all sides and *begins* to flow upwards in straight lines, but being subject to the law of motion, which makes fluids running through a funnel assume a rotary motion, it is soon thrown into a gyratory motion, which increases as it gathers fresh momentum.

Electricity is not the cause, but the fearful accompaniment of a storm; and in the tornado its fury is greatly increased by the friction of the whirl and the rapid condensation of the vapor above.

GEOLOGY OF A SECTION OF THE ROCK RIVER VALLEY,

FROM OREGON, IN OGLE COUNTY, TO STERLING, IN WHITESIDE COUNTY.

Read before the Illinois Natural History Society, June 27th, 1860.

By Oliver Everett, M. D., of Dixon, Illinois.

My object, in this paper, is to give some of the results of observations made by me upon the geology of the Rock River Valley, in Lee county, and a part of Ogle and Whiteside counties, or from about Oregon, in Ogle county, to Sterling, in Whiteside county. The surface in this part of the country is much more rolling, or undulating, than in most parts of the State. This is particularly the case in the upper portion of the section alluded to, in Ogle county and a part of Lee county, where it is frequently cut up into deep ravines, on the sides of which the underlying rocks are often exposed to view; and the banks of Rock River and its tributaries frequently present bold, perpendicular bluffs of rock, from fifty to two hundred feet high, thus giving a tolerably good opportunity for geological investigations. These features are most prominent in the region of one member of the geological series of which I shall hereafter speak, viz: the Upper or St. Peter's Sandstone. In another section, where the Trenton Limerock underlies the drift, there are frequently found deep pits in the ground. These pits are generally more or less circular, and are from one to two or three rods in diameter, at the surface of the ground, and run to a point below. They are from ten to twenty and sometimes thirty feet deep, and have, evidently, been produced by the earth, in these places, falling into and being carried away by subterranean streams of water in the loose rock below.

Below Dixon, although the surface is considerably undulating, it is not so abruptly broken by deep ravines, and the prairies generally slope gradually to the banks of the river, seldom exposing the rocks at all. Below Dixon there is very little woodland along the banks of the river, while above, between Dixon and Oregon, a considerable portion of the country along the river is covered with

timber. The timber is not generally of very heavy growth, although, in some places, on the bottom lands, it is quite large. It consists of the various species of oak and hickory common to the State, the black and white walnut, the sugar and silver-leaved maple, box elder, (Negundo accrifolium,) sycamore, the red and white elm, hackberry, ash, linden, cottonwood, etc. The red cedar, the white pine, the ground hemlock, (Taxus Americana,) the black and the paper or canoe birch, (Betula lenta and Betula papyracea,) are found on the extreme verge of the rocks overhanging the river and creeks, beyond the reach of the prairie fires. All these last mentioned species, except the red cedar, are found, as far as I have observed, only upon the bluffs formed by the St. Peter's Sandstone. We should naturally expect to find on a soil produced from the disintegration of this sandstone, some plants which are not common to the rich alluvial and clayey soils of a large portion of the State. Accordingly I have found several species not included in Dr. Lapham's Catalogue, and some of them not in the additional lists subsequently made by Drs. Brendell and Bebb, and which I presume are not often found in other parts of the State. Among which I might name two species of vaccinium, the Aretostaphylos uvauisi, Lupenu perrennis, Campanula rotundifolia, Talinum teretifolium, Lobelia kalmii, Cerastium oblongifolium, Linaria canadensis, Fragaria vesca, and the Viola lanceolata, which grows on the borders of ponds, or in wet places in this sandy soil.

The drift formation, through this section, is probably not so thick nor so uniform in depth as in most parts of the State. There are many things in relation to it which have peculiar interest, but my object in this paper is to speak of the rock beneath it.

There is, in this section of about thirty miles of the Rock River Valley, a pretty good opportunity to study several important members of the lower Silurian system, and some of the lowest strata of the upper Silurian series.

Commencing at Oregon, with the St. Peter's Sandstone, and ascending the geological scale, as we go down the river, we find the Buff Limestone, (of Owen,) the Trenton Limestone, the Galena Limestone, and the shales, etc., representing the Hudson River group of the lower Silurian system, and the Niagara Limestone of the upper Silurian series.

ST. PETER'S SANDSTONE.

The lowest rock which we find in the section under consideration is the Upper or St. Peter's Sandstone. It is the prevailing rock along the river, from a mile above Oregon to about three miles below Grand De Tour, a distance of thirteen or fourteen miles. On the north-west side of the river, I think that in no place does this rock appear on the surface more than two or three miles from the river. On the south-west side it extends several miles back from the river. I should think that the thickness of this rock could not be less than two hundred feet, and probably more. The country

where this rock prevails is characterized by great unevenness. It is frequently cut up into deep and sharp ravines, and, in many places, there are bold, precipitous bluffs, from one to two hundred feet high. I have not often found these bluffs capped with the Trenton Limestone, as spoken of by Prof. Hall as being the case in Iowa. In many places this sandstone is interspersed with numerous horizontal bands or layers of iron, or sandstone so impregnated and cemented with the oxide of iron, as to be very firm and resisting. These layers are from less than half an inch to two inches in thickness, and occur, one above another, in some places but a few inches, and in others several feet apart. These layers resist the action of the atmosphere for a great length of time, and only give away from the disintegration and wearing away of the rock beneath, when they break off and fall from their own weight. Between these layers the rock is sometimes very loose and friable, easily worked away with the pick.

It appears as if, during the deposition of this rock, that occasionally, in these localities, the surface was in some way covered with a sediment of the oxide of iron, which, acting as a cement, rendered this portion of the rock much harder and firmer than other parts of it. If you will examine one of these layers with a magnifying glass, you will see that they are made up principally of the same minute peculiarly formed grains of quartz, of which other portions of the rock is composed, stained and partially covered with the oxide of iron. We frequently find very beautiful ripple marks on these ferruginous layers. On some of them the impress of the eddies and ripples of the old Silurian ocean appear as fresh and palpable as if produced but yesterday. These markings are sometimes very singular and curious, mimicking the forms of organized life. Here is a specimen which I have been at a loss to determine whether it has been produced by the action of water or is an impression of some organized being. This rock is composed of small rounded grains of pure limpid quartz, which have a singular uniformity in their size and shape, in some places cohering so slightly as to crumble in the hand, and in other localities so firmly cemented as to make a good building stone. This rock is in some places of almost chalky whiteness, but more commonly it has a grayish aspect, while in other localities it has a reddish appearance, being stained with the oxide of iron.

As to the economical uses of this rock. There are several quarries on Franklin creek, in Lee county, and in Ogle county, where it has been pretty extensively used for building, and cut into window and door sills and caps. There was a beautiful arched bridge of cut stone, from one of these quarries, built over Franklin creek, for the Chicago and Fulton Railroad, when it was first constructed. Professor Hall says that this rock would make an excellent material for making glass.

It will be perceived that this rock, as it is found in the valley of Rock River, varies considerably from the description of it given by

Professor Hall, as it occurs in Iowa. Instead of its being uniformly the loose friable rock, spoken of by Mr. Hall, with scarcely cohesion enough to enable him to obtain cabinet specimens of it, we frequently find it forming bold perpendicular, and sometimes overhanging, cliffs, with strength and tenacity enough to make a good building stone. There are places where the rock is flinty and hard, and weathers out, like granite, in jagged and irregular peaks, high above the surface of the surrounding country.

BUFF LIMESTONE.

Next to the St. Peter's Sandstone, and separated from it in some places by two or three feet of shale and blueish clay, comes the Buff Limestone of Owen, classed by Hall with the Trenton Limestone. This is a thick bedded, compact, semi-crystalline magnesian Limestone, in layers of from one to two feet in thickness. It crops out in many places above the St. Peter's Sandstone. Between these thick ledges there are thin shaly layers, an inch or two in thickness, abounding in fossils. Although these layers are full of fossils, there appears to be but a very few species. They are very imperfect—most of them are casts, and appear to be such as are common to the Trenton Limestone proper. This rock is often quite fine-grained and compact, and makes an excellent building stone. From an analysis of specimens of this rock in Iowa, Professor Hall thinks that it may be very useful for the manufacture of hydraulic cement, as its composition was found to more nearly resemble than any of our other magnesian limestones, that of the best rocks used for that purpose in other places. These thick bedded layers are from twelve to eighteen feet in thickness.

TRENTON LIMESTONE.

The Blue Limestone of the Western Geologists, or the Trenton Limestone of the New York survey, succeeds these magnesian beds. This rock is quite variable in its appearance. In some places it has a blueish color, particularly on a recent fracture, but more frequently it is of a dull buff color. It is not so thick bedded as the preceding rock, and is in some places quite shaly, and breaks up into small fragments when quarried. In other places the layers are compact and thick enough to make a good building stone.

There are vertical crevices frequently found in this rock, which are from two to fifteen inches in width. Sometimes they are filled with debris, and in other places are open and serve as channels for subterranean streams of water from the pits in the elevated ground back from the bluffs, which I have spoken of above. At the base of the bluff, after a heavy shower, or at the breaking up of the winter, swollen streams of turbid water may be seen rushing from them.

The Trenton Limestone abounds in fossils. It is the oldest rock in this country in which we find a great profusion of the remains of organized beings, showing beyond doubt that the ocean of the lower Silurian era was filled with a multitude of the lower forms

of animal life. Here is a specimen not much more than twice as large as a man's hand, that has representatives from three of the grand divisions of the animal kingdom. This central figure is a fine large Trilobite, a beautiful specimen of the Articulata; and here are several fragments of coral and the stem of an Encrinite from the Radiata, while the Molusca is represented by several of the Acephala and a Gasterapod. There are great numbers of Arthocerata found in this rock. Some of them are of very great size. I have seen sections of them that were eight inches in diameter. I have a part of one in my collection which is not more than six inches in diameter at its largest part, that is eight feet in length. Ammonites of considerable size are found in this rock. Among the Acephala are several species of Septæna. Strophomena, Orthis, etc., are common in some of the layers of this rock.

This rock is somewhat extensively used for building material, although for that purpose it is not equal in value to the magnesian beds below it. It makes excellent lime, and is extensively used for that purpose. Some of the layers of this rock, in this locality, are made up almost exclusively of fossil shells and corals, and are very compact and fine-grained, and receive an excellent polish, making a very beautiful figured marble. The Trenton Limestone is found principally in the bend of the river, in the upper part of Lee county, extending about four miles south, and is also found in a narrow belt on the north-west side of the river, extending from Pine creek, in Ogle county, to within a mile of Dixon.

GALENA LIMESTONE.

The Galena Limestone succeeds and rests upon the Trenton Limestone. The line of demarkation between this and the Trenton Limestone is not always easily ascertained. Layers, partaking sometimes more of the characteristics of one of these formations and then the other, are often found intermingled for some distance, although the characteristics of the mass of the two formations are very distinct. It appears to be the prevailing rock, underlying the surface of the elevated prairie, over a considerable portion of the north-western part of the State—the streams having in many places cut down through it into the strata beneath. The Galena Limestone is a rock peculiar to the West, and is a very important member of the lower Silurian series. It is important not only from its thickness and the extent of country which it covers, and the many economical uses made of the rock itself, but from the rich minerals it contains. It being peculiarly the lead-bearing rock of the North-West, as is indicated by its name.

The Galena Limestone is a coarse-grained, porous, and sometimes friable rock. It has a dull grayish and sometimes yellowish color, and, from its porous character, weathers out very rough and irregularly. It is everywhere characterized by its peculiar fossil, the Sun Flower Coral, the Coscinapora sulcata or recepticalites of Hall. In the lower beds of this rock there is a very beautiful species of

Favosite quite common. Its pentagonal columns, or rather tubes, filled with transverse lamina of a pure siliceous material, radiating from a point, present a very beautiful appearance, particularly on a recent fracture. This coral is often found in large masses where it has weathered out of the rock, sometimes entire, but more frequently broken into fragments. Among the gasteropods found in this rock are the Marchisonia, Pleurotomaria, etc. The Orthoceras, Crytoceras, Ammonite, and some of the bivalves common to the Trenton Limestone, are often found in the lower beds of this rock. This limestone is the prevailing rock along the river, from a mile above Dixon to near Sterling, where it disappears beneath the Hudson River group and the Niagara Limestone. This rock, as may be seen by the map, spreads out over a much greater extent of country as we go back from the river, on either side.

HUDSON RIVER GROUP.

On the immediate banks of the river, along the rapids at Sterling, and at the base of the bluffs a mile above town, on the north side of the river, may be seen the various rocks, shales, clayey and bituminous deposits described by Professor Hall as the Hudson River Group. The rapids in Rock River at Sterling seem to have been produced by the wearing away of the shales of this formation. I have been unable to ascertain what the exact thickness of this group may be, but think that it is probably not more than twenty-five or thirty feet. On the map accompanying this paper I have represented this formation in a narrow belt, surrounding the Niagara Limestone, on the east and north side.

Although the rocks of this formation do not appear at the surface, except at the rapids and at the bluff above Sterling, I have been able to trace them, in the course indicated on the map, by examination of the rocks thrown up in the digging of wells.

NIAGARA LIMESTONE.

The Niagara Limestone is found on the north side of the river, above Sterling, extending through the north-eastern part of Whiteside county. This rock is also a magnesian limestone, and resembles, in its composition and appearance, the Galena Limestone. There is a good opportunity to examine this formation at the quarries, a mile above Sterling. There it may be seen resting on a green compact rock of the Hudson River Group. The lines of charts common to this rock are found there in abundance, sometimes forming layers six inches thick. The characteristic fossil of this rock, the Catenapora Escharoides, and a beautiful species of Favosite, are common there. I also noticed a species of Marchisonia and two or three bivalves. The rock from these quarries makes an excellent building stone, and is extensively used for that purpose.

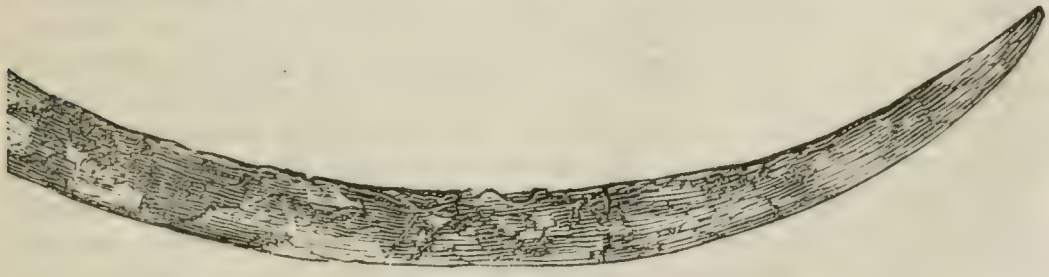
MASTODON GIGANTEUS.

By C. D. Wilber.

During the last ten years, in various portions of Illinois, have been found the teeth and tusks, and, in some instances, the vertebræ, of a huge mammal, called the Mastodon. All the remains, thus far discovered, are indicative of the same species, *i. e.*, *Giganteus*—so called from its vast size. Many teeth have been found in Northern Illinois, especially in the Lead regions. Some have been washed out by the rivers, at Spring flood, while others have been obtained in railway sections.

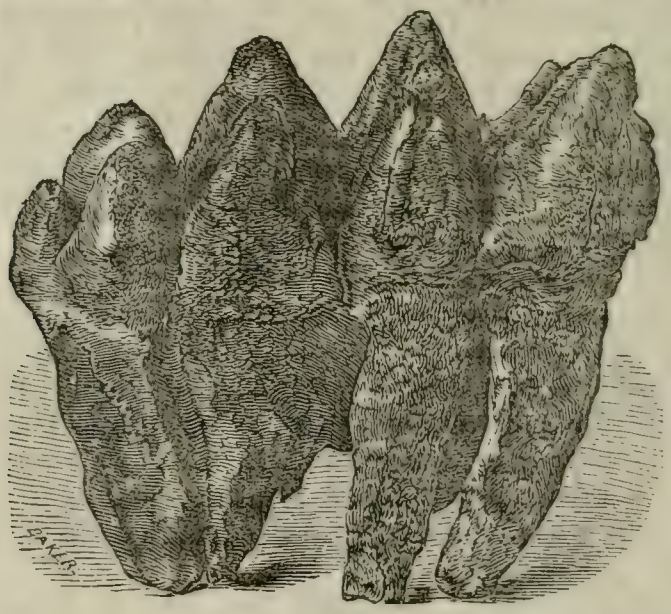
The "largest specimen" of this order, (Mastodon,) once lived near Aurora, where his remains were recently found, in excavating for the track of the Chicago, Burlington and Quincy Railroad. There were the tusks and seven teeth—all in a good state of preservation, "the tooth of time" having consumed all other vestiges. The teeth and tusks were found as near each other as when they were in the animal's head; from which we may conclude that he laid him down to die with much composure, and was allowed to sleep on quietly through the ages.

The tusks, when entire, measured ten feet in length and ten inches in diameter at the base; they were curved upward, and were considerably worn at the ends, on the under side. They appear to have been used as huge levers, for the purpose of overturning trees, large and small, whose foliage and branches served him for food—a conclusion at which we also arrive from the construction of his teeth.



The foregoing figure represents one of the tusks in the natural position. As it was uncovered, one of the laborers, an Irishman, with an ax, cut it nearly asunder, thinking it was "white wood." It resembles the tusk of the Elephant, (or Mammoth, which is simply a fossil elephant,) whose tusks are fixed to the upper jaw like incisor teeth, and have a solid structure. The tusk of the Mastodon has an outer shell, one inch in thickness, very hard, fibrous and compact, not unlike the massive curved cables stretched over the towers at the Niagara suspension bridge. The mass within is white, like decayed ivory. The weight of each tusk is 200 pounds, and judging from its shape, position and material, we are obliged to say that a forest of oak or pine would "grow small by degrees" before a drove of these formidable tree-eaters.

The teeth, as one would suppose, are of great size, and weigh from five to eight pounds each. The front teeth weigh from three to five pounds, and resemble, in their construction, those of graminivorous animals. They appear to have been worn out, the crown or enamel of the teeth having nearly disappeared.



The above cut represents a "wisdom tooth" of the Mastodon. It weighs seven pounds, and measures eight inches in length and breadth, and is about five inches in thickness. The protuberances of the surface, from which the name Mastodon is derived, are smooth, and seem to have been used for breaking portions of limbs of trees, which was done after the manner of an old fogy flax-break, the processes shutting into, but not touching each other. The pieces or chips thus made, were then masticated by the front teeth, which served as molars, an exception to the present mode of grinding. However, some contend that the front teeth were used only as nippers, for biting off branches or leaves and grass.

By observing the last figure, which represents one of the smaller teeth, the relation of the two sets will be readily perceived, and it will also appear that the huge monster was decidedly a vegetarian.

"The teeth consist chiefly of dentine, invested by enamel, though a layer of cement, thinner than in the Elephant, invests the fangs, and is spread over the crown. The whole number of teeth is twenty-four, of which rarely more than eight are in use at one time. They are developed from behind, forward, in order to relieve the jaws from the excessive weight of the whole at once. Two on each side, in each jaw, are developed soon after birth, and are shed early. The first and second of the upper jaw resemble those of the lower. The third is three-ridged. The fourth is three-ridged, larger, with the eminences notched. The fifth has three ridges, each with two eminences. The sixth is four-ridged, with a small heel; the points sometimes bifurcated, deep furrowed, and measuring six and one-fourth by three inches; and in one instance, nine and a half to five and a half inches."

Several years ago, six Mastodons were exhumed in New Jersey; and, as Cuvier had predicted from a single tooth, they had twenty ribs, like the Elephant. Within the ribs of one of the Mastodons, a dark colored earth was found, which, on being examined with a microscope, exhibited the remains of some vegetable, which Dr. Lyell considers to have been the half decayed twigs and leaves of the pine or fir tree. The whole mass of vegetable remains taken from one carcass was eight bushels, or one stomachful!!!

Taking the tusk as one-third of the length, which is the usual estimate, and allowing half the length for the height of the animal, we can easily restore the proportions of the Mastodon, and we are obliged, therefore, to conclude that when alive and in all his glory, he was thirty feet long and fifteen feet high. But this estimate need not transcend belief, for we have already, in several museums of Natural History, remains of the Megatherium, (great beast,) measuring twenty-four feet in length. This was also a grass-eating animal. The Zeuglodon, (yoked tooth,) whose remains are in the St. Louis Museum, (Wyman's,) was ninety feet in length. It be-

longs to an order of reptiles inhabiting the waters of primitive oceans, which, ages ago, became "dry land."

At this period the animal kingdom seems to have attained its limit. Huge beasts, like the Mastodon, stalked over the plains, and great Saurians plowed the waters, like Winans' steamers. The Prairie State was at that time mostly a watery waste, and Lake Michigan found its western shore many miles beyond its present limits. The northern part of the State was above the sea level, and was covered, doubtless, with coniferous trees and tall rush grasses. Fox river was tributary to the Gulf of Mexico, (as we have since called it,) and the Mastodon, like the ox, grazed along its banks.

It has been thought that this individual, on going from the river to the upland, was "swamped" in one of the "sloughs," and being very old could not extricate himself; so he died and his bones are with us until this day. Some have even said that the Mastodons were once so numerous that they consumed all our forests, leaving us the *prairies* and a few groves—a conclusion which accounts for our peculiar topography, and which is entitled to quite as much consideration as a dozen other theories in regard to our prairies.

For what purposes these creatures were made, "we do not know, for we were not present." Nor can we see any uses which they could serve, except to teach us that, in order to complete the great work of Creation, another race must appear possessed of higher characteristics, and having no relation to the greatness of physical proportions.

This animal must not be confounded with the Mammoth, or fossil Elephant—several species of which have been found in North America, in the same formation. The remains of *both* the Mastodon and Mammoth have been found together, at Big-bone Lick, Kentucky. Professor Rogers argues that they lived together, in the long period of surface tranquility which succeeded the strewing of the general drift, and were overtaken and exterminated together by the same changes, partly of climate, partly of a second but more local displacement of the waters, which reshifted the drift and formed the later lake and river terraces.

We subjoin a few notes taken from Dr. Warren's Report on the Mastodon, the most complete description extant. Dr. Warren had an entire skeleton in his museum in Boston. The skeleton of an Elephant was placed near the Mastodon, in order to show the contrast of size and similarity of construction. The remains referred to, in possession of Dr. Warren, were found near Newburg, on the Hudson river, in a large morass, the huge bones "lay sprawling out," each occupying its natural relation and position.

The specimen above referred to is very nearly the same size as the one found at Aurora, and the measurements are nearly the same for each portion of its structure.

The cranium is flatter than in the Elephant, narrow between the temporal bones, the face becoming twice as wide below the nasal

opening. The length of the superior surface, from the vertex to the edge of the pre-maxillary bones, is forty-eight inches, and the width between the superior orbiter processes twenty-eight inches; the posterior or occipital surface is nearly vertical, roughened for muscular attachments; the temporal bones are of great size, indicating the power of the muscles which filled them; lower jaw V-shaped—the anterior pointed extremity having on the internal surface a long wide groove for the tongue. The cervical vertebræ have short spinous processes, except the last, which is six and a half inches long; the dorsals are twenty, and, with the three lumbar, form a considerable arch, the first seven having very long spinous processes; the first lumbar measures across the transverse processes seventeen inches; the sacrum consists of five bones, and is twenty inches long on the lower surface; caudals probably about twenty two, very strong at the commencement of the tail, which reached to the knees. The ribs are twenty—thirteen true, and seven false; the first nearly vertical, resembling a clavicle, and twenty-eight inches long; from this the ribs increase to the ninth, which is fifty-four and three-quarter inches; thence decreasing to the last, which is twenty-one inches. The massive humerus is thirty-nine inches long, with equal circumference, with a remarkable projection, extending two-thirds down the limb, for the deltoid muscle; the circumference of the elbow joint is forty-four inches; radius is twenty-nine inches long; ulna much the stoutest and thirty-four inches long. The thigh bone is massive, and about as long as the humerus, seventeen inches in circumference at the middle, and thirty at the lower portion; the kneepan nearly globular; tibia human-like, twenty-eight inches long, thirty inches in circumference above and thirteen and a half in the middle; fibula twenty-six inches; feet more depressed and toes more radiating than in the Elephant.

This skeleton is eleven feet high; seventeen feet from end of face to beginning of tail; the latter being six and two-thirds feet; circumference around ribs sixteen feet five inches; tusks about eleven feet, of which eight and two-thirds feet project beyond the sockets. The size of the head of one specimen, found in Orange county, New York, is as follows: breadth, thirty-one inches; height, thirty-three and a quarter inches; length, forty-eight inches.

An analysis of the tusks shows the following constituents:

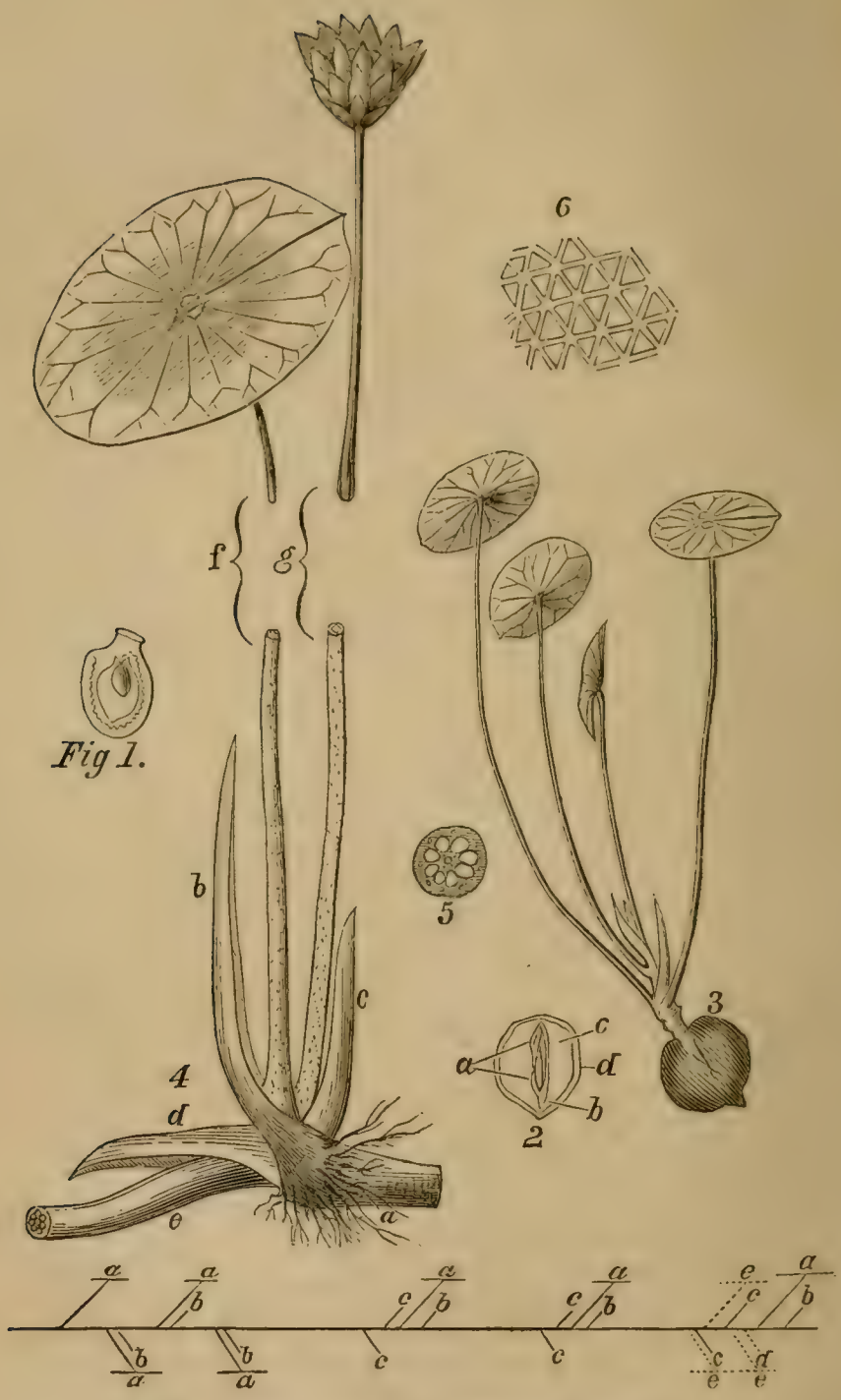
Animal matter,	26.2
Phosphate and carbonate of lime,	69.2
Water,	4.6
	100.0

About thirty species of the Mastodon have been described, most of which are European. Their remains are generally found in their natural state, not petrified; because, as in most cases, they have been preserved in morasses and peat swamps, whose antiseptic powers are well known.

The specimens found at Alton, consisting of teeth and jaw bones, were preserved in debris of limestone. The teeth were not changed in any respect. The bones were somewhat honey-combed by the action of lime.

The remains found at Aurora were slightly impregnated with iron, which is another means of preservation.

At what time this gigantic creature came upon the earth is a point not yet fixed. There are some traditions, faintly showing that the earlier races of men were acquainted with him, and that they have become extinct within two or three thousand years, or within a few centuries, like the Dodo and Dinornis. Lyell considers that, although they are geologically recent, their destruction occurred many thousand years ago, mainly through climatic changes. From the remains found in Europe, it is evident that the American Mastodon is much more recent, since it is here found cotemporary with the Mammoth, or Elephant, and, in Europe, as far down as the middle of the Tertiary formation.



THE WATER LILY. (*Nelumbium Lutem.*)

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THE WATER LILY.

ON THE PECULIAR GROWTH OF THE WATER LILY (NELUMBIUM LUTEUM, *Willd.*)

Read before the Illinois Natural History Society, June, 1860.

By Frederick Brendel, of Peoria, Illinois.

EXPLANATION OF THE PLATE.

Fig. 1—The ovary longitudinally divided.

Fig. 2—The seed longitudinally divided, showing the primordial leaves (*a*,) and the radicle (*b*,) one cotyledon (*c*,) and the bony pericarp.

Fig. 3—The young plant produced by the seed.

Fig. 4—The flowering plant produced by a bud: *a* the rootstock, *b* the outer scale of the bud; through the base of it passeth the stipule, (*d*,) and the terminal bud of which is to be seen the prolongated stem, (*e*.) Through the base of the stipule generally passeth another bud, prolongated into a runner; *c*, the inner scale of the bud, protecting the leaf and the flower bud; *f*, the leaf—this, measuring sometimes two feet in diameter, and the flower, (*g*) are, in proportion to the rest of the drawing, many times too small. The petiole and peduncle are rough, with black tubercles.

Fig. 5—A cut of the stem. The stem, rhizoma or runner, however we call it, has an internal structure more like the endogenous plants. Cylindrical cavities, generally 8 to 9, in the peduncle 6, in the petiole 4, larger ones and many interstitial smaller ones run side by side along, sometimes interrupted by tender diaphragmas. These cavities run only from one nod or rootstock to the other, the rootstocks being solid. The four larger channels of the peduncle are continuous, with two larger and two smaller cavities in the base of the leaf, indicated on the upper surface by four yellowish-green spots. The cavities again continue in smaller channels, which run on both sides of the nerves to the periphery of the leaf.

Fig. 6—The diaphragma magnified, showing a beautiful net-like structure.

Fig. 7—The diagram as constructed by Trecul: *a*, the leaves; *b*, the axillary stipules *c*, the extrafoliary stipules; *d*, the abortive stipule; *e*, the abortive leaves.

The Water Chinquapin (*Nelumbium luteum*, *Willd.*,) a plant of a very peculiar growth, which is common in our Western ponds and lakes, belongs to the Nelumbo family, of which Nelumbium is the single genus. This plant—and so, probably, the few other congenial species—differs so much in its growth from other dicotyledonous plants, that Trecul, a French botanist, in a paper read before the Academy of Sciences at Paris, said: "The singular organization of this plant seems to defy all our systems." Yet he makes some efforts to demonstrate that the leaves and stipules, although simulating an anomalous disposition, submit to all the laws of phyllotaxy. It must be remarked here, that Trecul speaks of N. codophyllum, Raf., and that this is doubtless the same as N. luteum, Willd., the only species which is known in the Western and Southwestern States.

The fruit of the Nelumbium is a bony nut, half imbedded in cavities of a large spongy obconic receptacle, containing a single seed, which is suspended on a filiform funicle, rising on one side of the nut to the apex. A second ovulum in the ovary is abortive, the funicle of which rises on the opposite side, as to be seen in the ovary at an early state. (Fig. 1.)

When the seed is germinating the radicle and the cotyledons do not come forth like in other seeds, but rest in the nut, which is generally laying on the surface of the mud, below the water. The primordial leaves are already highly developed in the seed, (Fig. 2,) bent down on the inside of the petiole, and inclosed in a very tender membranous, hood-like sheath. When the stem has left the nut, the petioles of the obicular peltate leaves, rolled inward from two sides, rise on their prolongated petioles, and, unfolding, float on the surface of the water.

In the axil of the second leaf there is a stipule, which envelops the next, and so on to the fourth or fifth leaf, the stipule of which envelops the terminal bud. The first four or five leaves, alternating on two opposite sides, are very close together; then the prolongated stem, with the terminal bud, runs into the mud, rooting there, and sending up one leaf, which is provided with three membranaceous protective organs, one axillary right as on the preceding leaves, and two others, which Trecul calls extrafoliary stipules —one behind the leaf, protecting the same, and a second below on the opposite side, which envelops the whole. The terminal bud passeth through the latter, piercing it at the base, and produces at a distance a leaf on the upperside, and so on. Now, this one-sided distribution of the leaves, when the first leaves are bifarious, and the number of stipules differing in the young and in the older plant, astonished the mind of Mr. Trecul, and endeavoring to solve the question he relied on the following teleological argumentation:

"The two primordial leaves need no protection, except that of the cotyledons and a thin hyaline membrane covering both together, like a miter. The following leaves need a protection, and so we find one stipule in the axil of the second, third, fourth, and

sometimes the fifth leaf; the merithalls being very short, one stipule is sufficient. But afterwards, when the rhizoma descends into the mud to a depth of twelve to fifteen inches, the merithalls grow longer before the terminal leaf has acquired strength enough to resist the action of destroying external influences—*f. i.*, fermentation of organic matters. Now, the axillary stipule, as it covers only the lower part of the merithall, is insufficient; nature prevented destruction by providing the upper extremity of every internode with two supplementary stipules. But nature works according to fixed laws, and there is no harmony between the early and the later state of growth—the first four or five leaves are distichous; the following which are provided with three stipules, appear only on the upper side of the rhizoma." To restore accordance with these different arrangements, Trecul supposes that the two extrafoliary stipules are the axillary stipules of abortive leaves, and that a third leaf and its stipule is abortive, and all these organs are abortive because nature did not want them. Teleology is generally founded upon hypothesis, and should be abolished in natural sciences. Cool observation relying upon facts leads on a weary but sure way, when hypothesis leads too often astray. Desirous to find a convenient explanation, we are induced by the slightest probability to believe without sufficient evidence. It seems to me that Trecul, to save a system, which in this case is not at all in danger, mingled entirely different things. The prolongation of the stem from leaf to leaf in the older plant is not a merithall, but a runner with a terminal bud, the origin of a new individual, consisting of a solid rootstock, and producing one leaf, one flower, and new runners, and the so-called extrafoliary stipules are the scales of the bud. The distribution of the leaves in the whole concern of connected individuals has nothing to do with the laws of phyllotaxis. The arrangement of the leaves in our plant is distichous in the individuals produced by the buds, as well as in those produced by seeds: that proves the position of the scales of the bud. The difference is, that the former produces a fructiferous scape and only one leaf; the latter produces four or five leaves and no fruit, but only a terminal bud, mediating the propagation in a secondary form. This reminds slightly of the alternate generation of some invertebrate animals.

In this way we need not the very ingenious, but too fictitious, explanation of Trecul; unexplained is only the want of the stipule in the axil of the first leaf. We say, better we do not know the reason, than to explain its absence by the hypothesis that nature did not want it.

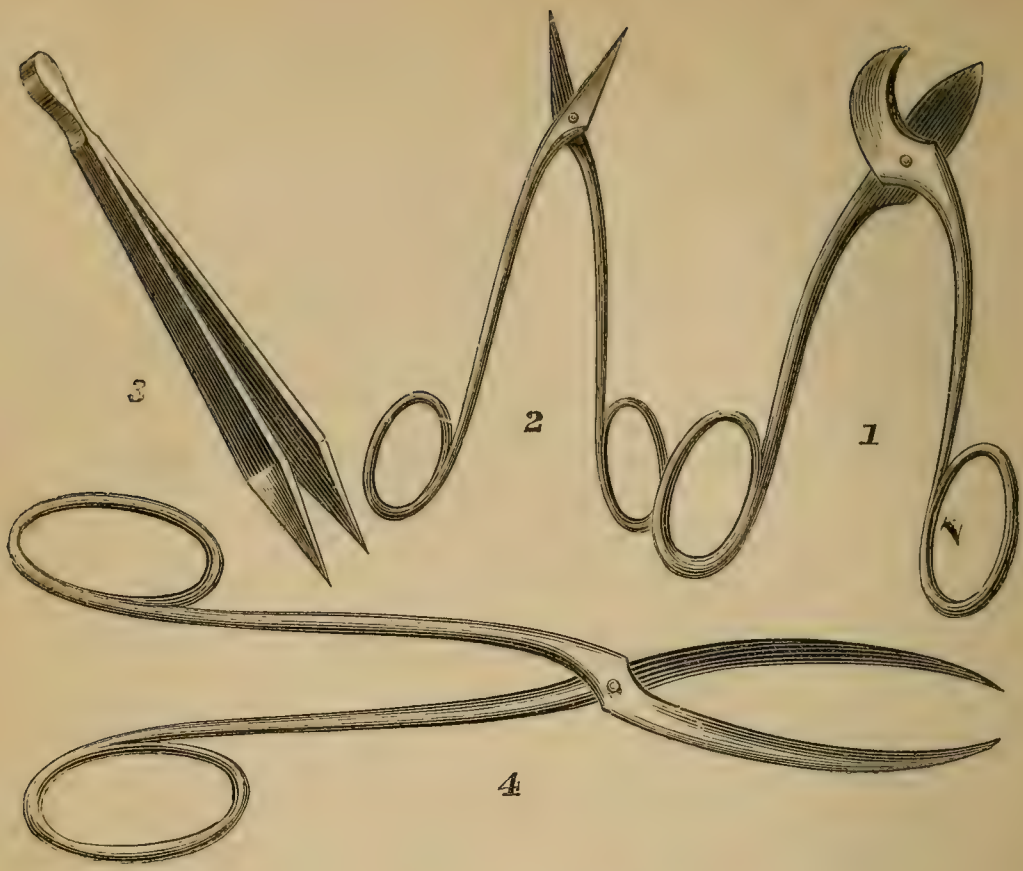

Fig. 5.

TAXIDERMY.

DIRECTIONS FOR COLLECTING AND PRESERVING SPECIMENS IN ORNITHOLOGY.

By R. H. Holder, Bloomington, Illinois.

In this paper upon preserving and mounting birds, prepared in accordance with a resolution of the Natural History Society, passed at its annual meeting in July, 1861, I have endeavored to make the process as easily understood as possible, by a plain account of my manner of operation, with illustrations of all the important portions of operator and subject. But with the most elaborate article and series of illustrations, it requires much practice and some artistic taste, to succeed in mounting birds successfully; though almost any one, with a little practice, may prepare specimens for exchange or study.

TOOLS AND MATERIALS.

Supposing you to possess a suitable gun, your next requisite is shot of a proper size for the particular specimens you wish to procure, though it is better to be provided with several sizes, say Nos. 6, 8 and 10, the latter being suitable for Warblers and other small birds; for Humming-birds, sift No. 10 through a common meal seive; you can always procure a few charges to each pound, of *dust* shot, with which, by choosing proper distance, you may obtain these diminutive creatures with little injury. A basket, such as used by fishermen, and called a "Trout basket," is best for carrying specimens, as you can lay in birds without danger of breaking the feathers.

Instruments necessary for skinning, are, a sharp knife, a pair of short-bladed, sharp pointed scissors, (Fig. 2,) a large, strong pair, (Fig. 1,) a pair of spring forceps, (Fig. 3,) and a pair with long blades, (Fig. 4,) a hook for suspending the bird whilst skinning, to

be attached to a wire or strong twine, and suspended from the wall, a shallow dish or tray to hold plaster of Paris.

Additional tools, for mounting, are a strong pair of wire cutters, two or three sizes of plyers, needles, thread and twine; moss, such as found on rocks or old logs—soft and green is best for small birds—and frost-cured prairie hay, or blue grass, for larger; tow, for filling out with, and cotton for various purposes, though the latter is to be avoided in all cases excepting in filling the throat and occiput, as hereafter described; annealed wire of various sizes, and for a preservative, arsenic, for which there is no substitute; all preparations, intended as such, not being any more efficient, and requiring more labor and time to apply.

HOW TO TREAT A BIRD WHEN SHOT.

Having wounded a bird, it is necessary that it be killed without further injury; to do this open wide your right hand and carefully inclose him in it; then, with the thumb and fore finger of the left placed under his wings, press upon his lungs until his struggles cease; plug the shot holes and mouth with cotton, and having prepared a stiff paper cone, drop your bird in, head down, and neatly fold the end over the tail, and lay in your basket, taking care during the whole proceedings to avoid rumpling or breaking the feathers, as it will save you much after labor.

TO CLEAN THE FEATHERS.

Having brought your specimens home in good order, and laid them upon the table, with the tools handy at your right hand, and tray of plaster on the left, you pass a strong thread through the nostrils, remove the cotton from the mouth and put in fresh; with a sponge and clean water, (a little warm is best,) wash all blood and dirt from the feathers, then, with a moderately stiff brush, (a hat, or soft hair brush is best,) apply the plaster, brushing briskly at the same time, until *perfectly dry;* by this means specimens may be restored, that otherwise would be valueless.

HOW TO SKIN A BIRD.

The bird is now ready for your knife, with the edge of which separate the feathers on the breast, and you will find a line, bare of feathers, as if left by nature for this operation; with the fingers of the left hand keep the feathers back, whilst with the knife you cut through the *skin*, from the lower end of the breast bone to the vent, as shown in Fig. 5; sprinkle a little plaster upon the exposed surface; now take hold of the skin with the fingers of the left hand, whilst you press against the body, with your forceps held in the right, as seen in Fig. 6. Having thus loosened the skin upon both sides, as low down as you conveniently can, place the thumb and forefinger of your right hand upon the skin over the breast, press downwards, and you will expose the whole of the breast to the

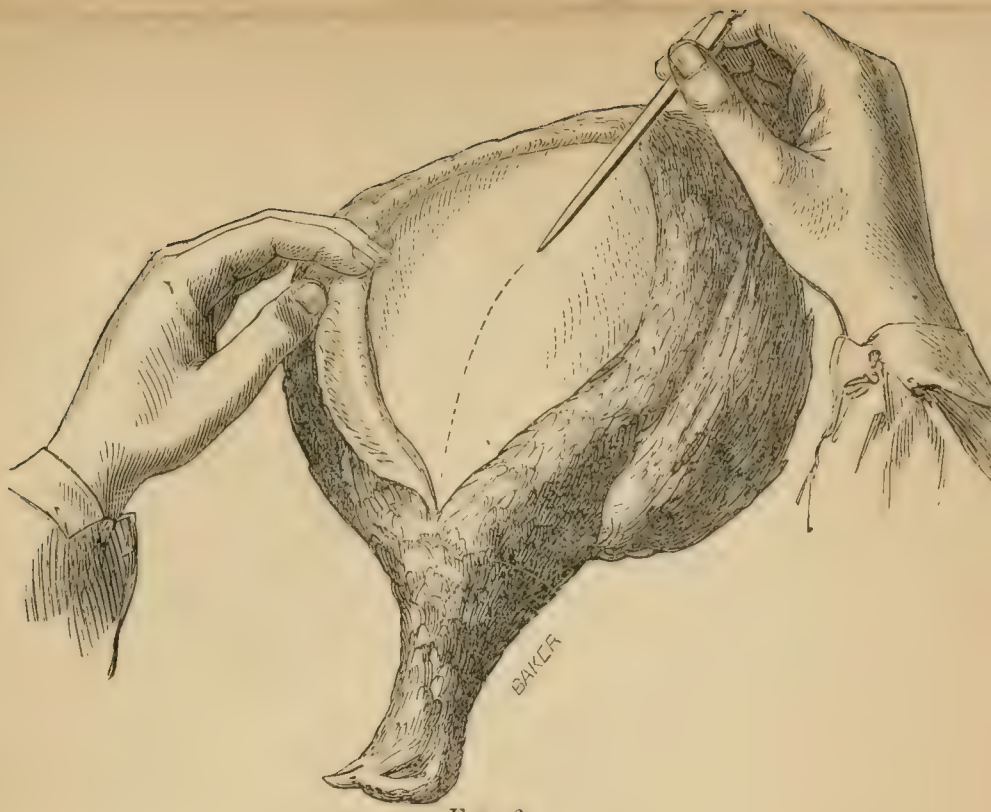

Fig. 6.

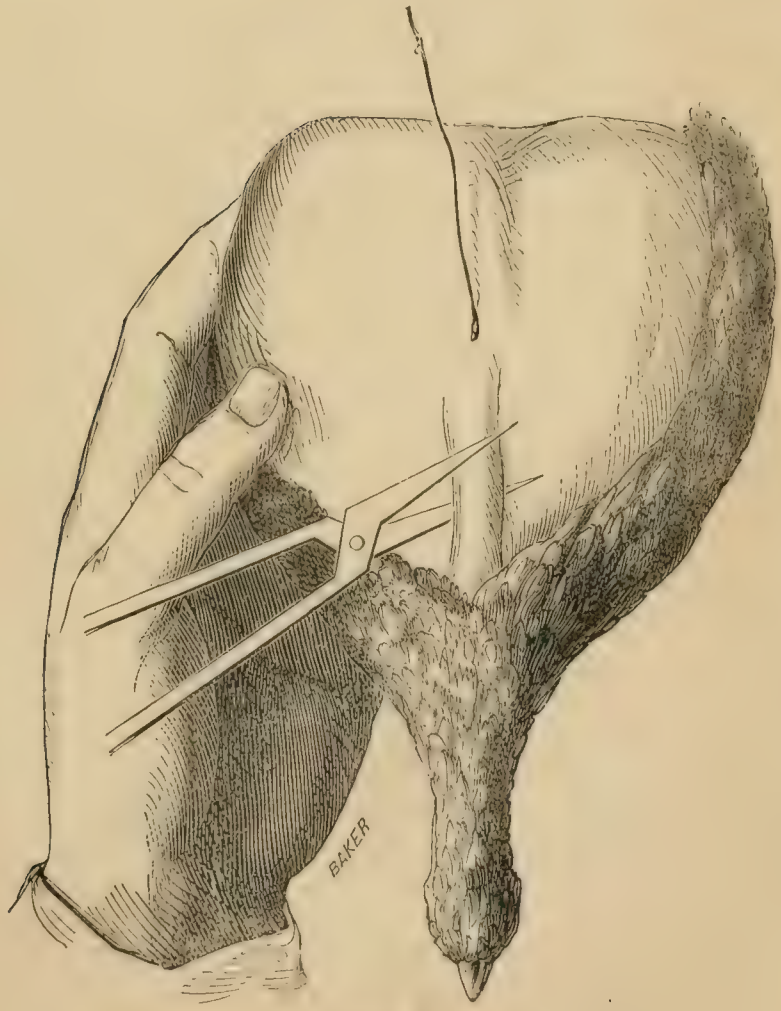

Fig. 7.

Fig. 9.

Fig. 10.

neck; insert the hook, and suspend by cord; now take hold of the neck, pull upwards, at the same time forcing your thumb and forefinger under the neck, bringing it clear of the skin sufficiently to insert your scissors, when you sever the neck, as seen in Fig. 7. Lay hold at the wing, pushing down, at the same time opening a place under the wing bone with your fingers, in which place your scissors, and cut off at the shoulder, as seen in Fig. 8. Having cut off both wings in this manner, you now carefully separate the skin from the back, using great care as you reach the loins, as here it adheres so closely that it is easily torn; now take hold of the leg, at the lower joint, with the left hand, and with the thumb and forefinger of the right, on either side of the thigh, press down the skin, insert your scissors at the joint, and sever, as shown in Fig. 9. Then carefully force down the skin to the base of the tail, and cut off; remove the oil sack and flesh adhering; next strip the legs of all flesh or fat, then take the wing bone, draw out to the forearm, when with your fingers force the skin down sufficiently to expose the flesh, and with your knife remove it, *not* separating the shafts of the feathers from the bone. In large birds, and especially in hawks, geese, etc., the wings can be more easily cleaned from the outside, making an incision the whole length of the forearm, on the underside, separate the skin and remove flesh; the opening need not be sewn up.

Having now reached the neck, take hold with your left hand, and with your right *strip* to the skull; here, carefully turning the skin, you reach the ears, which seize with your nails and *tear* out, then force down the skin, leaving bare the eyes, insert the point of your spring forceps in the socket, and work around, loosening the eye, then lift out and tear loose from the lids; next, with your knife, cut loose the tongue and separate the neck at the base of the skull; now, with your scissors, cut down each side of the jaw and through into the skull, removing the roof of the mouth and exposing the brain, which scoop out with your forceps; apply plenty of arsenic to all parts of the skin, especially about the head and base of tail; then fill the eye sockets with cotton, turn back the head, being careful to avoid stretching the skin, adjust the feathers, and your bird is ready for mounting, or to be made in form for exchange.

TO SKIN DUCKS, GEESE AND CRANES.

There are many birds, such as ducks, geese, cranes, etc., whose heads are too large to be drawn through the neck in the ordinary manner; with these proceed as in other birds, draw the neck through as far as possible, cut off, then separate the feathers on the throat, and make an incision large enough for the head to pass through, then proceed as before directed, sew up the cut with fine thread and short stitches, and adjust the feathers. If proper care has been taken, the place opening is not perceptible.

It must be understood that during the whole process of skinning there must be a free use of plaster, as fast as new surface of flesh and fat is exposed, and very much of your success in making good skins depends upon this. In large birds that are very fat or oily, you can baste strips of thick brown paper over the edges of the skin where you commence. Use corn meal as an absorbant.

TO MAKE A SKIN FOR EXCHANGE.

Having the skin off, you wish to prepare it for exchange; first pass a thread through the forearms of the wings, and tie close enough to bring the wings to their natural position, wrap some cotton around the leg bones, and the skin is ready for filling, which is done after this manner: suppose your specimen to be a quail; you take a round stick, about a quarter of an inch in diameter, and rather longer than the body and outstretched legs; take some tow or cotton, (the former is best,) and wrap around the stick, forming the neck the natural length and size, and the body as near the original shape and size as possible, having it rather smaller in preference to being larger; insert this in the body, the neck end of the stick entering the cavity of the skull; take two or three stitches, just sufficient to hold the skin together, cross the legs over the stick and tie; pass a little cotton in the mouth to fill out the throat; tie the bill, place the head in a position as seen in Fig. 10, cut a narrow strip of paper and pin around the body, and lay away to dry.

DIRECTIONS FOR MOUNTING—TO PREPARE WIRE, ETC.

Having the skin made, you wish to mount it; select your wire, having it large enough to support the bird rather firmly, but not too large, or you will be unable to pass it up the legs without risk of injury. Cut off a piece about four times the length of the specimen, twist one end around a nail driven firmly into the wall; seize the other end with your plyers and pull until you stretch it slightly; this will straighten it better than any other method. Cut into three pieces, making your cut obliquely, which gives you something of a point, and in most birds needs no further sharpening.

TO MAKE THE BODY.

Take some hay, or moss, and wrap it well with thread, forming it with your fingures at the same time, as near the size and shape of the natural body as possible, preferring that it should be rather less than larger; cut off your winding thread quite long, and with it arm a needle, and sew through the back, at *a a a* in Fig. 11, which will make a sharp offset, giving room for the bone of the wing to lie in; run a wire through the body at the back, and with your forceps turn the end in so as to fasten; wind some cotton smoothly around the wire, for a distance slightly exceeding the natural neck, but not any larger. See Fig. 11.

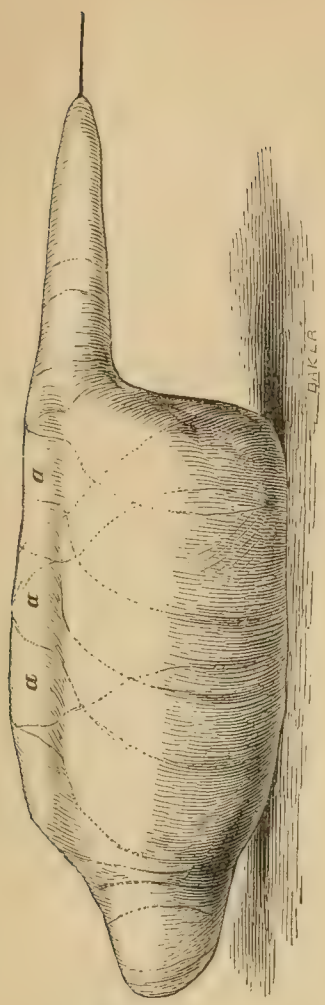

Fig. 11.

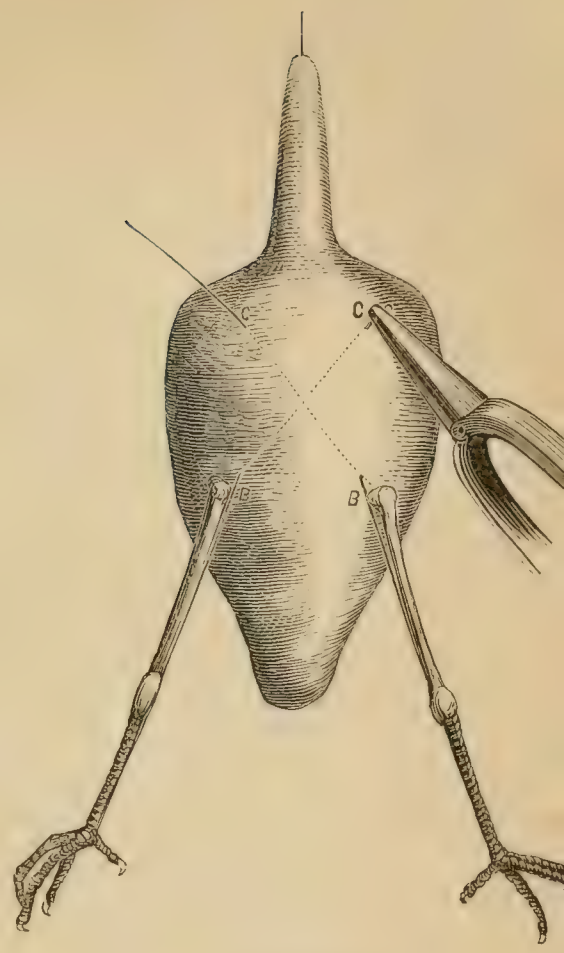

Fig. 12.

Fig. 13.

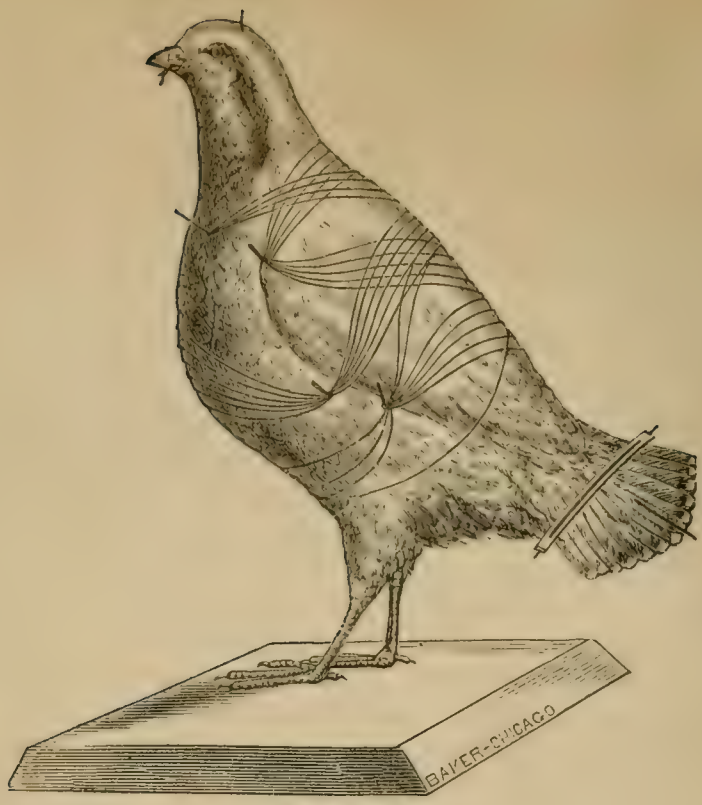

Fig. 14.

Fig. 15.

Let me impress upon the beginner these facts: you cannot take too much pains in forming the body, to get it the right size and shape; and that if you make it but a trifle too large you may as well throw the bird away, for you *cannot* make it a good specimen.

WHERE AND HOW TO PUT IN THE WIRES.

Take a wire and thrust it through the foot at the heel, passing up as close to the bone as possible through the feathered portion, turn back the skin, pass the wire up until a little past the end of the bone, wrap around both bone and wire cotton enough to fill out the thigh nearly as large as natural, draw back and proceed with the other in same manner.

Lay the bird upon its back, adjust the feathers, straighten the neck, take the artificial body in the right hand, and pass the wire of the neck up until it enters the skull; place the fingers of the left hand upon the head over where you expect the wire to come through, (which should be the center of the skull;) work the body slightly so as to *drill* through, press it forward until in its place; now take hold of the leg and enter the wire a little forward of the center of the body, pass it through and turning the ends in to fasten, as shown in Fig. 12—B B showing the place of entering, and *c c* where they protrude and fasten.

TO SEW UP.

Bring the legs together a little and see if the body looks full and round at the sides; if not, fill out with chopped tow, being careful not to fill too much, so as to stretch the skin; take a worsted or slender darning needle, armed with strong cotton, and commence at the anus and sew up; a stitch every inch is close enough until you reach near the breast, when half that distance will be right; in cutting off your thread leave it two or three inches long, to be cut shorter after the bird is dry.

TO GET THE WINGS INTO PLACE.

Punch holes on your block, press through the leg wires and fasten underneath; clasp the body with your hand and bring it to somewhere near the position you wish; next place your thumb under the wing, and fingers over, seizing the arm bone of the wing, lift it up and tuck into the place made in the body to receive it; pull the feathers from under, at the same time forward and over the bend of the wing; pass a sharpened wire or long pin through and into the body; proceed with the other in the same manner; now take hold of the bill with the left hand, with the right firmly hold the body, push back with the left, until you bring it upright, and near its natural position.

The beginner will find more difficulty in getting the wings properly in place than any other part of the operation, and unless right, it is impossible to make a bird look well. In lifting the

wing into place, be sure to get it high enough up, but not so high as to raise the scapulars, but so that they will lie smoothly over the fore arm; also see that the wings are neither thrown too far forward or back; and the best directions I can give here is, to study your specimen before you commence; see how far from end of tail the wings fold, and the same of the outstretched feet; make yourself familiar with the bird in every respect when in the woods, with its habits, and on your table, with its relative proportions, and you will be less likely to caricature nature, as seen in most of our public collections.

TO FILL OUT THROAT AND BREAST.

Your bird is now, as shown in Fig. 13, with the throat and breast at E E E, not filled out sufficiently to the point marked F; take a wire and drag off a little cotton and pass through the mouth, continuing until you have given sufficient fulness, at the same time smoothing with your fingers and giving the rounded outlines of throat and breast.

HOW TO WRAP A BIRD.

Having already thrust one pin in the body *through* the wings, now enter one just *below*, about the middle of the body, one back of the leg, and one at the shoulder, as shown on Fig. 12; now wind some thread from one to the other until you have secured the wings firmly in their place, and bound down any feathers not disposed to be smooth; *use plenty of thread*, as with this you can do much towards making your bird smooth and symmetrical.

TO SPREAD THE TAIL.

Take two narrow strips of card board and pass a wire through both ends of them, and bend together; with this clamp the tail, spread the feathers smoothly, twist the ends together, give it a little roundness, pass a wire between the clamps, through into the body, and set tail in position desired, as shown in Fig. 14.

TO MOUNT IN FLYING POSITION.

To set up a bird in flying position, you first put the head in position, throwing it *up* more than in a resting position; place the bone of wing as before described; raise up the wing a little above horizontal, run a pin down the fore arm into the body; now fill out the throat and breast, take a long pin or wire, and raising up the wing insert the pin *beneath* and another immediately over; stretch it out, see that every feather is in place, then twist the wires together, bend so as to give the natural concavity of the wings; spread the tail, bending it up as shown in Fig. 15.

FURTHER DIRECTIONS FOR MOUNTING CRANES, GEESE, ETC.

In mounting cranes, geese, and all long necked birds, proceed as before described, except that you fill out the breast with chopped

tow to its full roundness before sewing up, as you cannot introduce the cotton as directed for small birds; the throat is filled out as in others. With all large birds, in removing a piece of the skull for extracting the brain, and the flesh adhering, it necessarily destroys the symmetry of the head. to remedy which, introduce some cotton through the eye between the skin and skull, sufficient to restore its natural feathers.

VARNISH THE LEGS.

It is a good plan to give the legs a light coat of varnish, as it prevents their scaling, and protects them from insects.

TO PREPARE DRIED SKINS FOR MOUNTING.

Take a box large enough to receive the skins, and fill half full with clean fine sand thoroughly moistened but not *wet*; lay in your skins, and spread over a damp cloth, set away for twenty-four hours, when they will be soft enough to remove the filling; then fill every portion with cotton well saturated with water; if a long legged bird, also wrap the legs with wet cotton; set away for twenty-four hours, when, change the wet filling, dampen the covering cloth and set away again; on the third day they will ordinarily be ready for use; though quite small birds will take a little less and large a little more time. When ready to mount, remove the filling, and fill with cotton wet in *hot* water, and let it remain an hour before mounting.

BIRDS OF ILLINOIS.

CATALOGUE.

By R. H. Holder, of Bloomington, Illinois.

In the department of Ornithology, I have to report the collection of over two hundred specimens, comprising one hundred and fifty-two species, which are mounted, named, and ready to deposit in the museum of the Society. Nearly all the families in Ornithology found in this State, are represented, and one or two are nearly complete in genera and species. It is hoped that with the assistance of A. M. Gow, of Dixon, and Dr. Velie, of Rock Island, now associated with this commission, and by a system of exchanges begun this summer, that this department may keep pace with others of the Society.

With this report I offer a list of the Birds of Illinois, as complete as present information can make it, and arranged according to the classification adopted by Prof. Baird, in the ninth volume of Pacific railroad reports, only differing by grouping the genera into families, instead of the minute subdivisions given in that work. I must also acknowledge my indebtedness to the catalogues of Messrs. R. Kennicott and Henry Pratten, who left but few to add to the enumeration of species, making my labor one of classification, rather than collection. With the few species not enumerated in former lists, and added in this, the whole number of species found in this State is two hundred and forty-eight; but I have no doubt that a thorough exploration will greatly increase the number; I would recommend that catalogues of birds, from every section of the State, be requested of such persons as may be willing to devote so much time to the furtherance of Natural History. Southern Illinois and our large rivers afford peculiar facilities, and specimens and lists of birds from those sections will prove most acceptable.

Nothing, so far, has been done towards collecting eggs and nests. Would it not be advisable to make and fill a commission on Oology.

ORDER RAPATORES.

FAMILY VULTURIDÆ.

Cathartes Aura. Turkey Buzzard.

FAMILY FALCONIDÆ.

Falco Columbarius. Pigeon Hawk.
Falco Sparverius. Sparrow Hawk.
Accipiter Cooperii. Cooper's Hawk.
Accipiter Fuscus. Sharp-shinned Hawk.
Buteo Borealis. Red-tailed Hawk.
Buteo Lineatus. Red-shouldered Hawk.
Archibuteo Lagopus. Rough-legged Hawk.
Archibuteo Sanctijohannis. Black Hawk.
Nauclerus Furcatus. Swallow-tailed Hawk.
Ictinia Mississippiensis. Mississippi Kite.
Circus Hudsonius. Marsh Hawk.
Aquila Canadensis. Golden Eagle.
Haliactus Leucocephalus. Bald Eagle.
Pandion Carolinensis. Fish Hawk.

FAMILY STRINGINÆ.

Strix Pratincola. Barn Owl.
Bubo Virginianus. Great Horned Owl.
Scops Asio. Mottled Owl.
Otus Wilsonianus. Long-eared Owl.
Brachyotus Cassinii. Short-eared Owl.
Syrnium Cinereum. Great Grey Owl.
Syrnium Nebulosum. Barred Owl.
Nyctale Acadica. Saw-whet Owl.
Nyctea Nivea. Snowy Owl.
Surnia Ulula. Hawk Owl.

ORDER SCANSORES.

FAMILY PSITTACIDÆ.

Conurus Carolinensis. Carolina Parrot.

FAMILY CUCULIDÆ.

Coccygus Americanus. Yellow-billed Cuckoo.
Coccygus Erythrophthalmus. Black-billed Cuckoo.

FAMILY PICIDÆ.

Campephilus Principalis. Ivory-billed Woodpecker.
Picus Villosus. Hairy Woodpecker.
Picus Pubescens. Downy Woodpecker.
Sphyrapicus Varius. Yellow-bellied Woodpecker.
Hylatomus Pileatus. Pileated Woodpecker.
Centurus Carolinus. Red-bellied Woodpecker.
Melanerpes Erythrocephalus. Red-headed Woodpecker
Colaptes Auratus. Golden-winged Woodpecker.

ORDER INSESSORES.

FAMILY TROCHILIDÆ.

Trochilus Colubris. Ruby-throated Humming-bird.

FAMILY CYPSELIDÆ.

Chætura Pelasgia. Chimney Swallow.

FAMILY CAPRIMULGIDÆ.

Antrostomus Vociferus. Whippoorwill.
Chordeiles Popetue Night Hawk.

FAMILY ALCEDINIDÆ.

Ceryle Alcyon. Belted Kingfisher.

FAMILY TYRANNINÆ.

Tyrannus Carolinensis. King-bird.
Myiarchus Crinitus. Great Crested Flycatcher.
Sayornis Fuscus. Pewee.
Contopus Virens. Wood Pewee.
Empidonax Acadicus. Crested Flycatcher.

FAMILY TURDIDÆ.

Turdus Mustelinus. Wood Thrush.
Turdus Pallasii. Hermit Thrush.
Turdus Fuscescens. Wilson's Thrush.
Turdus Alicæ. Grey-cheeked Thrush.
Turdus Migratorius. Robin.
Sialia Sialis. Blue-bird.
Regulus Calendula. Ruby-crowned Wren.
Regulus Satrapa. Golden-crowned Wren.

FAMILY SYLVICOLIDÆ.

Anthus Ludovicianus. Tit Lark.
Mniotilta Varia. Black and White Creeper.
Parula Americana. Blue Yellow-backed Warbler.
Protonotaria Citrea. Prothonotary Warbler.

Geothlypis Trichas. Maryland Yellowthroat.
Geothlypis Philadelphia. Mourning Warbler.
Oporornis Agilis. Connecticut Warbler.
Oporornis Formosus. Kentucky Warbler.
Icteria Viridis. Yellow-breasted Chat.
Helmitherus Vermivorus. Worm-eating Warbler.
Helminthophaga Pinus. Blue-winged Yellow Warbler.
Helminthophaga Chrysoptera. Golden-winged Warbler.
Helminthophaga Ruficapilla. Nashville Warbler.
Helminthophaga Celata. Orange-crowned Warbler.
Helminthophaga Peregrina. Tennessee Warbler.
Seiurus Aurocapillus. Golden-crowned Thrush.
Seiurus Noveboracensis. Water Thrush.
Dendroica Virens. Black-throated Green Warbler.
Dendroica Canadensis. Black-throated Blue Warbler.
Dendroica Coronata. Yellow-rump Warbler.
Dendroica Blackburniæ. Blackburnian Warbler.
Dendroica Castanea. Bay-breasted Warbler.
Dendroica Pinus. Pinecreeping Warbler.
Dendroica Pennsylvanica. Chestnut-sided Warbler.
Dendroica Cærulo. Blue Warbler.
Dendroica Striata. Black-poll Warbler.
Dendroica Aestiva. Yellow Warbler.
Dendroica Maculosa. Black and Yellow Warbler.
Dendroica Palmarum. Yellow Red-poll Warbler.
Dendroica Superciliosa. Yellow-throated Warbler.
Dendroica Discolor. Prairie Warbler.
Myiodioctes Mitratus. Hooded Warbler.
Myiodioctes Pusillus.
Myiodioctes Canadensis. Canada Flycatcher.
Setophaga Ruticilla. American Redstart.
Pyranga Rubra. Scarlet Tanager.
Pyranga Aestiva. Summer Red-bird.

FAMILY HIRUNDINIDÆ.

Hirundo Horreorum. Barn Swallow.
Hirundo Lunifrons. Cliff Swallow.
Hirundo Bicolor. White-bellied Swallow.
Cotyle Riparia. Bank Swallow.
Progne Purpurea. Purple Martin.

FAMILY BOMBYCILLIDÆ.

Ampelis Garrulus. Bohemian Waxwing.
Ampelis Cedrorum. Cedar-bird.

FAMILY LANIIDÆ.

Collyrio Borealis. Butcher-bird.
Collyrio Ludovicianus. Loggerhead Shrike.

Collyrio Excubitoroides. White-rumped Shrike.
Vireo Olivaceous. Red-eyed Flycatcher.
Vireo Philadelphicus.
Vireo Gilvus. Warbling Flycatcher.
Vireo Noveboracensis. White-eyed Flycatcher.
Vireo Solitarius. Blue-headed Flycatcher.
Vireo Flavifrons. Yellow-throated Flycatcher.

FAMILY LIOTRICHIDÆ.

Mimus Polyglottus. Mocking-bird.
Mimus Carolinensis. Cat-bird.
Harporhynchus Rufus. Brown Thrush.
Thrirothorus Ludovicianus. Great Carolina Wren.
Cistothorus Stellaris. Short-billed Marsh Wren.
Troglodytes Aedon. House Wren.
Troglodytes Hyemalis. Winter Wren.

FAMILY CERTHIADÆ.

Certhia Americana. Brown Creeper.
Sitta Carolinensis. White-bellied Nuthatch.
Sitta Canadensis. Red-bellied Nuthatch.

FAMILY PARIDÆ.

Polioptila Cœrulea. Blue-gray Flycatcher.
Lophophanes Bicolor. Tufted Titmouse.
Parus Atricapillus. Black-cap Titmouse.

FAMILY ALAUDIDÆ.

Eremophilia Cornuta. Shore Lark.

FAMILY FRINGILLIDÆ.

Hesperiphona Vespertina. Evening Grosbeak.
Pinicola Canadensis. Pine Grosbeak.
Carpodacus Purpureus. Purple Finch.
Chrysomitris Tristis. Yellow-bird.
Chrysomitris Pinus. Pine Finch.
Aegiothus Linaria. Lesser Red Poll.
Plectrophanes Nivalis. Snow Bunting.
Plectrophanes Lapponicus. Lapland Longspur.
Plectrophanes Pictus. Smith's Bunting.
Passerculus Savanna. Savannah Sparrow.
Pooecetes Gramineus. Bay-winged Bunting.
Corturniculus Passerinus. Yellow-winged Sparrow.
Chondestes Gammaca. Lark Finch.
Zonotrichia Leucophrys. White-crowned Sparrow.
Zonotrichia Albicollis. White-throated Sparrow.
Junco Hyemalis. Snow-bird.
Spizella Monticola. Tree Sparrow.

Spizella Socialis. Chipping Sparrow.
Spizella Pusilla. Field Sparrow.
Spizella Pallida. Clay-colored Bunting.
Melospiza Melodia. Song Sparrow.
Melospiza Palustris. Swamp Sparrow.
Passerella Iliaca. Fox-colored Sparrow.
Euspiza Americana. Black-throated Bunting.
Guiraca Ludoviciana. Rose-breasted Grosbeak.
Cyanospiza Cyanea. Indigo-bird.
Cardinalis Virginianus. Cardinal Red-bird.
Pipilo Erythrophthalmus. Cheewink.

FAMILY ICTERIDÆ.

Dolichonyx Oryzivorus. Bobo'link.
Molothrus Pecoris. Cow-bird.
Aegelaius Phœniceus. Red-winged Black-bird.
Zanthocephalus Icterocephalus. Yellow-headed Black-bird.
Sturnella Magna. Meadow Lark.
Icterus Spurius. Orchard Oriole.
Icterus Baltimore. Golden Oriole.
Scolecophagus Ferrugineus. Rusty Grakle.
Quiscalus Versicolor. Purple Grakle.

FAMILY CORVIDÆ.

Corvus Carnivorus. American Raven.
Corvus Americanus. Common Crow.
Pica Hudsonica. Magpie.
Cyanurus Cristatus. Blue Jay.

ORDER RASORES.

FAMILY COLUMBIDÆ.

Ectopistes Migratoria. Wild Pigeon.
Zenaidura Carolinensis. Common Dove.

FAMILY PHASIANIDÆ.

Meleagris Gallopavo. Wild Turkey.

FAMILY TETRAONIDÆ.

Pedioceetes Phasianellus. Sharp-tailed Grouse.
Cupidonia Cupido. Prairie Hen.
Bonasa Umbellus. Ruffed Grouse.
Lagopus Albus. Willow Grouse.

FAMILY PERDICIDÆ.

Ortyx Virginianus. Quail.

ORDER GRALLATORES.

FAMILY GRUIDÆ.

Grus Americanus. Whooping Crane.
Grus Canadensis. Sand-hill Crane.

FAMILY ARDEIDÆ.

Garzetta Candidissima. Snowy Heron.
Herodias Egretta. White Heron.
Ardea Herodias. Great Blue Heron.
Ardetta Exilis. Least Bittern.
Botaurus Lentiginosus. Bittern.
Butorides Virescens. Green Heron.
Nyctiardea Gardeni. Night Heron.

FAMILY TANTALIDÆ.

Tantalus Loculator. Wood Ibis.
Ibis Ordii. Glossy Ibis.

FAMILY CHARADRIDÆ.

Charadrius Virginicus. Golden Plover.
Aegialitis Vociferus. Killdeer Plover.
Aegialitis Semipalmatus. King Plover.
Strepsilas Interpres. Turnstone.
Squatarola Helvetica. Black-bellied Plover.

FAMILY PHALAROPODIDÆ.

Phalaropus Wilsonii. Wilson's Phalarope.
Phalaropus Fulicarius. Red Phalarope.

FAMILY SCOLOPACIDÆ.

Philohela Minor. Woodcock.
Gallinago Wilsonii. English Snipe.
Macrorhamphus Griseus. Red-breasted Snipe.
Tringa Maculata. Jack Snipe.
Tringa Wilsonii. Least Sandpiper.
Ereunetes Petrificatus. Semipalmated Sandpiper.
Symphemia Semipalmata. Willet.
Gambetta Melanoleuca. Telltale Snipe.
Gambetta Flavipes. Yellow Legs.
Rhyacophilus Solitarius. Solitary Sandpiper.
Tringoides Macularius. Spotted Sandpiper.
200 Actiturus Bartramius. Bartram's Sandpiper.
Limosa Fedoa. Marbled Godwit.
Numenius Longirostris. Long-billed Curlew.

Numenius Hudsonicus. Short-billed Curlew.
Rallus Crepitans. Clapper Rail.
Rallus Virginianus. Virginia Rail.
Porzana Carolina. Sora Rail.
Porzana Noveboracensis. Yellow Rail.
Fulica Americana. Coot.
Gallinula Galeata. Florida Gallinule.

ORDER NATATORES.

FAMILY CYGNINÆ.

Cygnus Americanus. American Swan.
Cygnus Buccinator. Trumpeter Swan.

FAMILY ANSERINÆ.

Anser Hyperboreus. Snow Goose.
Anser Gambellii. White-fronted Goose.
Bernicla Canadensis. Canada Goose.
Bernicla Hutchinsii. Hutchin's Goose.
Bernicla Brenta. Brant.

FAMILY ANATINÆ.

Anas Boschas. Mallard.
Anas Obscura. Black Duck.
Dafila Acuta. Pintail Duck.
Nettion Carolinensis. Green-winged Teal.
Querquedula Discors. Blue-winged Teal.
Spatula Clypeata. Shoveller.
Chaulelasmus Streperus. Gadwall.
Mareca Americana. American Widgeon.
Aix Sponsa. Summer Duck.
Fulix Marila. Scaup Duck.
Fulix Collaris. Ring-necked Duck.
Aythya Americana. Red-head Duck.
Aythya Vallisneria. Canvass-back Duck.
Bucephla Americana. Golden-eyed Duck.
Bucephla Albeola. Butter Ball.
Harelda Glacialis. Long-tailed Duck.
Mergus Americanus. Goosander.
Mergus Serrator. Red-breasted Merganser.
Lophodytes Cucculatus. Hooded Merganser.

FAMILY LARIDÆ.

Larus Argentatus. Herring Gull.
Croicocephalus Philadelphia. Bonaparte's Gull.

FAMILY STERNINÆ.

Sterna Regia. Royal Tern.
Sterna Wilsonii. Wilson's Tern.
Sterna Frenata. Least Tern.
Hydrochelidon Plumbea. Short-tailed Tern.

FAMILY PELECANIDÆ.

Pelecanus Erythrorhynchus. Rough-billed Pelican.

FAMILY PHALACROCORACIDÆ.

Graculus Carbo. Cormorant.
Graculus Dilophus. Double-crested Cormorant.

FAMILY PLOTIDÆ.

Plotus Anhinga. Water Turkey.

FAMILY COLYMBIDÆ.

Colymbus Torquatus. The Loon.
Colymbus Septentrionalis. Red-throated Diver.
Podiceps Cristatus. Crested Grebe.
Podiceps Cornutus. Horned Grebe.
250 Podilymbus Podiceps. Pied-bill Grebe.

NATURAL HISTORY IN SCHOOLS.

Read before the Illinois State Teachers' Association, at Quincy, Dec. 25, 18[illegible]

By A. M. Gow, of Dixon, Illinois.

Mr. President and Fellow-Teachers:

It not unfrequently happens that the presentation of a claim upon the attention of educators for any particular branch of science is accompanied by the demand that it shall be introduced, at once, into our schools as a subject of general school training. Each enthusiast in any department of knowledge, feeling the exhilarating influence of his study upon his own mind, may be somewhat excusable when he presents a claim upon the attention of those engaged in the work of forming the popular mind, and insists that his darling pursuit may be made prominent in their systems of instruction. It is difficult sometimes, in the multiplicity of the subjects of science, to determine which shall be deemed most worthy of a place in the necessarily limited course of study in a large portion of the schools, and to arrange the branches selected in that order which will best serve the purposes of a real education. The essentially material teacher is best pleased with those studies which point ultimately to practical employment and the acquisition of wealth, while he of more refined taste seeks those which have for their object the cultivation of the nobler parts of our nature. The happy mean in the process of education lies between these extremes, and he is most fortunate who can properly discriminate between that which may be made immediately and practically productive, and that which develops the mind by quickening the perceptions, strengthening the power of reason, stimulating the moral faculties, by proper culture, and giving to the judgment that force which the well educated alone possess. Remarks Horace Mann, in his admirable lectures: "I hardly need to say that by the word *education* I mean much more than ability to read, write and keep common accounts; I comprehend under this noble word such a

training of the body as shall build it up with robustness and vigor—at once protecting it from disease and enabling it to act, *formatively*, upon the crude substances of nature—to turn a wilderness into cultivated fields, forests into ships, or quarries and clay pits into villages and cities; I mean, also to include such a cultivation of the intellect as shall enable it to discover those permanent and mighty laws which pervade all parts of the created universe, whether material or spiritual. This is necessary, because, if we act in obedience to these laws, all the resistless forces of Nature become our auxiliaries and cheer us on to certain prosperity and triumph; but if we act in contravention or defiance of these laws, then Nature resists, thwarts, baffles us, and in the end, it is just as certain that she will overwhelm us with ruin as it is that God is stronger than man. And, finally, I mean such a culture of our moral affections and religious susceptibilities as, in the course of Nature and Providence, shall lead to a subjection or conformity of all our appetites, propensities and sentiments to the will of Heaven."

We accept the definition of Education given us by this one of its most devoted friends and promoters, and in presenting the claims of Natural History, we do not wish to be considered as intruding our *hobby* on your attention or as desiring to ride it to the disadvantage of any other of the branches of science. Nor need the timid fear that we would add another text book or series to those already in our schools, or make any demand upon teachers they are not fully capable of meeting.

The perceptive powers of children are kept in constant exercise by their innate desire to learn. Every sense is alert to seize upon surrounding objects. Nothing escapes their attention, and each new object of observation serves as a stimulant to further inquiry and acquirement. Nature teaches wonderfully, and the elements for instruction are all around and about us, needing only to be appropriated and enjoyed. Children, actuated only by this craving curiosity, are constantly acquiring facts for future use. Ask a mother how it is that her child learns so much during the first few years of its existence, and she may reply that she has been its only teacher; but some reflection may convince her that she had little to do directly, in imparting the instruction it has received. Her teachings, for the greater part, were not intended as instruction, but the child did not the less acquire knowledge from her by every act and word. All his faculties were keenly alive to what was passing around. The mother, for the most part, was no more the intentional instructor than the chairs, the table, or the cat upon the hearth.

By observing the operations of nature, we may ascertain that the true development of children is hastened by simply furnishing the objects for the exercise of their continually expanding powers. The normal system of instruction claims to be the natural system, since the effort is made to imitate nature, in presenting natural objects to the minds of children, thereby stimulating the desire to

learn, quickening the perceptions, cultivating habits of observation, of comparing and classifying, and thereby of reasoning well and judging accurately.

"A child must not only be exercised into correctness of observation, comparison and judgment," says Mr. Mann, "but into accuracy in the narration or description of what he has seen, heard, thought or felt, so that whatever thoughts, emotions, memories are within him, he can present them all to others in exact and luminous words." Clearness of conception and accuracy in description are essentially important in correct education, as he is only half trained who sees imperfectly or describes inaccurately.

An anecdote is related of the poet Coleridge, illustrating the value of a knowledge of common things. On one occasion, traveling with a brother poet, he arrived at a country inn. Stopping to dine, they entered the house, while the host busied himself in taking care of the horse. Before the guests were ready to depart, the host was obliged to go to the field to his labor. When they concluded to go, they repaired to the stable, and commenced the operation of harnessing the horse, when an embarrassing dilemma was presented in the difficulty of adjusting the collar to their horse's neck. They examined the collar and they scrutinized the animal's head, but, with all their observation, the difficulty of accommodating the one to the other seemed insurmountable. After much consultation and many unsuccessful efforts, made both to the discomfort of the poor animal and themselves, they were forced to ask advice from the servant-maid, who was enjoying their ignorance and confusion. She willingly responded, and taking the collar, broad end up, slipped it easily over the animal's eyes, turned it narrow end up on the neck, and fitted it to the shoulders, much to their surprise and relief. The moral of our story is, that a knowledge of common things is not to be despised, and that, other things being equal, he is the best educated who has made the most use of his powers in the acquisition of the facts and principles involved in every-day life.

Children "have an innate love for whatever is beautiful. Portions of the external world have been exquisitely adapted to this inborn love of the beautiful, by Him who has so clothed the lilies of the field that they outshine Solomon in all his glory." Happy is that child who is free to roam in unrestrained and unconventional liberty, to enjoy what nature so liberally and so freely bestows. Happy is that man whose early desires have not been repressed, but have been permitted to strengthen to the improvement of his tastes and the cultivation of his fancy.

Taking the definition of education as given by Mr. Mann to be correct, and the principles of instruction we have alluded to as judicious and safe, it may be assumed that there is no better subject for training the intellect, developing the bodily powers, and awakening the moral faculties, than that contained in the several divisions of Natural History, embracing Zoology, Botany and Ge-

ology. And not only are these studies highly important, considered merely as subjects of educational discipline, but they are highly useful, in that purely practical and American sense which estimates worth by pecuniary value. The Normal system of instruction is not only fitted for the development of little children, but for those of mature age. If a child is surrounded by objects of interest and beauty, and is permitted to learn by the excitement of his curiosity and by a proper direction of his powers, his intellect must expand in proportion as his mind is awakened by desire. Such objects are all around us in bounteous profusion. Neglect, however, these means of natural development, and you may reduce and restrain the love of the beautiful and the desire of acquisition, until the child, like a Chinese oak, possessing a resemblance to the original design of Nature, becomes, by peculiar and unnatural cultivation—a dwarf. We remember a little incident. A short time since two individuals were walking over the prairie, when one observed a stone. Seeing something peculiar in it, he stooped to pick it up, and found, to his surprise, a beautiful fossil coral. Turning to his companion, he exhibited the curiosity, who, without appearing to notice or care for its singularity, remarked, with indifference, "pshaw! it's nothing but a stun." "Stuns" were a subject of supreme contempt to one whose whole being was sacrificed to the false idea of utility. It is a most desirable object to train minds to habits of observation, so that when any new subject is presented to the eye, or any unusual sound strikes upon the ear, it may make a durable impression. Some of the most valuable discoveries, affecting human health, happiness and convenience, were simply the result of an observation of simple and apparently unimportant circumstances, stimulating thought, producing reflection and in the end accomplishing the desired object. "Natural History," says Ruschenberger, "embraces every object in nature, organic and inorganic. The animal kingdom contains about two hundred and fifty thousand species, and the vegetable kingdom about eighty-five thousand species, making an aggregate of three hundred and thirty-five thousand organized objects for the study of the Naturalist. Besides these, rocks and minerals of every kind are to be added, which would probably swell the number to nearly four hundred thousand." The object of Natural History is to classify, systematize and study these creations, to discover their uses in the economy of nature, their relations to each other, and the value which they hold to the comfort and well-being of mankind. Here then is a grand field for the student, much of which is comparatively new and unexplored, all opening to him the finest opportunities for the cultivation and development of his intellectual powers. But it is not supposed that our people generally, educated in our ordinary schools, will or can become Naturalists, any more than they can be called Mathematicians because they study Algebra. To be a Naturalist requires the time and study of a life devoted with unremitting zeal and unflagging energy; but to be acquainted with the

general principles of classification, to be able to read intelligently, and to hear with pleasure and profit when subjects of this kind are introduced, is certainly desirable to any well educated man or woman. The wisest of men entreated God that he should be gifted with prudence and understanding to govern his people. In addition to this, the subject of his petition, God granted him all that the most ambitious could desire, so that he became a Poet, a Philosopher and a Naturalist. "He spake three thousand proverbs, and his songs were a thousand and five. And he spake of trees, from the cedar tree that is in Lebanon, even unto the hyssop that springeth out of the wall; he spake also of beasts, also of fowl, and of creeping things and of fishes." These were subjects worthy of the wisdom of Solomon, and yet they are esteemed unworthy, by some, of a place in our best endowed and most popular institutions, so that many an Alumnus leaves the halls of his Alma Mater tolerably versed in Ancient Classics and Mathematics, and entirely ignorant of the names, habits or value of the thousands of natural objects around him and under his feet. We would not be understood to depreciate or undervalue the study of the Classics, but we submit whether in this country, under our circumstances, it might not be as well to divide the attention between the Greek roots and those which, fresh and strong, bury themselves in our prairie soil —the roots of our trees and plants.

The utility of Natural History or its applicability to promote the material wealth of the State cannot be doubted. It was a great mistake to suppose the subjects of Zoology, Botany and Geology did not involve much that affects our comfort, convenience, health and wealth. I remember having planted a beautiful tree. It was nourished with care and became one of our garden pets. It was admired for its symmetry and beauty by all who beheld it. In course of time the garden and its appurtenances passed into other hands. What was before a beautiful retreat, was now to be turned to the making of money. Tenant houses were erected and the garden, neglected and exposed, was soon destroyed. Still the beautiful tree remained, a solitary monument to mark the spot where culture had been bestowed. But vandalism had not completed its work; the mechanic who was about to raise another structure, and loth to destroy a tree whose beauty charmed him, called the owner of the property to know whether he should cut down the tree or prune it closely on one side, to enable him to raise his frame. After a brief examination, the owner remarked, with an oath, "Cut it down, cut it down, trees don't make money." That man's idea was, that money was wealth, and in getting money he worked hard, lived meanly and died early. It was not in the same spirit that the sentiment was uttered, that "he was a public benefactor who made two blades of grass grow where one grew before." "In certain parts of Maine, the locust tree borer (*cytus pictus*) has destroyed nearly all the locust trees. In another part of Maine the apple tree borer (*saperda candida*) has destroyed whole orchards,

which a very little pains-taking would have saved, had the farmer only known the habits of the insects. A borer, very similar to the last mentioned, has done much damage to the sugar maples in Maine."

Trees do make money, and he who will furnish the antidote to the "bark louse," that infests our fruit trees, will make money for himself and the community. Mr. Walsh, of Rock Island, an able and enthusiastic Entomologist, has estimated, by careful calculation, the loss to our crops by the devastations of insects, at one hundred millions of dollars per annum. This, in the opinion of Naturalists, might be prevented. The insect armies that invade our fields are more to be dreaded than an army of foreign mercenaries. The utility of a study that will lead to the investigation of the character and habits of insect life, in order to facilitate their destruction, either by destroying their larvæ or in increasing their natural enemies, is, we think, apparent. The Hessian-fly, the midge, the chinch-bug, the bark-louse, the Minnesota grasshoppers, are very insignificant, individually, yet, when they invade our fields, the hopes of the farmer are dissipated and his labor is destroyed. Surely, if there is an antidote to such mischief, it would be useful to know and apply it. There has been some discussion in the Prairie Farmer concerning the value of the little bird known as the "Sap-sucker." It is maintained that it is one of our greatest enemies, inasmuch as he kills our trees by boring through the bark to extract the sap; while others maintain that it is one of the fruit grower's best friends, since it is so indefatigable in its destruction of the vermin which abound in the orchard. So, too, another writer in the same paper speaks of the "Brown Thrasher" as a pest to the farmer, and of no value to trees or fields. A little knowledge, properly applied, would settle these questions without a waste of paper, and thus demonstrate the practical utility of the study of Ornithology. Of the value of Botany and Geology it is not necessary to speak, though by some the former has been considered only a fit pursuit for sentimental, flower-language young ladies, while the latter has found favor only with those who wish to confute Genesis by Geology. Both of these ideas illustrate the narrowness and illiberality of those who make such objections.

Having treated briefly of the value of the subjects of Natural History, intellectually and in point of utility, it becomes us to speak of the subject as to its moral relations. "The double effect of the study of Natural History," says Ruschenberger, "is to impart a certainty to the mind, and religion to the heart. The creation is a visible ladder by which man ascends towards the invisible CREATOR. Philosophy, politics, history and morality itself, are subject to the intellectual revolutions of wavering humanity; but the facts of the creation are as invariable as God, and the analysis of a plant or an insect marks its demonstration with the seal of eternal truth." Children are liable to be cruel and tyrannical when no direction is given to their minds. Give a boy a gun and he

will slaughter every living animal that is not the subject of property, without discrimination, without compunction or remorse. He kills for the sake of the killing; and the dying agonies of a wounded sparrow excite no sympathy, no regret. Think you that if a companionship had been established between him and living things; that he had learned their value in the scheme of creation; their uses in the economy of Nature; their beauty, their innocence, their helplessness, that he would thus destroy them for mere wantonness? We know, from observation and experience, that there can be a softening, humanizing influence brought to bear upon youthful minds through a correspondence and communion with Nature's works. Those who are interested in birds and flowers must be refined by the association. An intimate connection with the varied works of creation leads the mind from vicious associations, and preserves it from contact and contamination. The man or woman educated to observe and reflect upon the condition of natural objects, can never be alone—will never want companionship. Under circumstances where others would be miserable and lonely, the Naturalist may indulge in sweet, though silent communion with Nature, and look "through Nature up to Nature's God."

The physical advantages to be derived from these pursuits are a matter of no small consideration. The practical study must be performed in the open air, requiring oftentimes a considerable exercise of strength and endurance. The development of the intellect without a corresponding increase of physical strength is a defective training which results in evil. Let a boy become interested in the collection of plants, of shells, of birds or of fossils, and there is no doubt that the increased vigor of his body would alone compensate for his exertions. We have known students, reduced physically to a low condition by a neglect of the laws of Nature and of health, to become completely rejuvenated by geological and botanical researches in the fields and quarries. How important that we should educate our youth symmetrically, and thus prevent those accidents so generally the concomitants of the student's life.

But it may be said that this is all very pretty and very true, but how can any of these subjects be brought within the range of a large portion of the common schools. They can only incidentally. The real live teacher, if he be interested in the subjects, even though his education is as yet defective, may give a direction to the minds of his pupils in this matter which will be of great service.

The New York Tribune gives a very beautiful incident, showing how hungry the children of a large city are for flowers. "Our old friend and correspondent, R. G. Pardee, who is now living in New York city, visited a day school last fall, when the Asters were in flower, and promised to save seed, plant them in the spring, and the present June to give each child a plant who would agree to set it out in the yard, or a pot, and take good care of it. A few

days since, Mr. Pardee visited the school again, to see if the children remembered the promise, and not one had forgotten it.

"Now," said he, "I am ready to fulfill my promise. I have planted the seed, and God has blessed it and the object for which it was planted; for he loves little children. Now about these little plants. I can't pull them up and bring them here, because they will wilt, and perhaps die; but as many of you as can find a place to plant one in the ground, and will promise me to take care of it, shall have one to-morrow at five o'clock, at my house in Thirty-fifth street. I will take them from the bed where they are growing, and wrap a little paper and dirt around the roots, and you can each take one in your hands and run home and set it out, and water it, and it will live and grow and bear flowers. But no one need come who is not willing to take care of it for months, and wait patiently for its flowers."

"I fear," said the teacher, "that they will be troublesome in going to your house."

"Oh, no; I presume of the thousands here, not more than a hundred will come."

"In this he was mistaken; for before four o'clock the streets began to fill with children. They soon filled the steps of Mr. Pardee's house, as well as those of his neighbors, and the sidewalks were lined with amateur florists. For two hours he labored as fast as possible to supply their little hands—the girls first, the boys, at his suggestion, generously giving way and quietly waiting their turn, until, instead of the anticipated one hundred, he furnished a majority of the whole school. For two hours, the street was a scene of great interest. Passers by stopped to gaze and wonder, and inquire what it all meant. The windows and doors of neighboring houses all exhibited curious faces and eyes gleaming with pleasure at such an unwonted scene in that quiet locality. Already had the flowers blossomed and borne fruit in the hearts of the children."

The intellectual, the moral, and the physical well-being of the school may be promoted by their planting one of each of the indigenous trees of the district in the schoohouse yard, and by observing their likenesses and their dissimilarities. Besides the practical lesson taught in the planting of a tree, which every person, especially in Illinois, should understand and practice, there is a moral influence imparted which cannot be calculated. Those who invest interest and labor in planting a tree or shrub will likely attach some value to the object by that act. If one is interested in trees of his own planting, and appreciates their value, he will likely take care of those in which the community have an interest. Every school might have a little cabinet containing many of the curiosities of the district. Fossils, minerals, botanical preservations, Indian relics, and anything curious might be collected, which, although not scientifically named and arranged, would do good.

To those who may desire to turn their attention these interesting branches of study and yet not know where to get the desired books,

we would recommend Dr. Ruschenberger's Natural History, (two volumes,) embracing the elements of Anatomy and Physiology, Mammalogy, Ornithology, Herpitology, Ichthyology, Conchology Entomology, Botany and Geology. To those who might desire more extended works, "Vanderhœven's Hand-book of Zoology," (two volumes,) is recommended; in Botany, "Gray's First Lessons and Manual;" Geology, "Lyell's Principles and Manual," also, "Emmons' Manual;" "Outlines of Comparative Physiology," Agassz & Gould; in Mineralogy, Dana's.

One of the chief designs of this paper is to direct the attention of the members of the State Teachers' Association to the fact of the existence of the Illinois State Natural History Society. A brief history of its formation may not be without interest. At the meeting of this Association, in December, 1857, held at Decatur, a paper was read from Mr. Cyrus Thomas, of Carbondale, Jackson county, suggesting the formation of a State Natural History Society, and suggesting the State Normal School as its head-quarters and the place for its Museum. In accordance with this suggestion, a meeting was called at the rooms of the Normal University, in Bloomington, on the 30th of June following, when a plan of operations was agreed upon, and officers elected, of whom Professor J. B. Turner was elected President. Since that time two annual meetings have been held, and at each succeeding meeting the evidence of increasing interest has been exhibited by increased numbers. Papers have been presented by President J. B. Turner, on "Microscopic Insects;" by Dr. Frederick Brendel, of Peoria, on "Forests, or Forest Trees;" by Cyrus Thomas, of Carbondale, on "The Study of Natural History;" by Dr. Frederick Brendel, on "Meteorology, in connection with Botanical Investigation;" by George Vasey, of McHenry county, on "Mosses of Illinois;" by Dr. E. R. Roe, of Bloomington, as "Notes on the Great Drouth in 1853 and '54;" by Cyrus Thomas, on "Orthoptera of Illinois;" by Professor J. B. Turner, subject, "Mind, Force, and Matter;" by B. D. Walsh, of Rock Island, subject, "Insect Life, in its relation to the interests of Agriculture;" by Dr. Oliver Everett, of Dixon, on "Geology of a Section of Rock River;" by Dr. E. R. Roe, of Bloomington, "Some Features of the Drift Formation in Illinois;" by Dr. Adams, of Jacksonville, on "A Plan for the Study of Natural History;" by Dr. Frederick Brendel, on "The Peculiar Growth of the Water Lily," (Nelumbium Luteum.) Following out the original design of Mr. Thomas, the Normal University building was planned with a large and beautiful hall, one hundred feet by thirty-three feet, for the Museum. Through the indefatigable exertions of Mr. C. D. Wilber, the agent of the Society—now its Secretary—and others too numerous to mention, the collection made within the last two years amounts to nearly sixty thousand specimens. Such a collection made within so short a period is perhaps the best evidence of the vigor and strength of the Society, and the devotedness of its members. Until the present time the

halls have not been ready for the display of the Society's collection, but it is expected that within a few weeks, under the good taste and management of Mr. R. H. Holder, of Bloomington, Treasurer and Curator, it will be open for exhibition. The library of the Society will embrace everything that can be procured by gift, purchase or exchange, upon Natural History in particular, and Science in general. The library, at present, contains three hundred volumes, which are under the care of Mr. Ira Moore, Librarian. Every member of the Society can avail himself of this means of adding to his stock of knowledge in any branch of the subject in which he is specially interested. It is to this object the funds of the Society will be chiefly devoted.

Commissions have been appointed in the several divisions of Natural History to investigate everything in their several departments and report at the next annual meeting. Among these it is expected that a complete list of the Ornithology of the State, as far as discovered, will be presented by Mr. R. H. Holder, together with a treatise on the Taxidermy of birds, or "Bird Stuffing." A complete Flora will also be published from the joint labors of Drs. Vasey, Brendel, Mead, Everett and M. S. Bebb.

It is due, however, to the general intelligence of our people of Illinois, to say that, without their generous appreciation of the subject, their hearty co-operation with the plans proposed, and their great liberality in giving and doing for the cause, comparatively little of what has been done could have been accomplished. The Society is indebted to the State Agricultural Society for the interest it has manifested in giving such ample opportunities to present the subjects, by the exhibitions of specimens, to the attention of the people at large, collected at the State Fairs; and also for the privilege of publishing their papers and reports in the Agricultural Society's Transactions, where they may be found entire.

Without the marked favor of the various railroad companies the Society wold have been almost helpless, but with their commendable liberality they have done more than anything else to demonstrate the public spirit and intelligence of the State. The Press, it is needless to say, has been one of the great levers in this movement. We owe it our gratitude; more said in its behalf would be superfluous.

And now, fellow teachers, what can we do to promote the interests of this Association? We answer much, and in many ways. The Museum and Library established at the Normal University was put in that place that it might benefit, directly or indirectly, every teacher and school in the State. They have cost and will cost a great expenditure of time, study and money to the friends of the enterprise, and you can assist and cheer them in their self-denying labors, by showing your sympathy for and appreciation of the cause; by extending a knowledge of it among the people and the schools; by forming auxiliary societies; by establishing school cabinets; by sending rare specimens of fossils, beasts, birds, fishes,

reptiles or plants, to the cabinet at Bloomington; and last, though not least, in giving of your means to increase the diffusion of knowledge by accumulating a large and valuable store of scientific works in the library. Articles VIII and IX of the Constitution prescribe that "Any resident of the State of Illinois may become a member of this Society on the payment of five dollars, if elected by a majority of the members present at any regular meeting; *provided*, the names of candidates for membership shall in all cases be presented on the recommendation of two members of the Society. Each regular member shall pay an annual assessment of one dollar, after the first year of his membership."

Hoping that many members of the Teachers' Association may be enrolled upon the catalogue of members in the Natural History Society, and believing that a new and nobler impulse for generous and general education may be extended even among our teachers and schools, we will engage your attention no longer.

OBJECT LESSONS.

By J. H. Blodgett.

A branch of teaching too little known and used, yet most nearly natural, is that of taking an *object* and giving instruction by presenting it to the direct observation of the pupils. It is not a process in which the teacher or the book tells the facts in regard to the thing considered, but one in which the living teacher puts in reach of their senses, where they see and handle, the mineral, the animal, or the flower and plant. In theory, this is the perfection of teaching. Things and qualities are thus taught before words and names. The latter being needed by the pupil, are retained by him with ease, while he can scarcely retain them at all when learned in the routine of an ordinary book lesson, given before he has himself noted the qualities. In actual practice, the objects cannot always be presented. A menagerie or botanical garden cannot be attached to every school, or a collection of the mineral productions of the earth. Some aid can be had from pictures, and yet we must depend largely upon the printed descriptions of travelers and naturalists. But *this* can be done. We can take the natural mode of teaching with reference to articles close at hand, and the terms necessarily employed will convey vivid meaning when they occur on the printed page or in the oral lecture, or narrative of a traveler from remote regions, with regard to strange objects there. There is a peculiarity in the arrangement of natural products wondrously favorable to thorough instruction in regard to most of the productions of the earth, with access to those of but a single State or even county. While the varieties and species of plants and animals as well as minerals are almost innumerable, they may be grouped into a few great classes or families which tell their likeness by qualities differing only in degree. Thus, a common cat serves to teach the history of the puma and the leopard, the tiger and the lion, with the wildcat of our own forests, and the whole tribe of soft-footed, retractile-clawed, bearded, furry, treacherous, semi-nocturnal beasts of prey. The foot of a common spaniel illustrates that of the fox and wolf, as also his teeth and his general habits are like theirs.

A spear of timothy grass grows in like manner, to a great extent, with the corn-stalk of our own fields, the sugar cane of the south, and the huge bamboo of the East Indies. A piece of LaSalle or DuQuoin coal, tells the same general story as that in English mines, or the peat in an Irish bog. An accurate knowledge of a bit of common limestone with its load of shells and other marks of dead generations, enables us to understand Vermont or Italian marble, English chalk cliffs, the gypsum of France, and the beautiful alabaster of a parlor ornament. Nature has furnished most parts of the habitable earth with a pretty full set of specimens of the work she does in other parts. Even the odd specimens so-called, of remote regions are but combinations of qualities and forms elsewhere manifested. The duck-billed Platypus, a great puzzle to naturalists who visit Australia, is described to us as having a bill like a *duck*, a body like a *mole*, and as laying *eggs*. That description, when the measurement of the animal is given, will be perfectly clear to any child who has caught a mole throwing up his tunnel in the garden or grass-plot; rolled on the haymow when sent to hunt hens' nests; and set ducks' eggs under a hen. The brilliancy and gorgeousness of the plumage of tropical birds is readily comprehended by the child who has been able to examine the dress of a humming-bird, or even to note the glossy changeable coloring of the neck of the common blackbird, stepping so briskly over the furrows of the Spring plowman. Yet the examples are not everywhere at hand to illustrate the works of nature elsewhere. Vast numbers never saw iron ore or native copper, or knew, by the eye, some most important classes of plants and animals. Hence, the importance of museums, where samples may be deposited showing what beds of ore exist, what forests there are in remote regions, and what beasts and birds and insects roam and sing and buzz there. Here, shells and corals, with mounted fishes, tell us of the wonders of the great deep. So far, we have only viewed these as teaching physical facts; but where else are we to gain knowledge of moral and intellectual truth, except as it is illustrated by these? Ever since Adam was set to dress the garden and name the animals, down to to-day, moral training has come much through nature's visible forms. Our Savior taught faith and trust in God by the lily and the grass of the field. Paul, the great preacher, taught the doctrine of resurrection by the grain of wheat cast into the ground. The seeming death and change of many winged insects, as they are successively grub, chrysalis and bug, is a lesson on the same point.

The museum of the Illinois Natural History Society is a great educational agent. Its location at the Normal University, will enable those preparing to go forth as teachers to know more fully what text books describe, and to make their pupils see more clearly the force of descriptions given in their readers and geographies. It will break down narrowness of view and awaken enthusiasm and energy in studying the great book everywhere open before us. Then we shall have in the scattered districts little groups of child

naturalists watching with interest the successive steps of a lady-bug's life, or learning to know the destructive caterpillar, when it comes in its beautiful winged apparel, laying eggs for future generations of voracious destroyers of the crops, but so splendid and graceful that like a rich rascal in human society, it receives admiration and immunity, instead of being made to pay the penalty of its crimes. Then, too, miniature museums will be forming in the common schools. A bit of lava will be secured to give reality to a description of a volcano, and a piece of iron ore will tell the story of Pilot Knob and the Iron Mountain. An Indian pipe, hatchets and arrow-heads, will remind the little folks of the red man's history. Nor will the little ones alone be interested. Let a teacher begin to gather such a collection and if he has a little enthusiasm, and it begins to be understood that such a collection is being made, he will find that the whole neighborhood will be interested to give or put on deposit curious articles. His school cabinet will be remembered when strange objects are met with in plowing, or on a journey. The general interest in the school will be increased and the lessons assigned in text books better learned and more thoroughly understood.

This is no fancy sketch. There are schools where this is so now. Those birds in the museum at Bloomington have indirectly awakened in two schools that could be named great interest and zeal in the study of Ornithology. The same schools and others are also wide awake as to the rocks and minerals about them.

Object lessons have received little attention in this country. In Great Britain and Germany the case is different. There the subject is much more popular and more extensively practiced. Books that scarce find any market here are published in Great Britain with titles like the following: "Lessons on Objects;" "Lessons on Shells;" "Model Lessons," for primary schools; "Information on Common Objects;" and the Home and Colonial School Society puts up little cabinets of objects to be sold to such schools as may use such mode of teaching. The cabinet comprises a set of calcareous minerals, also silicious, saline and inflammable; with specimens of the metals, and needles, pens and other common things made of them; of vegetable matters, specimens of field grains, small fruits, spices and gums; of animal production, shells, bones, feathers, ivory, leather, parchment and other articles, of which a small amount answers as a specimen; together with cloths of various fabrics, as flax, silk, cotton and wool. All this costs but little. A movement has been inaugurated by the Natural History Society, to have small cabinets made for sale, the proceeds to be used for a book fund.* Here schools may secure collections that will aid much in the work of Object Teaching, if so situated that they cannot by their own

*NOTE.—I have heard that B. D. Walsh, of Rock Island, expects to put up cheap cabinets of Insects, illustrating the characteristics of the different families. I hope it is true, and that the schools will second the effort to diffuse such knowledge.

labor or exchange, secure them at home. This museum will strengthen the current turning toward Object Teaching, and inaugurate a new mode of teaching in our schools. It will prove one of the best educational forces of this period of our State history, and the men who have sacrificed money and time for its establishment, will yet be regarded as great educators, even though some of them never "kept school." It is highly appropriate that the dedication of the rooms takes place so near the time of the meeting of the State Teachers' Association.

Object Teaching has been so little used that a short specimen lesson may not be amiss here. The lesson presented is not intended to teach new facts to the children, any farther than they are led to observe them, and thus give form to their knowledge instead of adding to it. The lesson is from Mayo's Model Lessons. The article before the children is a lock of WOOL.

"What is this? Wool. Where does wool come from? It comes off the sheep's back. What sort of a thing is a sheep? An animal. What is wool then? Part of an animal. Of what use is the wool to the sheep? To keep it warm. Can the sheep make its own wool? No. Who gave the little sheep this warm clothing? God. Yes, God gave the sheep this warm clothing because it cannot make any for itself.

"Now pass this wool about; look at it and feel it, and tell me what you can find out about it. It is soft. Repeat—wool is soft. It is all hairs. Do you see all the hairs? Yes. Repeat, then—wool is formed of hairs. Feel it again. It is dry. Repeat—wool is dry. What more? It is warm. Does it feel warm when you touch it, like fire? No. What do you mean then? It keeps us warm. Repeat—wool keeps us warm. Yes, it keeps us warm, because it prevents the warmth of our bodies from passing away from us.

"Who can tell me what wool is used for? To make stockings and flannel. What is that very thick flannel you have on your beds? Blankets. Do you know any kind of clothes made of it? Yes, father's coat. And what have some persons on their floors to keep their feet warm? Carpets. Carpets are made of wool?

"Now repeat all you have said of wool. Wool comes off the sheep's back, the clothing which God gave it to keep it warm; wool is soft, dry, and formed of hairs; it keeps us warm; it is made into stockings, flannel, blankets, and carpets."*

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*NOTE.—Any one who has not paid attention to the subject will be surprised to find more than a large octavo page of fine print, occupied by the *mere outlines* of the lessons on a common pen, in a book on Object Teaching, edited by Henry Barnard, and published by George Sherwood, Chicago.

NOTES ON ILLINOIS INSECTS.

By Cyrus Thomas, of Murphysboro, Illinois.

In attempting to write a paper, or work of any kind, on the insects of any section, although the most simple and unscientific language be used, yet an outline of the classification of these animals is absolutely necessary, in order that you may be understood by readers not Entomologists. Think for a moment of the vast number of species belonging to this *class*, and the truth of the foregoing remark will be admitted. Fully one hundred and fifty thousand species have already been described; which, in ten years more, may be increased one-third. In Illinois, alone, we have probably five thousand different species; perhaps more. To describe all these, and give a history of the transformations and habits of each, would require half a dozen quartos of a thousand pages each. Therefore, in order to avoid this difficulty, Naturalists have adopted a system of classification, by which this vast multitude can be arranged in groups, each group having certain characteristics in common. And, as a general thing, the various species of each group not only agree in figure but have similar habits. For instance, the family Carabidæ, among the beetles, contains only predaceous species, while the almost equally extensive family Curculionidæ contains only vegetable eaters. The definition of "*species*" is one of the most difficult tasks assigned the Naturalist. It corresponds very nearly with the common term "*sort*" or "*kind*." It is that race or chain of beings, descended from common parents, and which always produces the same kind, similar in every respect, or very nearly so. For instance, the White Oak is a species, the Black Oak is another; and the acorn or fruit of one will not produce a tree of the other kind. Insects being small animals, great care is necessary to avoid confounding one species with another, or making two species out of one, where the sexes differ. On the fact of the permanency of species hangs the entire system of classification. For if what is now a White Oak may in a century produce a Black Oak or a Chestnut, and what is now a frog may in five hundred years produce a bird, a description given by Aristotle

or Linnæus would be of no service to us of this day. In fact, Natural History would cease to be a science. Then starting with the admitted fact that species ever remain distinct, we next gather into a group those species having the parts of the body similarly arranged, and proportioned alike, though varying in color, size or marks, which collection is termed a *genus*—(plural *genera*.) Next, those genera that are alike in a number of particulars, and that contain species having similar habits, are grouped together and form a *family;* which, at least among insects, is the most natural and definitely marked group from *species* to *class*. All the *families* of insects have been collected into some eight or ten groups, called *orders*, which are distinguished from each other by tolerably well marked characters. And, finally, all these *orders* taken together form the *class Insecta*, which stands in the great Animal Kingdom as a division, in rank, equal to the *Quadruped class* (Mammalia,) or the *Bird class* (Aves,) etc.

The term *insect*, (which includes all in the class *Insecta*,) at the present day, is limited to those animals with articulated bodies, divided into three chief portions—the *head*, the *thorax* and *abdomen*, having three pairs of legs, and generally, one or two pairs of wings. They also pass through several transformations, called their metamorphoses. They pass through, during their lives, four forms or states of being, in many species very different from each other, to which the following names have been given—the *egg*, the *larva*, the *pupa*, and the *imago* or perfect insect. The egg is the first form in which they enter upon a state of being—all known species (with the exception of some few species, chiefly among the two-winged flies,) being first produced in this form. When hatched from the egg they enter upon the larva state, in which they generally assume a worm-like form. In this state some are possessed of legs, others have none, some are true grubs, others caterpillars; whilst others, as grasshoppers, bugs, etc., have the form of their perfect state, only differing in size and wanting wings. Some pass this portion of their lives in the water, others in the trunks or leaves of trees, in plants, fruits, the ground, in filth or the bodies of other insects or other animals. And it is also during this state that the vegetable-eaters are most destructive to vegetation, for during it their only business is to eat and grow. After having passed through the length of time assigned them by nature for this form of existence, they next enter upon the *pupa* state. In this state the majority of insects cease to eat, lose their larva form, and in cocoons, hardened cases or otherwise, enter upon a death-like state of rest. Though some, as crickets, grasshoppers, bugs, etc., continue active, eating and increasing in size, frequently casting off the skin, whilst little wings begin to appear, which increase in size at each moulting. From this state they next pass into the *imago* or perfect state. When this is reached they do not increase in size or undergo any further moultings, and their chief business now seems to be to prepare for a continuation of the species. And here

I may be allowed to correct a common error, by stating that little flies and little beetles, etc., will never become larger ones.

These various and wonderful changes in the form of insect life are worthy the attention not only of the professed Naturalist, but of the farmer and of every lover of Nature and her laws. It is no idle thing to trace the finger of a wise Creator in the wonderful plans of his handiwork in even so small a thing as an insect. If a loathsome crawling reptile were to descend into the earth and there, for a time, remain buried in a death-like sleep, coiled in a made cell or a cast off skin, and then come forth a beautiful bird, decorated with all the colors of the rainbow, we would look upon the changed animal with wonder and amazement. Yet to see a worm transformed into a brilliant beetle or gay butterfly excites no amazement; first, because it is a common occurrence, and, secondly, because of its small size. Is not the manifestation of power and wisdom as great in the one case as it would be in the other? In these changes is exhibited to us a type of the various changes through which all animals pass, even up to man himself.

The great animal kingdom, as before stated, is divided into different vast groups, each having a distinct and somewhat different series of changes or metamorphoses through which they pass. Yet that all do pass through some such series of changes can no longer be doubted. And it is in connection with this fact we find any reasonable explanation for neuters among insects, and of the means bees adopt to supply a new queen.

In speaking of or describing insects, when no reference is made to a given period of their existence, the perfect insect is intended.

In describing insects it is necessary to make use of some terms not used in ordinary language; therefore, I will give a short explanation of some few of these terms, not that I expect to use them, but as a means of reference. The bodies of perfect insects are considered to be divided into three parts; first, the *head*; second, the *thorax*, which is the portion to which the legs and wings are attached, and is situated between the head and the abdomen; third, the *abdomen*, the hinder part of the insect, and is generally divided into segments or rings. From the front of the head arise two slender, thread-like, jointed appendages, varying in the different families and genera; these are called *antennæ*. From the mouth of such as have horny jaws (*mandibles*) arise sometimes four and sometimes six slender jointed appendages, generally much shorter than the antennæ, and generally composed of three or four joints; these are called *palpi*. The under side of the thorax is called the *pectus* or *sternum*. The triangular piece between the base of the wings, or wing-covers, is called *scutellum* or *scutel*. The horny wing-covers of beetles and bugs, and leathery wing-covers of grasshoppers are called *elytra*. The upper side of the abdomen, *tergum*; the underside, *venter*—its *base* is the part that joins the thorax; the *apex*, the latter end. The legs and feet, taken together, are often called *feet*; *femur* or *femora* are thigh or thighs;

tibiæ, shanks; *tarsi*, toes. The horny jaws are called *mandibles*. The long snout, with which some insects are furnished, is called *rostrum*. The first or basal joints of the antennæ or rostrum are those next the head.

In connection with the foregoing remarks, I herewith present a list of Illinois Coleoptera, together with a few remarks upon the order and families. I would be glad to descend more into particulars, and describe and give the history of some of the most important and obnoxious species, but space and time will not permit it.

COLEOPTERA.

This order is usually placed at the head of the list by systematists, though not always. It contains a larger number of species, and has received more attention than any other order of insects. The word *Coleoptera* signifies wings in a sheath; and the name has been applied on account of the hard, horny wing-covers with which the species are furnished. The common name, *beetle*, is applied to exactly the same insects. The characters of the order may be stated, in short, thus:

"Insects with jaws moving sideways, two thick, horny wing-covers (elytra) meeting in a straight line on the top of the back, and two filmy wings, which, when at rest, are folded transversely under the wing-covers. The larvæ are called grubs, generally provided with six true legs, and sometimes also with a terminal proleg. Such species as undergo their transformations in nuts, fruits, and in timber, are often destitute of legs. The pupæ are inactive."

FIRST FAMILY—CICINDELIDÆ.

This family includes those active ferocious beetles, that we frequently see flying and lighting before us in the road, when the sun is hot; as we approach, they again take flight and drop down a few steps in advance, generally with their heads turned toward us. They have long legs, and run with great rapidity. The species found here are of medium size, one-third to three-fourths of an inch long, mostly with bright colors, generally green or bronzed, with white spots or marks. They have received the name of tiger-beetles, from their bright colors and ferocious habits. A bright green species, with six white dots on the elytra, is thought, by many, to be a "blister-fly."

As all the species of this family, both in the larva and perfect state, live on other insects, of course they are beneficial to us, and not injurious.

Megacephala—Virginica.
Cicindela—generosa, purpurea, formosa, lembalis, sexguttata, modesta, repanda, hirticolles, cuprascens, duodecemguttata, vulgaris, lepida, punctulati, lecontei.

2—CARABIDÆ.

This is the most numerous family of the order, embracing a great many genera, often very difficult to distinguish. In fact, a great many unnecessary genera have been formed, which has only added confusion to this troublesome family. This family includes the predaceous ground beetles, found under shocks of wheat and corn, under logs, rails, etc. Those black and dark brown beetles, seen running rapidly away when we turn over a log, plank or rail, in the field or at the roadside—those that fly in at the window of a night, when the air feels damp, and drop about the floor and on the table, etc., and as soon as they light commence running hither and yonder—mostly belong to this family. They are generally of a dark color, though several species are of a brilliant metallic luster, mostly green or bronze. The elytra, or wing-cases, are mostly longitudinally striated.

Notwithstanding these insects are often found in situations that cause them to be suspected of mischief, yet they are our friends, and are there only for the purpose of destroying other insects, on which they prey.

The Illinois species, so far as determined, are as follows:

Casnonia—Pensylvanica.
Septotrachelus—dorsalis.
Galerita—janus.
Zuphium—Americanum.
Cymindis—pilosa, limbata.
Calleida—decora, punctata.
Dromius—piceus.
Apristus—Americanus.
Lebia — atriventris, pleuritica, viridipennis, furcata, pulchella, ornata, axillaris, scapularis, viridis, pumila, moesta.
Brachinus—fumans, librator.
Scarites—subterraneus, quadriceps.
Pasimachus—elongatus.
Clivina—bipustulata, Americana, cordata.
Schizogenius—lineolatus.
Dyschirius—sphæricollis, globulosus, æneolus.
Scaphinotus—elevatus.
Sphæroderus—stenostomus.
Carabus—serratus, vinctus, silvosus, lapilayi.
Calosoma—scrutator, Wilcoxi, frigidum, sayi, calidum, externum.
Omophron—tessellatum, Americanum.
Blethisa—quadricollis.
Elaphrus—ruscarius, clairvillei.
Panagæus—fasciatus.
Chlænius—erythropus rufipes, lithophilus, sericeus, æstivus, Pensylvanicus, vicinus, tricolor, impunctifrons, emarginatus, tomentosus, niger, pusillus.
Oodes—Americanus, parallellus.
Diplocheila—major, laticollis, obtusus, brevicollis.
Dicælus—purpuratus, violaceus, sculptiles, dejeanii, elongatus.
Badister—pulchellus.
Patrobus—longicornis.
Calathus—gregarius.
Pristodactyla—impunctata.
Platynus—angustatus, ruficornis, sinuatus.
Anchomenus—sinuatus, cincticolles, extensicollis, viridis, decorus.
Agonum—8-punctatum, cupripenne, excavatum, nutans, æruginosum, Harrisii, placidum, nigriceps, luctuosum, punctiforme, anchomenoides.
Anchonoderus—pusellus.
Poecilus—chalcites, lucublandus, fraternus.
Loxandrus—erratecus.
Feronia—erythropus, mutus, luczotii, caudicalis, luctuosus, mandibularis, monedula, Haldermani, scrutator, orbatus, stygicus.
Percosia—obesa.
Amara—impuncticollis, rubrica, musculus.
Triæna—angustata.
Bradytus—exaratus, avidus.
Geopinus—incrassatus.
Cratacanthus—dubius.
Agonoderus—lineola, pallipes, dorsalis.
Amphasia—fermoratus, interstitialis.
Spongopus—verticalis.
Anisodactylus—discoidens, Baltimoriensus, nigrita, rusticus, carbonarius, nigerrimus, tristis.
Eurytrichus—terminatus, (testaceus?)
Salenophorus—iripennis.
Pangus—caliginosus, lugubris.
Harpalus—Pensylvanicus, (bicolor?) compar, faunus, vulpeculus, herbivagus, erythropus.

Stenolophus—ochropezus, conjunctus.
Bradicellus—autumnalis.
Acupalpus—humilis.
Bembidium—impressum, inæquale, paludosum.
Ochthedromus—nitidulus, Americanus, salebratus, dorsalis, patruelis, versicolor, quadrimaculatus, affinis, (fallax ?) lucidus.
Tachys—inornatus, flavicandus.

DYTISCIDÆ.

This entire family consists of water insects—those species inhabiting stagnant waters. Their posterior legs are formed into a kind of fringed paddles or oars, which enable them to swim with great rapidity, using them in the same manner that the frog uses its hind legs. They are very voracious, devouring other insects, and even attacking young fish. They are also furnished with wings, and may frequently, especially after night, be seen flying about candles and fires.

The following Illinois species have been identified:

Dytiscus—Harrissii, fasciventris, verticalis, hybridus.
Cybister—fimbriolatus.
Acilius—fraternus.
Colymbetes—sculptilis.
Ilybius—fenestralis, pleuriticus.
Agabas—ambiguus.
Matus—bicarinatns.
Coptotomus—interrogatus.
Copelatus—glyphicus.
Laccophilus—maculosus.
Hydrocanthus—iricolor.
Hydroporus—undulatus, Americanus.
Haliplus—immaculaticollis.
Cnemidotus—duodecimpunctatus.

GYRINIDÆ.

This family also consists of insects that inhabit the water. They are generally to be seen on standing or gently running water, collected in groups, often in great numbers. They are active, whirling round in circles, from which circumstance they are called "whirlwigs." When handled they emit a disagreeable odor.

These insects live on small dead insects found floating on the surface of the water—at least Westwood so informs us.

Our species are few, and so far have not been examined and determined by our Entomologists. I can give but one species about which I have no doubt.

Dineutes—labratus.
Gyrinus—[Of this we have some species; probably *borealis* and *limbatus* ?]

PARNIDÆ.

This is a small family of minute sub-aquatic insects, inhabiting the borders of ponds, ditches, etc. It is supposed by Latreille that they live on animal matter.

Illinois species:

Elmis—4-notatus.
Macronychus—glabratus, lateralis.

HYDROPHILIDÆ.

The insects belonging to this family are also water insects, remaining during the day in the water, and coming forth in the evening, take wing. Their feet are also furnished with hairy fringes, which they use as paddles to assist in swimming.

Our known Illinois species are:

Helophorus—lineatus.
Hydrochus—scabratus.
Hydrophilus—triangularis, ovalis.
Hydrocharis—obtusatus, glaber.
Berosus—striatus.
Hydrobius—globosus.
Philhydrus—cinctus, bifidus.
Cyclonotum—subcupreum.
Also some species of sphæridium and cercyon not determined.

PHALACRIDÆ AND ANISOTOMIDÆ.

These are two small unimportant families, closely connected with the genus Spæridium, beforenamed, which latter is not aquatic. The only species known to inhabit Illinois, are:

Phalacrus—pencillatus.
Leiodes—discolor, [probably.]
Agathidium—piceum?

SCAPHIDIIDÆ.

A family of small insects, residing in agaries, fungi, and under the bark of rotten trees. Illinois species:

Scaphidium—4-guttatum, piceum.

SILPHIDÆ.

These insects render us great service, in removing from the surface of the earth dead animal matter, which is their chief food. They may be distinguished by the three or four jointed club at the end of their antennæ. They are accompanied by a nauseous odor. Our species are as follows:

Necrophorus—americanus, orbicollis, marginatus, velutenus, pustulatus.
Necrodes—surinamensis.
Oiceoptoma—marginata.
Thanatophilus—candatus.
Necrophila—americana.
Silpha—inæqualis, peltata, marginalis.

NITIDULIDÆ.

This family, as extended by the Melsheimer Catalogue, includes a variety of insects, somewhat differing from each other in their habits; and some of the genera appear to be very near the *Curculionidæ* in structure and habits. Some of the species are found among bones and animal remains; some beneath the bark of trees; some on flowers, and various other places. Some species are thought to be injurious to plants, by puncturing the flowers, and injuring the fruit, such as the blackberry, raspberry, etc. But, as the family appears to be in considerable confusion, we can lay down no particular characteristics or habits. Illinois species:

Cercus—abdominalis.
Nitidula—bipustulata. Ziczac.
Prometopia—6-maculata.
Omosita—colon.
Phenolia—grossa.
Cryptarcha—ampla.
Ips—fasciatus, 4-signatus, sanguinolentas.
Rhizophagus—nanus.
Trogosita—castanea, subnigra, dubia.

COLYDIIDÆ.

Small insects residing mostly under the bark of trees. The two species determined as Illinois species, are:

Ditoma—quadriguttata.
Colydium—longiusculum.

CUCUJIDÆ.

Also a family of small insects, closely allied to the foregoing; mostly of an oblong, depressed form.

Catogenus—rufus.
Cucujus—clavipes.
Læmophlœus—biguttatus.
Brontes—dubius.
Telephanus—velox.
Silvanus—dentatus, planatus, surinamensis.

CRYPTOPHAGIDÆ.

Also small insects, generally inhabiting boleti, fungi and similar vegetable substances. Some of the species are very minute.

Cryptophagus—celaris, gilvellus.
Atomaria—atra?

LATHRIDIIDÆ.

Corticaria—denticulata, americana.
Lathridius—musæorum.

EROTYLIDÆ.

Engis—4-maculata.
Dacne—fasciata, heros.
Ischyrus—4-punctatus.
Triplax—dimidiata, humeralis.
Languria—bicolor, Mozardi, puncticollis, trifasciata.

MYCETOPHAGIDÆ.

Mycetophagus—flexuosus.

The three foregoing families consist, mostly, of very small insects, and are closely allied in habits, some residing in boleti, fungi, and decaying vegetable substances; others, beneath the bark of dead or decaying trees; others, as species of Lathridius, are said to devour the corks of wine and other bottles, thus becoming injurious.

DERMESTIDÆ.

With this family we enter upon the list of injurious insects. The species are not large, yet much too well known for our good. It includes those species that feed on dry hides, skins, furs, feathers, bacon and other dried meats. It is the larvæ of some of the species included in this family that cut to pieces and destroy our ladies' furs; of others, that so often damage the hides and skins stored up by our traders. In fact, scarcely anything escapes their attack. Our collections of birds, insects, and other animals, are often ruined by these voracious pests. Books and papers are also often seriously injured by them. Illinois species:

Dermestes—lardarius, marmoratus, caninus, vulpinus.
Attagenus—pellio, ornatus.
Anthrenus—castaneæ

BYRRHIDÆ.

Small insects with "short oval or rounded, very convex" bodies, "generally covered with short sericeous pile." Found on the ground, in sandy places and foot paths. Our species:

Byrrhus—varius, americanus.

THROSCIDÆ.

Of this family I know nothing. The genus Throscus is said to be allied to the Elateridæ or snapping-jacks. Our single known species is:

Throscus—constrictor.

HYSTERIDÆ.

This family is composed of species easily distinguished by their form, which is that of a parallelogram, with slightly rounded corners. The body is very flat, highly polished, and very hard, so much so that it is with difficulty a pin can be made to peretrate it. They reside in the dung of horses and cows and under the bark of damp decaying or dead trees. Their color is mostly jet black, occasionally having a red spot or spots on the elytra. The species are all small, seldom exceeding the fourth of an inch in length. The larvæ of *Hister interruptus* is at least ten times the size of the perfect insect. Illinois species:

Epicrus—minor.
Hister—arcuatus, abbreviatus, interruptus, americanus, bimaculatus.
Paromalus—bistriatus.
Platysoma—LeContii.
Hololepta—æqualis.
Saprinus—pensylvanicus, assimilis.

LAMELLICORNIA.

This family, as given in the Melsheimer Catalogue, is a very unwieldy affair, though well marked by its distinguishing character, which is given as follows: Antennæ generally short, nine or ten jointed, and terminated by a large club, composed of several—generally three—of the terminal joints formed into long plates, which open like the leaves of a book. Many Entomologists have divided this group into several families, and as there are quite a number of genera varying much in habit I shall group them somewhat after Westwood, and at the end of each group append such remarks as I think applicable:

Chœridium—capistratum.
Canthon—lævis. [This is the well known pill roller.]
Copris—carolina, anoglypticus, ammon.
Phanæus—carnifex.
Onthophagus—hecate, ovatus.

The foregoing species are included in the family *Scarabidæ* of MacLeay. Among them are found our common black and brassy-green dung beetles, so frequently seen in the roads and streets, during the hot days of summer.

Aphodius—fimetarius, concavus, strigatus, omissus, serval, curtus, granarius.
Acanthocerus—aphodioides.

These are mostly small insects, being much less, generally, than the previous group, but having similar habits.

Trox—tuburculatus, porcatus, capillaris, terrestris, acqualis.

Insects of medium size, having a large thorax and exceedingly thick, rough external covering; inhabiting dried animal substances and excrements.

Geotrupes—splendidus, blackburni, excrementi, egerici.
Balbocerus—farctus, lazarus, melibocus.

Similar in appearance and habits to the *Scarabidæ*.

Lucanus—dama, lentus. [Stag-beetles.]
Dorcus—parallelus.
Ceruchus—piceus.
Platycerus—quercus.
Passalus—cornutus.

This last is a well known, large, long, black beetle, found in and under old dry, well rotted logs—having a horn on the thorax.

Dynastes—tityus.
Xyloryctes—satyrus.
Heteronychus—relictus.
Podalgus—cuniculus, tridentatus.
Chalepus—tracypygus.
Cyclocephala—angularis.
Pelidnota—punctata.
Areoda—lanigera.
Trichestes—pilosicolles.

The *P. punctata* and *A. lanigera* are very abundant, coming forth from their hiding places in the evening, at twilight. They are near an inch in length, thick, fleshy beetles. They devour the tender leaves of the trees, among which they hide during the day.

Phyllophaga—quercina, balia, hirticula, futilis, ilicis, pruinosa, brunnea.
Diplotaxis—sordida.
Omaloplia—sericea, micans.
Serica—vespertina, tristis.
Dichelonycha—linearis.
Anomala—varians, minuta, lucicola.
Macrodactylus—subspinosus. [The Rose-chafer.]
Strigoderma—arboricola.
Hoplia—trifasciata, mucorea.
Osmoderma—eremicola, scabra.
Trichius—piger, affinis, delta.
Cremastochilus—castaneæ, variolosus.
Gymnetis—nitida.
Cetonia—inda, herbacea, fulgida, melancholica, sepulcralis.

The foregoing species, though varying in size from over an inch in length to one fourth of an inch, they resemble each other considerably in appearance, being heavy, rounded and fleshy. They are vegetable-eaters, living mostly on the leaves in the perfect state, and most probably on the roots of plants in the larvæ state. Some species of the last named genus delight in the sweet juices that flow from wounded fruit and other trees, and even attack the fruit of the peach.

BUPRESTIDÆ.

These beetles are often brilliantly colored, of a coppery luster, or black, with golden spots or lines. They are of medium size—our species varying from one-eighth to three-fourths of an inch in length. They are of a long oval in outline, obtuse before and tapering behind. The head is sunk to the eyes in the fore-part of the thorax. They are frequently seen on the trunks and limbs of

trees, and on flowers, during the warm part of the day when the sun is shining. Their larvæ are wood-borers; and frequently do considerable injury to our forest and other trees, by boring into their trunks. The larvæ may generally be recognized by the great enlargement of the segment next the head. Dr. Harris tells us that some of these beetles eat leaves and flowers. The *B. divaricata*, of Say, that attacks the wild, and, also, the garden cherry and the peach trees, is found in our State, as well as a number of other injurious species.

Acmaeodera—tubulus.
Stenurus—divaricata, (cherry-borer;) lurida, baltimorensis.
Chalcophora—Virginica, liberta.
Buprestis—aurulenta.
Chrysobothris—femorata.
Oxypteris—longipes.
Trachypteris—fulvoguttata.
Agrilus—bilineatus, rufficollis, lateralis.
Brachys—tessellata.
Metonius—ovatus.

EUCNEMIDÆ.

The insects of this family are similar in form and habits to the following, (*Elateridæ*,) except that they do not possess the power of leaping. The only species I have the name of is:

Eucnemis—amœnicornis.

ELATERIDÆ.

The insects of this family are well known by the faculty they have of throwing themselves upwards with a jerk, when laid on their backs. They are called "spring-beetles," "jumping-jacks," etc. They are generally of a long, slender form, tapering behind, rather blunt before. The head is sunk to the eyes in the fore-part of the thorax. The larvæ of these insects are long and slender, and somewhat cylindrical, with the terminal segments generally a dusky color. They (*larvæ*) live upon wood and roots, and are found under the bark of trees and at the decaying roots of trees and stumps. Some of these are very destructive to vegetables, eating their roots, and thus destroying them. The beetles, during summer, may be found on trees, especially the hickory and oak.

Hemicrepidius—memnonius.
Monocrepidius—lobatus, vespertina.
Cratonychus—brevicollis, communis.
Perothops—mucidus.
Adelocera—auripilis.
Alaus—oculatus. [A very common large species, with two large eye-like spots on the thorax.]
Athous—cucullatus, melanothalmus.
Limonius—cylindriformis, quercinus, hirticollis.
Cardiophorus—cardisce.
Elater—rubricollis, piceus.
Cryptohypnus—dorsalis, bellus.
Corymbites—micans, uppressifrons.
Agriotes—pubescens.
Dalophius—pauper.

RHIPICERIDÆ.

Having branched antennæ.

Zenoa—picea.

ATOPIDÆ.

I am unacquainted with these.

Ptilodactyla—elaterisea.

LYCIDÆ.

A family that approaches the following, containing insects resembling the male glow-worm. Larvæ are said to reside under the bark of trees:

Dictyoptera—perfaceta.
Digrupha—reticulata, terminalis.

LAMPYRIDÆ.

These insects are of an elongate, oval form. It is among these we find the celebrated glow-worm. The body is of a soft consistence; dusky, reddish and yellow colors prevail. "The larvæ," Mr. Westwood says, "feed upon the bodies of snails, and other terrestrial molluscous animals. The perfect insects I have generally found on the leaves and flowers of plants, and the *Chauliognathi* I have taken in great abundance on the yucca, (Eve's-needle,) when in flower, also on the caraway, in bloom. Whether they injure the plants or not, I am unable to say, but think not.

Lucernuta—atra.
Ellychnia—corrusca, lacustris.
Photinus—pyralis.
Pyractomena—angulata.
Photuris—pensylvanicica,
Chauliognathus—pensylvanicus, marginatus.
Silis—bidentata.
Telephorus—bilineatus, impressus, carolinus, excavatus, scitulus.
Podabrus—tomentosus.

MALACHIIDÆ.

Similar in habits to the last family; live, as do some of the last named species of that family, on other insects. Body very soft.

Collops—4-maculatus, bimaculata.
Anthocomus—terminalis, literalis.

CLERIDÆ.

This family is composed of small and medium sized insects, generally long, slender, and sub-cylindrical. The Illinois species are generally of a deep blue color, ornamented with bright spots of other colors. The body is much firmer and harder than the preceding family. They frequent flowers and low plants. Some are found under the bark of old trees and logs, in which latter situation they pass their larvæ state. Our species:

Trichodes—nuttalli.
Clerus—ichneumoneus, rosenarius, nigripes, dubius, undulatus.
Thaneroclerus—sanquineus.
Hydnocera—pallipennis.
Phyllobænus—dislocatus.
Ichnea—laticornis.
Enoplium—pilosum.
Necrobia—rufiper, violaceus.

PTINIDÆ.

These insects have the thorax bent down, so as to bring the head under the breast. They live, during the larva state, in old stumps, palings, furniture, etc., which they perforate with round holes, in every direction, casting out at the entrance their borings, which look like fine saw-dust or powder. The hardest, dry hickory, ap-

pears a favorite with them. It is to this family the "death watch" belongs, which often sends terror to the heart of the superstitious. Among these are some species which are said to attack our fruit trees. Illinois species:

Bostrichus—aspericollis. [Apate.]
Apate—basilaris, fur, 4-maculatus.
Xyletinus—sericeus.
Anobium—abesum. [Larva is a death watch.]

RHYSODIDÆ.

Our only species, of which I know nothing, is,

Rhysodides—sculptiles.

SCOLYTIDÆ.

The insects of this family have the body nearly cylindrical, obtuse before and behind, and, are generally, of some shade of brown. The head is rounded, sunk pretty deeply in the fore-part of the thorax, and does not end in a snout. In the larva state they are very destructive to forest and other trees. They bore through the bark, to the wood, where they traverse the surface of the main wood in various directions; thus causing the bark to loosen: and by this means the tree is finally destroyed. They are generally of small size.

Scolytus—pyri.
Tornicus—xylographus?

We also have a number of other species of this family, belonging to the genera, Platypus, Tornicus, Hylesinus, Hylurgus, etc., which have not been determined. I think it is by one or more species of this family that our shade trees are so often destroyed.

CURCULIONIDÆ.

This family, which contains a vast number of species, is too well known by our fruit growers to need comment from me. Scarcely a plum tree is planted but they find it; nuts, leaves, grains, and almost every kind of fruit and seed are subject to their attack. But as I desire, at some future day, when I have gathered more facts, and determined more of our species, to write an article on this family, I will not attempt now to descend into particulars. The following Illinois species have been determined:

Dryaphthorus—corticales.
Sitophilus—granarius, [grain weevil,] aryzeæ, [rice weevil.]
Sphenophorus—13-punctatus, coriosus, cinereus.
Conotrachelus—NENUPHAR. [The "curculio."]
Mononychus—vulpeculus.
Cryptorhynchus—foveolatus, luctuosus.
Centrinus—scutellumalbum.
Baridius—trinotatus.
Balaninus—nasicus. [Hazelnut weevil.]
Anthonomus—signatus.
Magdalinus—armicollis.
Pissodes—nemorensis.
Sixus—concavus, musculus.
Hylobuis—pales.
Arrhenodes—septentronis.
Apion—sayi.
Ithycerus—curculionoides.
Rhynchites—bicolor, æneus.
Attelabus—nigripes.
Cratoparis—lunatus.
Bruchus—cratægi, pisi, [pea-bug,] musculus.

CERAMBYCIDÆ.

This is the family of "wood-borers." The beetles are sometimes called long-horned or capricorn-beetles, from their long antennæ. The antennæ are long and regularly tapering, and generally curved like the horns of a goat. The body is oblong, sub-cylindrical, somewhat flattened above, and tapering behind. The thorax is either quadrate or barrel-shaped, and narrower than the wing covers. The beetles, during the daytime, remain on the trees and among the leaves, but come forth and fly about at night. They deposit their eggs in the chinks and crevices of the bark of trees, into which the larvæ bore, as soon as hatched. The hardest wood will not turn them; but they continue to bore until ready to be transformed into the perfect insect. Some species of this family are far too well known to our fruit growers. These insects vary in size, from the fifth to one and a half inches in length. Some are of a brown color; others ornamented with black and yellow spots or stripes; others, again, are blue or violet. Those known to inhabit Illinois, are:

Paranda—brunnea?? [I fear this is a mistake, yet give it.]
Orthosoma—cylindricum.
Prionus—inbricornis.
Purpuricenus—humeralis, axillaris.
Stenocerus—longipes.
Eburia—quadrigeminata.
Chion—garganicum.
Elaphidion—atomaria, rufulum, vicinum, villosum, parallelum.
Criscephalus—agrestis.
Asemum—mœstum.
Hylotrupes—bajulus.
Arhopalus—fulminans.
Callidum—ligneum, antennatum, amœnum, varium.
Phymatodes—variabilis.
Physocnemum—brevilineum.
Eriphus—suturalis.
Clytus—speciosus, nobilis, flexuosus, erythrocephalus, sagittatus, campestris, capræa, hamatus, undulatus, supernotatus, ruricola.
Cyrtophorus—verrucosus.
Euderces—picipes.
Stizocera—unicolor.
Stenopterus—sanguinicollis, rufus.
Molorchus—mellitus.
Acanthoderes—decipiens.
Graphisurus—pusillus, fasciatus.
Aedilis—obsoletus.
Leptostylus—aculiferus, macula, alpha.
Hyperplatys—maculatus.
Desmiphora—tomentosa.
Monohammus—dentator, confusor, scutellatus, pulverulentus, tigrinus, pulcher.
Plectodera—scalator.
Tetraopes—tornator, 5-maculatus, femoratus.
Dorcaschema—nigrum.
Anærea—calcarata, mutica.
Compsidæ—tridentata, lateralis.
Saperda—candida, (*bivittata*, Say.,) [the borer;] vestita, concolor, discoidea.
Atimia—confusa.
Stenosoma—sordida.
Oberea—tripunctata, schaumii.
Distenia—undata.
Desmocerus—cyaneus.
Toxotus—decoloratus.
Pachyta—cyanipennis.
Acmæops—proteus.
Strangalia—luteicornis, bicolor, elegans.
Leptura—canadensis, erythroptera, rubrica, vittata, vagans, sinuata.
Trigonarthris—proxima.
Anoplodera—4-vittata.

This family, as given above, which follows the Melsheimer Catalogue, includes, also, the families *Prionidæ*, and *Lepturidæ*, as given in Westwood's "Modern Classification."

CHRYSOMELIDÆ.

This family includes several groups of species differing considerably in several respects, and is, by many Entomologists, divided

into several distinct families. The name signifies golden-beetle, which has been given on account of the brilliant metallic colors with which many of the species are ornamented. Most of the species are leaf-eaters, and, consequently, injurious to plants, and especially to cultivated vegetables. The species are generally of small size, some being quite minute.

Orsodacna—ruficollis.
Donacia—proxima, lucida, piscatrix, cuprea.
Hæmonia—melsheimeri.
Lema—trilineata, sexpunctata.

The foregoing species belong to the family Crioceridæ, as limited by Westwood, who is followed by Harris. The hind legs, in some of the species, have the thighs much thickened and enlarged. Harris gives them the name of "oblong leaf-beetles." The *L. trilineata* injure potato plants, by eating holes in the leaves.

Odontota—scapularis, nigrita, suturalis.
Uroplata—inæqualis, rosea.
Cephaloleia—metallica.

These are small insects, sometimes collected into a family, called *Hispidæ*. They mine the leaves of apple and other trees and plants.

Chelymorpha—cribraria.
Deloyala—signifer, clavata.
Coptocycla—aurichalcea, bivittata. [These two are the species that attack the leaves of the sweet potato.]

These species belong to the family *Cassididæ*, as limited by Westwood. The larvæ have the peculiar habit of carrying a shield over their backs, which they can raise or lower, by means of their tail.

Galeruca—saggitaria, gelatinariæ, notata, tuberculata, decorata.
Cerotoma—caminea.
Diabrotica—vittata, (cucumber-beetle,) 12-punctata.
Phyllobrotica—discoidea.
Œdionychis—petaurista, thoracica, vians, miniata.
Œdipodes—pilosa.
Graptodera—chalybea, exapta.
Disonycha—alternata, collaris, subplicata.
Crepidodera—erythropus.
Phyllotreta—striolata.
Thyamis—testacea.
Psylliodes—denticulata.

Most of these belong to the tribe of flea-beetles, (Galerucidæ,) so named on account of their small size and leaping powers. They attack the leaves of vegetables, especially the crucifera.

Labidomera—trimaculata.
Polygramnua—10-lineata.
Calligrapha—Philadelphica, decipiens, bigsbyana.
Chrysomela—auripennis, costa, rimilis, elegans.
Melasoma—scripta, interrupta.
Gastrophysa—cæruleipennis.
Helodes—trivittata.
Calospis—strigosa.
Noda—purvula.
Metachroma—4-notata, infuscato, canella.
Bromius—vitis.
Chrysochus—auratus.
Hetaraspis—curtipes.
Glyptoscelis—barbatus.
Myochrous—squamosus.
Chlamys—assimilis.
Exema—gibber.
Clythra—obsita.
Babia—quadriguttata.
Coscinoptera—dominicana.
Pachybrachis—bivittatus, luridus, infaustus, abdominalis, pubescens.
Monachus—saponatus.
Cryptocephalus—mutabilis, venustus, ornatus, 4-maculatus, auratus.

These insects are collected, by some writers, into the restricted family, *Chrysomelidæ.* Some of the species are clothed in beautiful metallic colors, and feed on the leaves of various weeds, and sometimes on useful vegetables. Some species feed on our common knot-weed; another on the leaves of the dog's-bane.

COCCINELLIDÆ.

This is the Lady-bug or Lady-bird family, so well known on account of their abundance and their beautiful colors. They are distinguished by the hemispherical and convex form of the body. They are probably the most useful insects to man that belong to the order, rendering him a great benefit, by destroying myriads of plant-lice. Their eggs are deposited in the midst of the plant-lice, upon which the larvæ commence feeding as soon as hatched.

The prevailing colors are red and yellow, with black spots; but this is sometimes reversed, and we find some species that are black, with red or yellow spots:

Illinois species:

Hippodamia—13-punctatum, convergens, glacialis, parenthesis, maculata.
Coccinella—bipunctata, venusta, tricuspis, novemnotata, munda, normata, multiguttata.
Mysia—pullata, 15-punctata.
Psyllobora—20-maculata.
Chilocorus—bivulnerus, cacti.
Exochomus—tripustulatus.
Brachyacantha—ursina.
Scymnus—Americanus.
Epilachna—borealis.
Sacium—fasciatus.

ENDOMYCHIDÆ.

This family is composed of species similarly colored to the lady-birds, though they are more oblong in outline. They subsist chiefly on boleti and fungi.

Endomychus—biguttatus.
Lycoperdina—lineata.
Phymaphora—pulchella.

TENEBRIONIDÆ.

This family is composed of insects mostly of a deep black color; body generally oblong or ovate, and somewhat depressed, though not flat. They mostly inhabit dark places, such as cellars, stables, pantries, and damp situations, from which the light is excluded. A common large Illinois species frequently enters the house at night, in company with species of Carabidæ, and may be taken for one of that family. Some feed upon and do much damage to meal, flour, bran and breadstuff, baked and unbaked; others live on boleti and similar vegetable substances; while others appear to frequent animal excrements or decaying animal substances. Some are found under stones, planks, and around houses, mills, etc.

Blapstinus—interruptus.
Opatrinus—notus.
Oplocephala—bicornis, viridipennis, excavata.
Platydema—Americana, ruficornis, bifasciatus.
Diaperis—hydni.
Crymodes—discicollis.

Uloma—culinaris, impressa, ferruginea.
Tenebris—molitor, obscura.
Centronipus—calcaratus.
Iphthinus—Pensylvanicus, ulpis, saperdoides, femoratus.
Upis—ceramboides.
Bolitophagus—cornutus.
Meracantha—canadensis.
Helops—micans, tenebrioides.
Penthe—obliquata, pimelia.
Allecula—obscura.
Mycetochores—binatata.
Cistela—fuscipes, sericea.

Of the above there are several genera that Westwood and others have placed in other families. Thus, Diaperis in *Diaperidæ*, found in boleti, fungi, under bark, etc; Helops in *Helopidæ*, found on flowers, under the bark of trees, etc.; Cistela in *Cistelidæ*, the larvæ of which live in rotten wood. The following family, although separated in the Melsheimer Catalogue, which I am following in my arrangement and nomenclature, is closely allied in habits to the foregoing.

MELANDRYIDÆ.

Our species are:

Melandrya—striata.
Phaiona—umbrina.
Serropalpus—substriatus.
Dircæa—4-maculatus.
Eustrophus—bicolor, tomentosus.

MORDELLIDÆ.

This is a family composed of singular hump-back insects, with heads bent under the breast, and deep body, tapering to a point behind. They frequent flowers and plants, and, when alarmed, tuck their heads under their breasts and drop to the ground. They are generally of small size:

Anthobus—trifasciata.
Mordella—oculata, melæna, marginata.
Ripiphorus—dimidiatus.

MELOIDÆ.

This is the blister-fly family. It also contains the potato-bug, that does so much damage by destroying the plants of our Irish potatoes. Although species considerably differing from these are gathered into this family, yet from the well known potato bug the characters of the family may be gathered. The *Meloe angusticollis* is a singular insect, found in the fall, along the warm fence corners, under the grass. The females, with immense swollen abdomens, which the warped wings but partially cover. They are a deep blue-black color; and from the joints oozes a yellow acrid fluid.

Horia—sanguinipennis.
Meloe—augusticollis.
Epicanta—vittata, marginata, atrata, cinerea.
Cantharis—ænea, engelmanii.
Zonitis—bilineatea.
Cepaloon—lepturides.
Nacerdes—melanura.

The five following families, not being important in an agricultural point of view, and my knowledge of them being very limited, I will give a list of the Illinois species, so far as they have been determined, without further comment.

LAGRIDÆ.

Statyra—ænea.

PYROCHROIDÆ.

Pyrochroa—flabellata, femoralis.

SALPINGIDÆ.

Salpingus—virescens.

ANTHICIDÆ.

Notoxus—anchora, monodon, bicolor, bifasciatus.
Anthicus—basilaris, elegans, cervinus.

PSELAPHIDÆ.

Tyrus—humeralis.
Bryaxis—dentata, hæmatica, longula.
Batrisus—globosus.

STAPHYLINIDÆ.

The insects of this family are easily distinguished by their short elytra or wing-covers, which generally extend over but a small portion of the abdomen. They are generally of a long, narrow, depressed form. They run and fly with great agility; are voracious, preying upon decaying animal and vegetable matters. The species of our State are generally of small size, seldom exceeding three-fourths of an inch in length, and mostly less than one-fourth of an inch long. I have seen myriads of a small species issue from the ground of a warm summer evening and swarm in the air, when they were taken for gnats.

Tachinus—fimbriatus.
Staphylinus—villosus, cingulatus, vulpinus, maculosus, cinnamopterus, violaceus, tomentosus.
Philonthus—cyanipennis, Baltimoriensis.
Quedius—laticollis.
Oxyporus—vittatus.
Cryptobium—badium, bicolor.
Pæderus—littorarius.
Apocellus—sphæricollis.

With these I close the list of Illinois Coleoptera. And here it becomes my duty to say that this list is made up from lists furnished me by Dr. Helmuth, of Chicago; Dr. Walsh, of Rock Island; Dr. E. Brendel, of Menard county, and the Evanston Institution, including a list of my own collection. The list furnished by Dr. Helmuth includes fully three-fourths of this entire list. The other lists, as well as my own, go over much of the same ground, each including from wo to four hundred species.

I will here present a short list ot species belonging to the order *Hemiptera*, which I have determined. Although comprising but a small portion of the species found in Illinois, belonging to this order, yet I deem it best to present it, in order to make a commencement of a Catalogue. I shall not, in this list, make any attempt to be systematic, as I have not the time at present to do so.

Galgupha—maruta. Nob. Nov. sp.
Pentatoma—(Catostyrax) cynica. Say.
" (Mormidea) augur. Say.
" (Asopus) sanguinipennis—Nob. Nov. sp.
Pentatoma—calceata. Say.
" rufescens. Nob. Nov. sp.
" punctipes, No. 1. Say.
" punctipes, No. 2. Say.
" bimaculata. Nob. Nov. sp.
Hymenarcys—perpunctata. Serv.
Coreus—tristis. Say.
" (Acanthocoris) galeator. Fabr.
Reduvius—raptatorius. Say.
" crassipes. Fabr.
" acuminatus. Say.
Aradus—acutus. Say.
Lygæus—tercicus. Fabr.
Pamera—constricta. Say.
" Nodosa. Say.
Macropus—leucopteius. Fitch. [Chinch-bug.]
Myodoch—opetilata. Say.
Berytus—(Neides) spinosus. Say.
Rhinuchus—(Anisosceles) nasulus. Say.
Capsus—oblineatus. Say.
" 4-vittatus. Say.
Galgulus—oculatus. Fabr.
Gerris—marginatus. Say.
Cicada—septemdecem. Linn.
" pruinosa. Say.
" parvula. Say.
Membracis—camelus. Fabr.
" (Miler) galeator. Fabr.
Cercopis—quadrangularis. Say.
Tettigonia—8-lineata. Say.
" quadrivittata. Say.
Flata—(Acanonia) conica. Say.
Iassus—subbifasciatus. Say.
Fulgora—sulcipes. Say.

The species marked above as new species are some that I named and described in a paper presented to the Chicago Academy of Sciences.

Before concluding these notes, I may add that since the last volume of the Agricultural Transactions of Illinois was issued I have ascertained several new species of Orthoptera, two of which have been named by Mr. Uhler, of Baltimore; one by myself; the others yet remain unnamed. But I will not attempt to present any thing in regard to them, until I have gathered further facts respecting their habits and transformations. I will also add that I desire, during the coming summer, to make as large a collection as possible of our grasshoppers, and would be glad to receive from each county in the State collections, either pinned or dropped in alcohol, the collector's name and locality accompanying those sent; also any information in regard to their habits, injuries, history, etc., will be thankfully received, as I desire to prepare a full report on our species, their habits, injuries, the remedies, etc., which will be handed over to the Agricultural Society, if desired.

[illegible] free by Dorcas
[illegible] to Jane [illegible]
[illegible] 50 [illegible]
[illegible] for 1059

NOTES ON OTHER SPECIES.

Otisorex platyrhinus, Dekay, (*Sorex p.*, Wagner,) of Mr. Kennicott's list, I have not placed in the list, as I have some doubts about it being a native of Illinois. Yet it is not impossible Mr. Kennicott is correct, though I think the species referred to is, *S. cooperii.*

Sorex richardsonii, and *S. Hoyi*, may possibly be found within our State.

The following species may also be found in the State:

Blarina Carolinensis.

Sciurus Vulpinus.

Reithrodon Humilis?

The *Arvicola hirsutus*, of Mr. Kennicott's first list, is probably *A. riparia.* As to his *Arvicola oneida*, (Dekay,) I can say nothing. Also, as to *Putorius agilis*, (Aud. and Bach.,) in his list, I can say nothing. Same in regard to *Sciurus cinereus.*

I have preferred following closely the descriptions of Dr. Baird, even when the specimens were before me, which I have done throughout with but little change.

PLAN FOR A NATURAL HISTORY SURVEY.

By Cyrus Thomas, of Murphysboro, Illinois.

All the work done by the Society, and every step taken, should be done in such a manner that it will not be necessary to go over the same ground the second time. But in order to do this, it is necessary to have some *plan*, some *method* of operating. Therefore, I, as an humble member of the Society, propose the following for the consideration of the Society:

First—in regard to our flora.

The Phenogamic plants of Illinois having been pretty thoroughly determined by our Western botanists, but little remains to be done so far as the determining of species is concerned. Nevertheless, this field is by no means finished; enough for more than one year's work remains for our most active botanists. Let the catalogue for the State be corrected and completed during the year; and in doing this, let the introduced plants be ascertained and so marked in the catalogue. Let the suite of specimens at the Museum be completed, care being taken to furnish such specimens as exhibit most distinctly the specific characteristics.

Let another part of the next year's work be to determine the geographical range of our trees and some of the other most important plants. The Society during its present session making out a *list* for that purpose. And, also, to assist in this part of the work, I would suggest that the Society, during the present session, divide the State into districts, defining accurately the boundary of each. Let there be at least four, and probably five or six would be better. For instance: 1st—The Northwest—that part of the State west and northwest of the Illinois river. 2d—The North—that part east of the Illinois river and north of Bloomington. 3d—The Central—that part south of Bloomington and north of the Ohio and Mississippi Railroad. 4th—The South—Egypt.

And at the same time this should not interfere with the general division into *prairie* and *timber*, which runs through all. If this districting is done it will answer for both plants and animals. And although an artificial arrangement, which will give way to such divisions as Nature has established, yet it will answer a good purpose

in recording facts to be used in ascertaining Nature's boundaries and for future explorers.

And as another part of the work for the coming year, let our botanists make a commencement upon the Illinois Cryptogamia.

Next—as to animals.

Let the list of mammals be carefully corrected and completed, and those not now to be found in the State so marked; and, as far as possible, the time of their departure ascertained. Also, let the geographical limits of each species be determined. And it should be made a special point this year to place in the Museum a complete suite of our mammals (male and female,) and, also, a skull of each species.

During the coming year our Ornithologists should get ready their catalogue of birds.

Ichthyology and Herpetology will have to remain among the generalities another year.

Our Conchologists ought to be able during the year to prepare a complete catalogue of Illinois Mollusks, and furnish a complete suite of shells to the Museum. They can also make a commencement at determining the geographical distribution of species.

Crustacea and Arachnida will have to lie over until some one can be induced to take hold of them.

As to Insects, I propose that for the next meeting we prepare a *general* catalogue, including all the species in all the orders that have been and that we may be able during the year to determine as inhabitants of our State, but that our entomologists take specially in charge the list of Coleoptera, and try and render it as full as possible by next year.

Then, summing up, we have before us, for the year ending June, 1861—

1. Correcting and completing the catalogue of Illinois Phenogamia.
2. Determining the geographical range (within the State) of our trees, and some of our other most important plants, and whether they are confined to prairie or timber.
3. Complete the suite of plants in the Museum.
4. Correct and complete the catalogue of Illinois Mammals, and determine the geographical range of each species.
5. Furnish the Museum with specimens of both sexes of each species, and a skull of each.
6. Prepare a catalogue of our Birds.
7. Correct and complete the catalogue of our Shells, and furnish the Museum with specimens of each species.
8. Prepare a catalogue of all Insects known to inhabit the State, so far as determined.

And besides all this let the general work of gathering and determining, in all departments, classes and orders, go on, especial reference being had to the early completion of our lists of Reptiles and Fishes.

So much in regard to the Flora and Fauna. Is the ground too extensive? Much of the work has already been done, and this is proposed in order to clear up and dispose of these branches, that our energies may not be expended in traveling over the same ground a second time.

It will also enable us to say to the people at large what particular specimens we want; what particular aid we need, etc. And then they are more willing to take hold and assist.

And to complete the plan, specific work should be assigned to such members as are willing to undertake it; and to them should be sent, first, the map of the specimens gathered in the State—to each, those of his particular class or order. And the Society, then, should extend to these members such aid, in the way of books, preservatives, instruments, etc., as possible, in our present weak state.

And to do this work most profitably, not only to ourselves, but the world at large, the Society, at its present session, should direct its executive committee to propose to the Smithsonian Institution to co-operate with that Institution.

The members should furnish the Society with a list of the works on Natural History they have. The reason is obvious.

Hoping the Society will consider these things and act according to the judgment of those present, I will close.

ADDITIONS TO THE FLORA OF ILLINOIS.

By Dr. George Vasey, of Ringwood, Illinois.

To Prof. Turner, *President of the Illinois Natural History Society:*

Dear Sir:—The question is sometimes asked: What is your Natural History Society accomplishing? To answer this inquiry, so far as the Department of Botany is concerned, I propose to give a list of the additions which have been made to the Flora of the State, by members of the Society, and to make such remarks thereon, as may appear of interest.

The catalogue of Illinois plants published in the third volume of the Transactions of the Illinois Agricultural Society, was prepared by I. A. Lapham, Esq., of Milwaukee, partly from personal observations made in the State, and partly from the information of botanists residing in the State. This catalogue enumerates some one thousand and fifty-two species of plants; and, considering the means at hand for its preparation, must be considered as remarkably well executed. About this time, an interest was being awakened among Naturalists, which led tothe organization of the Natural History Society. In the next volume of the Transactions of the Agricultural Society, are three lists of plants additional to the catalogue of Mr. Lapham; one by Dr. F. Brendel of Peoria, one by Mr. M. S. Bebb of Marion county, and one by the present writer. There is also, in the same volume, a remarkably full and interesting article on the Trees and Shrubs of Illinois, by Dr. Brendel.

I also prepared for the annual meeting of the Natural History Society in June last, a list of additional species which had come under my observation up to that time, and also a list by Dr. S. B. Mead of Augusta. This list was subsequently published in the *Prairie Farmer.* Since that time quite a large number of additional species have been collected by myself in several excursions into different parts of the State. All these various additions I now incorporate in the accompanying catalogue. Beside the persons whose names have been already mentioned, there have been several others engaged in observing the vegetation of the localities where they reside. So far as is known to me, they are Dr. F.

Scammon of Chicago, Mr. E. Hall of Athens, Mr. R. K. Slosson of Morris, and Dr. O. Everett of Dixon.

Of the species here enumerated as many as ten are not only additions to the Flora of the State, but are also additions to the Flora of the Northern United States, and indeed to that portion of our country included in Dr. Gray's Manual of Botany, which embraces Virginia, Tennessee and Kentucky.

There is no doubt that a full exploration of our State will yet present many interesting additions. Many of the plants in the following catalogue have been collected by several botanists and the plan of the present article will not admit of making reference to them by name in each instance. It would also increase the interest of the article, if the localities of the rare plants could be given, together with plain and intelligible descriptions; but this must be deferred to a future occasion. The mosses and liverworts are not here included.

CATALOGUE.

Hepatica acutiloba, D. C.
Thalictrum diœcum, L.
Ranunculus rhomboidens, Goldie.
" pennsylvanicus, L.
" hispidus, Mx.
*Delphinium, consolida, L.
Actea spicata, var. rubra, Mx.
Jeffersonia diphylla, Pers.
Sarracenia purpurea, L.
*Paparu somniferum, L.
Dicentra canadensis, D. C.
*Nasturtium officinali, R. Br.
" obtusum, Nutt.
" sinuatum, Nutt.
" sessiliflorum, Nutt.
Cardamine rhomboidæ, var. Tor.
Arabis hirsuta, Scop.
Draba micrantha, Nutt.
*Camelina sativa, Crantz.
*Sinapis alba, L.
Lepidium intermedium, Gray.
Cakile americana, Nutt.
Turritis glabra, L.
Viola lanceolata, L.
Solea concolor, Ging.
Ascyrum crux andrea, L.
Hypericum kalmianum, L.
Hypericum ellipticum, Hook.
" adpressum, Barton.
" dolabriforme, Vent.
" gymnanthemum.
" nudiflorum, Mx.
Elodea petiolata, Pursh.
*Vaccaria vulgaris, Host.
Alsine michauxii, Fenzl.
*Stellaria media, L.
*Cerastium viscosum, L.
" oblongifolium, Torr.
Sagina apetala, L.
" nodosa, Fenzl.
Claytonia caroliniana, Mx.
Talinum teretifolium, Pursh.
*Malva sylvestris, L.
*Malva crispa, L.
*Hibiscus trionum, L.
Tilia Pubescens, Ait.
*Linum usitatissimum, L.
Floerka proserpinacoides, Willd.
Vitis vulpina, L.
" indivisa, Willd.
" bipinnata, T. & G.
Rhamnus alnifolius, L'Her.
Ceanothus ovalis, Bigelow.
" intermedius.

Polygala cruciata, L.
Lupinus perennis, L.
Trifolium arvense, L.
*Melilotus alba, Lam.
*Medicago sativa, L.
*Medicago lupulina, L.
Desmodium ciliare, D. C.
" marilandicum, Boot.
Lespedeza hista, Ell.
Vicia caroliniana, Walt.
" americana, Muh.
Lathyrus ochroluecus, Hook.
" palustris, L.
" maritimus, Big.
Baptisia australis, R. Br.
Cassia obtusifolia.
Schrankia uncinata, Willd.
Prunus pumila, L.
Geum album, Gmelin.
" strictum, Ait.
" triflorum, Ph.
" macrophyllum, Willd.
Potentilla paradoxa, Nutt.
" anserina, L.
" palustris, Scop.
Fragaria vesca, L.
Rubus strigosus, Mx.
" triflorus, Rich.
*Rubus idæus.
Rosa blanda, Ait.
*Rosa rubiginosa, L.
Crategus coccinea, L.
Epilobium angustifolium, L.
" molle, Torr.
Oenothera albicaulis, Nutt.
Gaura filipes, Spach.
Jussiæa repens, L.
Ludwigia sphærocarpa, Ell.
Circea alpina, L.
Myriophyllum verticillatum, L.
Hippuris vulgaris, L.
Ribes cynosbati, L.
" hirtellum, Mx.
" missouriense, Nutt.
Saxifrage pennsylvanica, L.
Mitella diphylla, L.
Hamamelis virginica, L.
Sanicula canadensis, L.
Archangelica atropurpurea, Hoff.
Sium angustifolium, L.
*Conium maculatum, L.
Conio selinum canadense, T.&G.
Eulophus americanus, Nutt.
Aralia spinosa, L.
Cornus alterniflora, L.
" circinata, L'Her.
Viburnum lentago, L.
" dentatum, L.
" pubescens, Pursh.
" acerifolium, L.
Galium boreale, L.
" concinnum, T. & G
Fedia radiata, Mx.
Valeriana edulis, Nutt.
*Dipsacus sylvestris, Mill.
*Tussilage farfara, L.
Aster corymbosus, Ait.
" ptarmicoides, T. & G.
Solidago stricta, Ait.
Xanthium spinosum, L.
Boltonia diffusa.
*Coreopsis tinctoria, Nutt.
Tanacetum vulgare, L.
Artemesia dracunculoides.
Graphilium uliginosum, L.
*Cirsium lanceolatum, Scop.
*Cirsium arvense, Scop.
*Centaurea cyanus, L.
Hieracium canadense, Mx.
Lobelia kalmii, L.
Campanula rotundifolia, L.
Vaccinium vacillans, Sol.
" macrocarpon, Ait.
Arctostaphylos uvaurse, Sp.
Andromeda polifolia, L.
Pyrola elliptica, Nutt.
Bumelia lycioides, Gaert.
Lysimachia longifolia, Ph.
Naumburgia thyrsiflora, R.
Utricularia gibba, L.
" subulata, L.
Aphyllon fasciculatum, T. & G.
Linaria canadensis, Spr.
*Linaria vulgaris, Mill.
Pentstemon digitalis, Nutt.
Mimulus jamesii, Torr.
Gratiola sphærocarpa, Ell.
Veronica peregrina, L.

Castilliea sessiliflora, Ph.
Gerardia setacea, Walt.
Verbena officinalis, L.
Cunila Mariana, L.
Pycnanthemum incanum, Mx.
Calamintha glabella, var. Gr.
Scutellaria parvula, Mx.
Onosmodium carolinianum, D.C.
Hydrophyllum canadense, L.
Phacelia bipinnatifida, Mx.
Phlox maculata, L.
" reptans, Mx.
*Ipomea purpurea, Lam.
Hydrolea quadrivalvis.
Gentiana dentosa, Fries.
Obolaria virginica, L.
Foresteronia difformis, D. C.
Asclipias phytolaccoides, Ph.
" nuttalliana, Torr.
" parviflora, Ph.
Acerates paniculata.
" monocephala, Lap.
Gonolobus macrophyllus, Mx.
Fraxinus sambucifolia, Lam.
Chenopodium urbicum, L.
" glaucum, L.
Coriospermum hyssopifolium.
*Amarantus hypochondriacus, L.
*Polygonum orientale, L.
*Polygonum convolvulus, L.
" aurifolium, L.
*Fagopyrum esculentum, M.
Rumex maritimus, L.
Dirca palustris, L.
Shepherdia canadensis, N.
Callitriche verna, L.
Euphorbia polygonifolia.
Ricinus communis, L.
Ulmus racemosa, Thomas.
" ulata, Mx.
Celtis mississippiensis, Bos.
Betula alba, var. Spach.
" papyracea, Ait.
" pumilia, L.
*Salix babylonica, Tour.
" petiolaris, Smith.
" nigra, Marshall.
" longifolia, Muhl.
" lucida, Muhl.
Salix rostrata, Rich.
" cordata, Muhl.
" eriocephala, Muhl.
" discolor, Muhl.
" candida, Willd.
" pedicellaris, Pursh.
Populus grandidentata, Mx.
" monilifera, Ait.
Pinus banksiana, Lambert.
" strobus, L.
Larix americana, Mx.
Taxus baccata, var. L.
Juniperus communis, L.
Symplocarpus fœtidus, Salis.
Orontium aquaticum, L.
Sparganium natans, L.
Peltandra virginica, Raf.
Naias flexilis, Rosth.
Potomageton pectinatus, L.
Triglochin palustre, L.
" maratimum, var. L.
Scheuchzeria palustris, L.
Limnobium spongia, Rich.
Platanthera, flava, Gray.
" lacera, Gray.
Goodyera pubescens, R. Br.
Arethusa bulbosa, L.
Pogonia ophioglossoides, Nutt.
Aletris farinosa, L.
Iris Duerinkii.
Smilax glauca, Walt.
" tamnoides, L.
" hispida, Muhl.
Trillium nivale, Riddell.
Polygonatum gigantum, Deit.
Smilacina bifolia, Ker.
Lilium superbum, L.
Zygadenus glaucus, Nutt.
Stenanthium angustifolium, Gr
Tofieldia glutinosa, Willd.
Juncus balticus, Willd.
" paradoxus, E. Meyer.
" articulatus? L.
" nodosus, L.
Eliocharis intermedia, Sch.
Scirpus planifolius, Muhl.
Rhynchospora capillacea, Torr.
Cladium mariscoides, Torr.
Carix bromoides, Schk.

Carix chorrdorrhiza, Erhr.
" limosa, L.
" livida, Willd.
" crawei, Dew.
" careyana? Torr.
" Oederi, Ehrh.
" filiformis, L.
" comosa, Boot.
" hystricina, Willd.
" cylindrica.
" careyana.
" stenolepis.
Aira cespitosa, L.
Agrostis perennans, Tuck.
Calamagrostis longifolia, Hook.
" arenaria.
Boutelona hirsuta, Lagas.
Glyceria pallida, Trin.
Poa serotina, Ehrh.
Setaria viridis, Beauv.
Triticum caninum, L.
Triticum repens, L.
Hierochloa borealis, R. & S.
Panicum anceps, Michx.
Equisetum limosum, L.
" variegatum, Schr.
Polypodium vulgare, L.
Struthiopteris germanica, Will.
Allosurus atropurpureus, G.
Asplenium ebeneum, Ait.
Cheilanthes tomentosa, Link.
Woodsia obtusa, Torr.
Cystopteris bulbifera, Bern.
Aspidium thelypteris, Swartz.
" spinulosum, Swartz.
" goldianum, Hook.
Osmunda regalis, L.
Lycopodium lucidulum, Mx.
Selaginella ruprestris, Spring.
Chara polyphylla.

This mark [*] indicates that the species is introduced and naturalized.

MUSEUM OF THE ILLINOIS STATE NATURAL HISTORY SOCIETY.

By C. D. Wilber, of Bloomington, Illinois.

[see frontispiece.]

The State Normal University has been made the depository for all collections in the various departments of Natural History which may be made under the auspices of the Society, and also for such collections as may be donated. For this purpose, two large halls in the University building have been united by an arch, affording a spacious gallery one hundred feet in length and thirty-three feet wide. This hall, called the Museum of Geology and Natural History, has been fitted up in the most approved style, from plans furnished by Richard H. Holder, Esq., of Bloomington, who visited the Museums of the Philadelphia Academy of Sciences, the Boston Academy, and the Salem Museum. The following is a brief outline of the plan adopted:

Arranged along the floor, in front, near the windows, are twelve glass structures or houses, each four feet by eight feet and ten feet high, furnished with shelves and bases, for the department of Ornithology. In these structures, which are of pure French glass, the birds are arranged in families, each with its name and habitat. At present they are chiefly occupied by the Birds of Illinois.

Across an aisle, four feet in width, are placed twelve structures, made also of plate glass, corresponding with the structures for Birds. These are in the form of parallelograms, each three feet by twelve feet, and surmounted by a glass show case of the same dimensions and eight inches in depth. In the lower spaces are placed specimens of our coal flora, such as Lepidodendra, Sigillaria, etc., which are too large for shelves. These, as they are all of one geological epoch, are grouped with reference to the localities

whence they were taken. The glass show cases above are devoted to carboniferous fossils and shells.

In the rear of the parallelograms is an extended bureau of drawers, divided into two sections, at the middle of the room. Each division contains four hundred and eighty drawers, and each drawer is fifteen by eighteen inches and three inches in depth, furnished with a glass cover, and arranged in series of ten; every two series, or twenty drawers, being protected by folding doors. These are devoted to Botany and Entomology.

Above this range of drawers, along the wall, are sections of common shelves, provided with folding doors, designed to contain fossils, ores, minerals and crystals. The fossils are to be arranged in the order of the geological formation or epoch which they illustrate. At present they are grouped according to the localities in the State where they are found.

In the southern division of the Museum are placed the Minerals of Illinois and the adjacent states, presenting a typical view of the mineral wealth of the Mississippi Valley, and designed to illustrate what is termed Economical Geology. For example: all the varieties of Iron ore, with samples of every process of its manufacture, are arranged by themselves; Lead, its ores and oxides; also, Copper; Coal, its varieties and products; Soils, with accompanying analyses, etc., etc. The corresponding northern section is occupied by a collection of Crystals, arranged according to the basis of each order, viz: Carbonates, Silicates, etc. Each specimen will be accompanied with its specific name and the name of the locality, also of the person donating the same to the Society.

A space above these sections, in both divisions, is devoted to such collections as are preserved in alcohol, viz: Reptiles, Fishes, Crustacea, etc.

A series of paintings, by Bryant, illustrating the principal geological epochs, are placed in line at the top of the last described sections, and, when finished, will occupy the entire length of the Museum. Of this series four are now complete.

The library cases, two at each end of the Museum, are provided for the scientific works, reports and papers of the Society.

The principal design of the Society, in regard to this general collection of Natural History, is to furnish the greatest possible number of Object Lessons in each department, and so arrange the objects or specimens that they will convey to the student or observer a correct view of the order or philosophy of Nature; in short, to make of the Museum a well arranged volume, whose illustrations, indicating the order of creation, were prepared by the Great Artist, who laid the foundations of the earth.

Valuable collections have been received from the following persons: J. T. Gulick, Sandwich Islands; P. A. Chadbourne, Massachusetts; J. W. J. Culton, Michigan; C. P. Williams, Michigan; William Hovey, Michigan; Rev. E. R. Beadle, Hartford, Connecticut; F. D. Fyler, Winsted, Connecticut; E. J. Pickett, Rochester,

New York; Joseph Even, Morris, Illinois; A. W. Nason, St. Johns; C. A. Montross, Centralia; Jasper Johnson, Vienna; Miss Katie A. Thompson, Vienna; Cyrus Thomas, Murphysboro; Dr. M. Davis, Oswego; William H. Allen, Grafton; F. A. McDonald, Grafton; William McAdams, Jerseyville; Drs. Bennett & Chaffee, Alton; Capt. E. H. Beebe, Galena; Dr. Oliver Everett, Dixon; A. M. Gow, Dixon; Rev. A. H. Conant, Rockford; T. J. Willever, Bloomington; Dr. J. W. Velie, Rock Island; Dr. Whittlesey, Galva; Rush Emery, Hamilton; Dr. William H. Githens, Hamilton; Daniel Gordon, Moline; George Shockey, Iowa; Miss Martha Coggeshall, Nantucket; Prof. J. H. McChesney, Chicago; John P. Reynolds, Springfield; A. H. Worthen, Springfield; M. S. Bebb, Springfield; E. Hall, Athens; J. W. Powell, Wheaton; Dr. E. R. Roe, U. D. Eddy, H. W. Boyd, and H. B. Cole, Bloomington.

At the meeting of the Society, July 3d, R. H. Holder presented his entire collection of the Birds of Illinois. A similar donation was made by Dr. George Vasey, of the Flora of Illinois, consisting of nearly fourteen hundred species, collected by him during the last ten years. Rev. Dr. Eddy, of Bloomington, presented a cabinet of fossils and specimens, illustrating the Drift. Mr. Bryant donated to the Society the collection of paintings already referred to. Mr. Wilber presented a suite of western minerals and fossils. B. D. Walsh and Cyrus Thomas have presented valuable collections of insects. The Railroad and Express companies of the State, with a liberality never exceeded, have also contributed greatly to the present success.

The Museum above described can be referred to only as a beginning. Three years of labor have been devoted to it. It will prosper in proportion as it advances the educational interests of the State. Its founders hope for success upon no other basis.

It will be dedicated, with appropriate exercises, as a FREE OFFERING TO THE CITIZENS AND SCHOOLS of Illinois, on Wednesday, December 25th, 1861.

INSECTS INJURIOUS TO VEGETATION IN ILLINOIS.

By Benj. D. Walsh, Esq., Rock Island, Ill.

"Insects are little contemptible vermin, unworthy the notice of any grown man." Such is the popular opinion on the subject. Let us see if it will stand the test of a rigorous examination.

The wheat crop of the State of Illinois, according to the United States census, was, in round numbers, three and one-third million bushels in 1839–40, and nine and one-third million bushels in 1849–50. In 1859–60, at the same rate of increase, it would be over twenty-six million bushels, and there is no doubt but that—owing to the extraordinary abundance of all our harvests—it this year very largely exceeds that amount. We may safely assume twenty-five million bushels as what would have been a fair average crop for the season of 1861.

It is only two years since the entire wheat crop of the State was so damaged by the chinch-bug that a great deal of it was not cut at all, and a great deal that was cut barely paid for the harvesting. Scarcely a year elapses but what more or less damage is done to it by this insect, and by the Hessian-fly and the wheat midge. A large breadth of winter wheat, which is commonly supposed to be "winter-killed," is in reality killed by the Hessian-fly; and there may be, and probably are, many other insects which depredate upon this crop, but whose habits have not yet fallen under the notice of entomologists. Eleven bushels to the acre, according to the census, was the average produce in this State in 1849–50. It cannot possibly be less than twenty bushels in 1861. What is the cause of this enormous discrepancy? It cannot be that the land is tired of wheat, for if it was tired in '50, it must be still worse tired in '60. It cannot be attributed to improved methods of cultivation, though this, no doubt, has had some influence, for, in that case, the crop of each successive year would be gradually larger and larger. Neither can we attribute it to the weather, for the only thing specially remarkable about the season of '60 was the very early plowing time, and springs equally early must be in the recollection of every old

settler, which were followed by quite moderate harvests. The only remaining cause to which it is possible to attribute the luxuriant wheat crop of '60, is the almost entire absence of noxious insects. We had no chinch-bug, no Hessian-fly, and, so far as I am aware, but a single case of wheat midge, in one of our central counties. The difference, therefore, between eleven and twenty bushels per acre, for the year which has just elapsed, must be principally attributed to the absence of these "little contemptible vermin, which are beneath the notice of any grown man." Now it was shown before, that at the rate of eleven bushels per acre, twenty-five million bushels would be a fair average crop for 1860. At the rate of twenty bushels per acre, it must be over forty-five million bushels. Whence we arrive at the astounding conclusion, that in one single year the State saves upon one single crop the value of twenty million bushels of wheat, through the absence of certain tiny creatures, not one of which is so big as a grain of rice.

Taking the average of years, we may safely assume that a fifth part of the wheat crop—or, which is the same thing, a quantity equal to one-fourth of what we actually do harvest—is destroyed by insects. Even at the low price, therefore, of seventy-five cents per bushel, we have *over four and a half million dollars' worth* of wheat annually destroyed by "little vermin which it is not worth our while to notice." But this is not all. Other crops are damaged by other insects, though not generally to so ruinous an extent; so that we cannot put the whole annual damage done by insects to the State of Illinois at less than TWENTY MILLION DOLLARS.

These facts may appear trite and obvious to some, but that they cannot possibly be generally realized by our citizens is proved by the very circumstances under which I am now writing. Here is a great and wealthy State, sustaining annually a loss of twenty million dollars, and to him who furnishes the best suggestions for diminishing this loss is offered the sum of twenty-five dollars. It is exactly as if a manufacturer, who was annually losing eight thousand dollars through the dishonesty of his hired men, was to offer to any detective officer who could put him on the track of the rogues the munificent premium of ONE CENT.

Throughout the whole length and breadth of the United States, there is at present but one man—Dr. Asa Fitch, the State Entomologist of New York—specially engaged in investigating the habits of noxious insects, and experimenting on the best methods of counterworking them. But the number of noxious insects is enormous, and it is beyond the powers of any one man, or any ten men, to attend to them all. Dr. Fitch has commenced cataloguing and describing the noxious insects found in his own State, and they already amount to three hundred and sixty, although, as he himself says, the list is quite incomplete. His five "Reports," published at the expense of the State of New York, contain a vast amount of valuable information, so far as they go. But it so happens that many of the noxious insects of Illinois are southern and not northern

species; and if we wait until they come under the personal notice of northern entomologists, we shall wait a very long time indeed. For example, Dr. Fitch tells us that in the whole course of his entomological career of twenty-five years, he met with but *three* chinch-bugs in New York; and Dr. Harris was more unfortunate still, for in the State of Massachusetts he only found one poor solitary specimen up to the day of his death. It would take a good arithmetician to count the chinch-bugs to be found in Illinois.

In the remarks which I am now about to offer, I can make no pretension to any special investigation of the habits of the noxious insects of Illinois, and of the most efficient modes of destroying each individual species. To do this would require a long series of laborious observations and experiments, continued through several years; and while there are so many unexplored fields in science open to the student, it is not likely that any man will gratuitously devote himself to a matter of dry practical detail, involving no discovery of new principles, but simply the practical application of old and well known discoveries. The days are past—if indeed they ever existed—when a Curtius was always to be found to immolate himself for the good of his country. The most that I can do, will be to develop general views of the Natural History of Insects—some of them as old as the hills, some, I believe, original—and to suggest methods by which those general views may be practically applied to keeping within due bounds such insects as are injurious to our crops. Nothing but actual experiment can determine the practical value of these suggestions.

Calculating from several distinct bases, I estimate that there are about thirty thousand distinct species of insects found within the limits of the United States—probably about ten times the number of all our other animals put together. Of this enormous amount, about one-fourth are insects of prey—or cannibals—specially appointed by an All-wise Providence to keep the other three-fourths within due bounds. It is not meant that out of one hundred insects, indiscriminately captured, twenty-five will be cannibals, because it is not so. Carnivorous species are always less numerous *in individuals* than the tribes upon which they live, for the simple reason that if there was a hawk to every pigeon, the hawk would catch the pigeon and then starve; if there was a wolf to every deer, the wolf would catch the deer, and then he too would starve. What is asserted is, that out of one hundred distinct *species* of insects, captured indiscriminately, nearly one-quarter will be cannibals. And cannibals they are called with great justice; for, although the poets tell us that tiger will not prey upon tiger, nor lion upon lion, and that man is the only animal that makes war upon his own species, yet many cannibal insects will kill and devour their own kind. Some of them, it may be observed, prey generally and indiscriminately upon other insects, and some, again, confine themselves to one particular species, or to one particular family. They may be properly divided into three great groups—

First—Those which in the larva state hunt after their prey themselves, as the great *Carabus* family, (ground-beetles,) comprising nearly a thousand species, already named and described, to be found within the United States; the *Coccinella* family, (lady-birds,) of which there are described about one hundred species; the *Libellula* family, (dragon-flies,) nearly three hundred species, and a great many other families, which it would be tedious to particularize.

Second—Those which in the larva state confine themselves to cells or nests, constructed by the parent insect, and provisioned with the bodies of one or more insects, as food for the young larvæ. The different families of digger-wasps, (*Fossores*,) of which there are, probably, one thousand North American species, may be taken as examples. The common black and yellow mud-wasp, (*Pelopœus lunatus*, F.,) belongs to this group, although, like a species of *Trypoxylon* and four distinct species of *Pompilidæ*, which I possess, it constructs its nests above ground, of mud, and cannot, therefore, be strictly termed a *digger*.

Third—Those which deposit their eggs in other living insects, the larvæ proceeding from which feed on the bodies of those living insects, and eventually destroy them. The Great Ichneumon family, and four other closely allied families, having nearly the same habits, and which may be properly classed as Ichneumons, are instances in point. There are about three thousand distinct species of them, named and described, in Great Britain, and probably double that number will be found eventually in the United States.

We read in books—and I can vouch for the fact from my own knowledge—that there are even ichneumon-flies which make other ichneumon-flies their special prey, thus forming check upon check. Spiders, as we all know, prey upon insects; and it is a species of spider that is selected by the common mud-wasp to provision its nest; but lest the mud-wasps, on the other hand, should become unduly numerous, Providence has created a large species of ichneumon-fly, which deposits its egg in the larva of the mud-wasp, from which I have myself bred them. So the spider preys upon flies and other insects, the mud-wasp preys on the spider, and the ichneumon-fly preys on the mud-wasp; each in its appointed place and at its appointed time, carrying out the great law of nature, "kill and be killed, eat and be eaten."

So skillfully is the whole system balanced and adjusted—a check here and a check there, and a counter-check upon both in another place—that in a state of nature, such as exists in our woods and forests, it is only in some special seasons, and in certain special localities, that a particular insect becomes unduly numerous. For instance, in 1791, and again in 1853, the palmer worm stripped the forests and orchards bare throughout the State of New York and the whole of New England, "as if they had been scorched with fire," to use Dr. Fitch's expressive language. Yet during all the intervening and succeeding years it was never observed in any extraordinary numbers.

But the necessities of civilization do not allow the face of the earth to remain, as a general thing, in a state of nature. Nature intended that plants of various kinds should grow mixed up together, mutually controlling and checking one another, and mutually, too, benefiting one another; for the poisonous secretions of one plant may form the healthful food of another. But civilized man finds it convenient to have all his wheat grow in one field, all his corn in another, and all his turnips in a third; and the plants that Nature intersperses among these crops—thus following out her original plan, so far as she is allowed—he ruthlessly cuts down and denominates "weeds." Every western farmer must have noticed how rapidly, in a favorable season, the chinch-bug overspreads a wheat field. Now if the same number of wheat plants had been scattered promiscuously over a township of land, mixed up with several hundred other species of plants, it must be obvious that this insect could not increase with near such rapidity, because its appropriate food would not be always ready to its mouth. On the same principle, a lot of hogs, that would thrive and multiply if they had daily fed to them a bushel of shelled corn on one single spot of ground, would starve if the same quantity of corn was scattered over the whole county, and they had to pick it up for a living.*

Again, nature intended that every plant should stand undisturbed, and perfect its seed where she has herself placed it, and that part of that seed should fall on the ground, part be devoured by the fowls and insects of the air, and part be gathered by the Indian; just as at this very day, the red Indian gathers his wild rice by hand on the head waters of the Mississippi. But instead of this, the natural process, civilized man, after having compelled his wheat to grow all in one field by itself, so soon as it is ripe cuts it all off even with the ground and carts it into his barn, straw and all; thus, no doubt, carrying off and destroying the eggs of many cannibal insects, and interfering generally with the wise arrangements of nature.

Now it is universally the case, that whenever man, by his artificial arrangements, violates great natural laws, unless by some artificial means he can restore the overturned balance, he pays the penalty affixed to his offense. The voluptuary may overload his stomach, but, unless he has recourse to his dinner pill, he pays the penalty of an indigestion. So with the farmer and the horticulturist. Until they can restore the natural equilibrium which has been disarranged by their artificial processes, they pay the penalty in the damage inflicted on them by plant-feeding insects. They must assist nature, whenever, for necessary purposes, they have thwarted and controlled her, if they wish to appease her wrath.

If these views be correct, it would seem to follow, as a necessary

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* This point has been well developed by Dr. Fitch, in his annual address before the New York Agricultural Society, 1859, with a copy of which he has been kind enough to favor me.

consequence, that one of the most effectual means of controlling noxious insects is to be found in the artificial propagation of such cannibal species as are naturally designed to prey on them. We must fight fire with fire, and use one nail to drive out another. Cats are bred all over the world to prevent rats and mice from becoming unduly numerous; ferrets are bred for the same purpose in Europe, and are found very useful. Every sportsman knows that different breeds of dogs are employed in hunting down and catching various kinds of wild animals. In all these cases man sets a quadruped to catch a quadruped. There can be no good reason given why he should not also set an insect to catch an insect. The idea of propagating cannibal insects artificially, may at first seem startling, but fifteen years ago, if any man had proposed the artificial propagation of fish, it would have startled the world just as much. And yet, nowadays, this is a regular business, not only in France, where it was first invented, but even in the New England States. Bees and silkworms have been bred artificially for centuries, and the Mexicans raise annually, by a most elaborate process, a million pounds of cochineal, each pound containing, according to an exact calculation of Humboldt's, seventy thousand distinct insects. Entomologists, too, are in the constant habit of breeding insects of all kinds, partly for the sake of studying their habits, and partly for the sake of becoming acquainted with their transformations. Now if naturalists do this on a small scale, in the interests of science, there can be no physical reason why it should not be done by others, on a large scale, in the interests of agriculture. There can be no physical reason why it should not be just as common to send to the insect-breeder for a box of dragon-flies, or an ounce of the best inchneumon-flies, as it now is to send to the druggist for a pound of Spanish flies or a quarter of an ounce of cochineal.

It is perfectly true, as every entomologist is aware, that it is generally more difficult to breed cannibal insects than plant-feeders. But so is it more difficult to breed insect-eating birds than grain-eating birds; and yet experience has taught bird-fanciers how to do it successfully. Even among the plant-feeding insects, every one who has had much practice on the subject knows that there are certain species and certain families which are hard to breed by the ordinary methods. But every now and then some successful experimenter discovers a peculiar method of treating them, which removes all the difficulty before experienced. The gigantic caterpillar of the death's head moth, (*Acherontia atropos*,) is well known to European entomologists to be hard to raise to maturity, yet I was acquainted with an English dealer in insects, who, by a peculiar process, always succeeded in so doing. Many North American hawk-moths, (*Sphingidæ*,) are similarly troublesome to breed; yet I have recently had communicated to me by Mr. Wm. H. Edwards, the New York Lepidopterist, a most original method of treating them, which he has practiced for two years with uniform success. If a thousandth part of the time and money expended in breeding

race-horses had been expended in breeding insects, there would probably be now little practical difficulty in raising any species whatever to maturity.

Although, so far as I am aware, cannibal insects have never yet been bred for utilitarian purposes, yet it is by no means an uncommon practice to collect such as are found at large in the woods and fields, and apply them to subdue some particular insect that is annoying us. Thus, for a long series of years, the larvæ of lady-birds, (*Coccinellidæ*,) and of lace-wing flies, (*Hemerobiidæ*) have been employed by European gardeners to destroy plant-lice, which they do most effectually. The nest of our American bald-faced hornet is occasionally suspended in a house to kill off the house-flies; and I was informed by a young lady who teaches school, that she once turned a dragon-fly loose in her school room for the same purpose, and that, as I can readily believe, the experiment was perfectly successful. We are also told by Kuhn,* "that six or eight specimens of *Pentatoma bidens*, [a European bug, closely allied to the large stinking bugs, often noticed on blackberries, &c., in the United States,] shut up in a room swarming with the bed-bug for several weeks, completely extirpated the latter." And M Boisgerard,† states, "that having placed some female Calosomæ, [a beetle of the Carabus family,] upon trees greatly infested with the caterpillars of Bombyx dispar, the larvæ of the Calosomæ were found in the following season in the nests of the caterpillars, and that in the course of two or three years the trees were cleared."

The bird known by the name of the English Pheasant—although it is not, in reality, a species indigenous to England—is artificially propagated there in enormous numbers, for sporting purposes. Groves of timber are planted purposely to afford them shelter—buckwheat is sown solely for the sake of providing them with appropriate food in winter—and a whole army of game-keepers is maintained to make war on pole-cats, weasels, hawks, owls, and other predaceous animals, whether biped or quadruped, which nature has appointed to prevent such birds from becoming unduly numerous. The consequence is, that on the estates of many noblemen, pheasants may be seen any day walking about as plentiful as common fowls in a farm yard. Suppose, now, instead of pheasants, we wished to multiply, artificially, the number of a particular species of *dragon-fly*, or *snake-feeder*, as it is absurdly called in this country. We know, to begin with, that the female dragon-fly lays a very great number of eggs, and that the larvæ live in the water, generally in stagnant water,‡ and are cannibals like the full-grown

*Quoted in Westwood's Introduction, II, page 486. †Ibid, I, page 66.

‡Authors lay it down as a rule that the Libellulina are confined to stagnant water; but I possess an undescribed species of Gomphus, allied to *G. notatus*, Rambur, the larvæ of which occurs in the Mississippi. I am enabled to state with certainty that this species is undescribed, because Dr. Hagen, the great Prussian Neuropterist, has kindly favored me with a copy of the first two volumes of the magnificent work on the Libellulina now in course of publication by him and M. Selys de Longchamp of Belgium.

insects. All that would be necessary, therefore, would be to provide a suitable pond of water, which the ordinary operations of nature will soon fill with a host of plant-feeding larvæ, and to take proper measures to keep out frogs, geese, ducks, certain water beetles (*Dyticidæ*) and other pre-eminently rapacious insects. The young dragon-flies would then be placed precisely in the situation of the English pheasants—good shelter, plenty of food and no enemies to destroy them. And the result would be that they would increase with a rapidity which we may easily estimate from the consideration, that a pheasant lays about a dozen eggs, and a dragon-fly, several hundred.

This, or something approaching to this—the conditions of the process being, of course, varied, according to the peculiar habits of the species operated upon—would be the method to be taken with the first great group of cannibals above referred to, most of which are general feeders. In the case of the other two groups, however, the difficulty would be greater, for the simple reason that so far as our very limited knowledge on the subject extends, many of them are confined to feeding on some particular species of insect, and cannot exist upon any other. For example, the minute Ichneumon-fly (*Eurytoma destructor*, Say,) which was observed more than forty years ago by Thomas Say, to be parasitic on the Hessian-fly, has not hitherto, I believe, been noticed to be parasitic on any other species of insects. In order to breed this Ichneumon, therefore, we should, in the present state of our knowledge, be obliged first to breed Hessian flies, which would involve the destruction of a corresponding quantity of wheat or other small grain. Thus, to mend one hole we should make another; and should be much in the situation of a lady who raised a colony of mice purposely to feed out to her young kittens. There is some reason, however, to think that a more accurate investigation of the habits of these interesting insects will show us, that they are not so much confined to particular species as is generally supposed; and that most of them prey indiscriminately upon two or more closely allied species. Similarly amongst the plant-feeders, the capricorn beetle, (*Clytus pictus*, Drury,) which is so rapidly destroying the locust trees in the eastern part of this State, must have confined itself originally to our indigenous walnuts, as is manifest from the well known fact that the locust is not indigenous but imported.*

It is not generally known that several of our most noxious insects are themselves not indigenous but imported. The house-fly, there can be little doubt, was originally introduced in ships, which, in the summer, always swarm with them; and it is a curious fact that we have in a similar manner supplied the South Sea Island-

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*In September, 1860, I noticed swarms of this pretty species at Jacksonville, at Bloomington, and at LaSalle, and heard much complaint of their ravages. In the same month, I took two specimens near Rock Island. In 1858 and 1859, I met with but one solitary individual near Rock Island, which I split out of a billet of fire wood.

ers with our American mosquito. The bark louse again, which in 1855, was confined to the immediate vicinity of Lake Michigan, but which has now worked its way westward to the Mississippi, is identical with the European species; and has doubtless been introduced from Europe, where it is comparatively harmless. The Hessian-fly was imported from Germany in 1776, in some wheat straw shipped for the use of George III's Hessian mercenaries, and has done us a hundred times the damage in dollars and cents, that the royalist troops ever inflicted upon us from one end to the other of the war of the Revolution. The wheat midge was imported about 1820–28—probably from England, where it is sometimes rather troublesome. And not to mention minor pests, a European leaf-eating beetle (*Galeruca calmariensis*) has for years been destroying the ornamental elm trees in the city of Baltimore and its vicinity, whence, no doubt, if not checked by artificial means, it will in process of time extend itself over a considerable portion of the United States.

It generally happens that when a noxious insect is accidentally imported into the country, the cannibal species appointed by a wise Providence to keep it in check are not imported along with it. For example, there are three small Ichneumon-flies, that prey on the wheat-midge in England, and not one of them has yet found its way to this country. There was an account, indeed, quite recently, in a Canadian paper, of such an insect having been discovered in Canada; but supposing even that this is correct, at the average rate at which imported insects progress—about thirty miles a year—it will take thirty years before it gets to Illinois; and in the meantime our farmers are losing annually enormous sums of money for the want of it. In England, on the contrary, where the midge is kept within due bounds by its three parasites, the greatest damage that I can find on record as having been done by this insect, is the destruction of *one-twentieth* (!!) of the crop, which is recorded by Kirby & Spence as a very extraordinary event!! Now whatever we may think of the idea of artificially propagating cannibal insects—and however visionary we may choose to pronounce all such schemes—it must be evident that in such a case as this, where it is a question not of artificial propagation, but of artificial introduction, the parasites ought to be imported at the public expense. There is the antidote, on the other side of the Atlantic; here is the bane, right in the midst of us. If you wish to be healed, stretch out your hand and take hold of the medicine.

One thing at all events is certain: *out of nothing comes nothing;* and if nothing is attempted, nothing will ever be accomplished.

Before I conclude, I wish to offer a few remarks more especially applicable to three or four of our most noxious insects.

THE HESSIAN FLY.

It a curious fact that for many years back the Hessian fly has done but very little damage in the eastern States. Yet it has not been extirpated there; for Dr. Fitch informs us that specimens may occasionally be met with in wheat fields in New York. What then is the reason that it should have ceased to be troublesome in the east, and still continue troublesome in the west? There can be no rational cause assigned but the presence in the east of four distinct species of parasitic flies, which prey upon it so extensively there that, according to Mr. Herrick, of Connecticut, they destroy nine out of every ten. It is possible one or more of these parasites may exist in Illinois; but the presumption rather seems to be that they have not yet reached us. It would be very desirable that some competent person should examine into this point; and that if the slow processes of nature have not yet furnished us with the natural check upon the Hessian-fly, artificial means should be immediately employed to introduce it amongst us.

Whether any or all of these four parasites of the Hessian-fly have been imported from Europe, or whether—which seems the more probable supposition—they are indigenous insects which have permanently acquired new habits, is a question of very great scientific interest, but practically, perhaps of minor importance. It certainly does seem very remarkable that of the two allied insects, the Hessian-fly and the wheat-midge, the former should have been attacked by no less than four Ichneumons within sixty years of its importation, and the latter although it has been imported about forty years, should not as yet have been attacked by a single species.

Although the Hessian-fly belongs to the same genus, (*Cecidomyia*,) as the wheat-midge, yet it differs remarkably from that insect and most of its congeners, in being *double-brooded*, or having two distinct generations produced every year; the eggs of the one being deposited in the spring of the year, and of the other in the fall, upon the winter wheat. It must be obvious, therefore, that if no winter grain were grown anywhere in the State, the insect would be soon starved out; and this is no doubt the reason that, in the north of Illinois, where the farmers have very generally given up growing winter wheat, we hear scarcely anything of it.

Pasturing winter wheat, infected with the Hessian fly, very closely with sheep, has always been considered the best remedy, the sheep biting so close that they eat the insect along with the green stem on which it is located. A correspondent of the *Illinois Prairie Farmer* states that in the years 1856–7 he pastured a piece of infected wheat very close indeed with cattle—so close that his neighbors thought he had ruined it—and yet reaped a fair crop from it after all.

THE APPLE TREE BORERS.

Dr. Fitch, speaking of the striped borer (*Saperda bivittata*, Say.) says that a certain preventive is "to rub the bark of the trees with soap, the latter part of May, each year," and that "he had applied it to a part of his trees and omitted it from others, and in the following spring had found young borers in almost every tree where the soap had not been applied, whilst not one could be detected in any of the soaped trees." This is the *experimentum crucis* of Bacon, and appears to settle the question as to this insect. It is a pity all experiments with insects are not carried out upon an equally satisfactory footing.

In the State of Illinois our apple trees appear to be more troubled by the *Chrysobothris femorata* than by the *Saperda bivittata*, which I have never met with near Rock Island. The former insect attacks not only the *trunks* of apple trees, but also *small limbs*, only three-quarters of an inch in diameter. The place where this borer has been at work may frequently be recognized by a slight scratch, crossways of the limb, looking just as if it had been made by the claw of a cat. I presume that this is the spot where the parent insect deposited its eggs, but as it has a fresh appearance, even when the insect underneath it is nearly mature, it is probably used also by the larva to get rid of a portion of its castings.

Whether soap is as effectual a remedy against the *Chrysobothris* as against the *Saperda*, remains to be proved.

THE CURCULIO.

No ichneumon-fly preying upon the curculio has yet been discovered in the United States; but there exists such an insect in Canada, discovered within the last twelve months, and Dr. Fitch has figured and described it as the *Curculio Parasite*, (*Sigalphus curculionis.*) I have taken a *Phanerotoma* near Rock Island, very closely resembling it, and of another closely allied genus I possess *Chelonus sericeus*, (Say.) and nine smaller species, but upon what insect these ichneumon-flies are parasites, I have no knowledge whatever. Whether the curculio *causes* the "black knot" in plum trees or not, it is an undoubted fact that it *breeds* in the "black knot," and, therefore, every piece of it that can be found should be carefully burnt, if we wish to diminish the numbers of this pest.

It is a well established fact that where plum trees overhang water, the curculio will not deposit its eggs in the plums. It has also been stated, though the fact does not rest upon equally good authority, that the same result follows if the ground under the plum trees is paved with flat stones, or even tramped very hard. The reason seems to be that the insect foresees that its larvæ will require to burrow into the earth as soon as they leave the fruit and

avoids those trees which have not moderately soft earth underneath them. Paving the ground, however, under fruit trees, would probably injure their growth, and the same end might perhaps be attained, without injuring the trees, by erecting a platform of boards round every tree, at a suitable distance from the surface of the earth. But here, again, as in so many other cases, experiments are needed.

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THE CHINCH BUG.

These skunks of the insect world are neither one-brooded, like the wheat midge, nor two-brooded, like the Hessian-fly, but many-brooded, like the common house-fly. That is to say, there are several generations of them produced every year, for they are found in the larva state all through the summer, and even as late as October; and, like the house-fly, they *hybernate*, or pass the winter in the perfect state. I have always found them abundant in moss in the winter months, and I have occasionally noticed them under logs, etc., at the same season. There can be little doubt but that on a farm they chiefly hybernate in the old tufts of grass and dead weeds which are allowed to accumulate near fences; for it is always on the outside edge of a piece of wheat that they commence their depredations. Moreover, twenty years ago, when Illinois was thinly settled, and the prairie fires swept annually over the greater portion of its surface, we heard nothing of the chinch bug, probably because the fire used to destroy most of them in their winter quarters. Wherever worm fences have been replaced by board fences, it would be found a very useful precaution to burn annually along them in the winter. A single chinch-bug thus destroyed, might, if left alone, become the parent of fifty thousand.

Hot dry weather is required for the rapid multiplication of this insect, and a heavy shower of rain checks them immediately. When they are leaving the wheat at harvest time, and going on to the corn, it might perhaps, in some cases, where water was convenient, be a paying operation to pour a little upon every hill of corn that stood within a moderate distance of the wheat. But the most effectual method is to plow the wheat stubble as soon as ever the wheat is cut, as deeply as can be conveniently done; by which operation a great many of the perfect insects, and probably all their eggs—which appear to be deposited close to the surface of the ground, or a little underneath it, at the root of the plant—will be buried never to rise again.

It has been generally said that there is no insect which depredates on the chinch-bug. I have reason to believe that there are no less than FOUR distinct species which do so. On the 19th of last September, having received from St. Paul, Minnesota, a specimen of *Ips quadrisignata*, (Say,) with a statement that it was destroying a great deal of sweet corn in that vicinity, and knowing that this insect was tolerably abundant near Rock Island, I exam-

ined a large patch of sweet corn in the field of one of our market gardeners, to see if I could detect it there. I did not find it, although I carefully opened about fifty ears; but underneath the husks of almost every one I noticed, as is quite usual, one or more chinch-bugs, some in the perfect state, and some in the pupa, and I also noticed, to my great surprise, quite a number of specimens of four very common species belonging to the lady-bird (or *Coccinella*) family, all the known American species of which are cannibals. With the exception of the chinch-bugs and a few individuals of a smaller and closely allied species of bug, (*Anthocorus pseudochinche*, Fitch,)—which has frequently been mistaken for the true chinch-bug although it is not half its size and is shaped very differently—there were no other insects under the corn-husks. The idea at once occurred to me that these lady-birds were depredating upon the chinch-bugs; and I was confirmed in this opinion upon finding a pupa, which was evidently that of some Coccinellide, probably *C. munda*, (Say,) in the same situation. Now since the pupa was there, the larva must also have lived there, for it is not the habit of these larvæ to get into holes and corners to complete their transformations; and if the larvæ lived there, there was nothing else for them to live on but the above mentioned two species of bug, the smaller of which never occurs in any great numbers like the larger and more mischievous chinch-bug.

That the lady-birds were then and there preying upon chinch-bugs, I have but little doubt; but it does not necessarily follow that they *habitually* prey upon chinch-bugs. They might have been driven to prey upon them for lack of more agreeable food; as a cat will sometimes eat bread when she cannot obtain meat. Nothing but actual experiment and observation can determine the truth in this matter.

Authors, copying from one another, generally lead us to suppose that the *Coccinella* family feeds exclusively upon the different species of plant-lice. That this is the case with many of our North American species, is undoubtedly true; for I have myself bred four species which had that habit. On the other hand Mr. Rob. Kennicott discovered *Chilocorus stigma*, (Say,) preying both on the common bark-louse of the apple and on the bark-louse of the pine, (*Aspidiotus pinifolia*, Fitch.) In the spring of 1860 I found numerous specimens of a nine-spotted lady-bird (*Coccinella novemnotata*, Herbst,) under dry cow-dung along with many of their orange-colored eggs; and although there was a variety of other insects there, there was no appearance of any plant-lice. And lastly, in the summer of 1860 I discovered swarms of *Hippodamia maculata*, (DeGeer,) preying on a species of bark-louse, which differed only from the common species (*A. conchiformis*) in having *bright red* instead of *white* eggs, and in infesting not the apple tree but a species of willow, (*Salix nigra*, Marshall.*) What

* For the determination of this species I am indebted to my friend M. S. Bebb, Esq., who has paid particular attention to the very difficult family of willows.

is especially remarkable is that the very species which was thus in the summer detected preying on a bark-louse was one of the four which in the fall was to all appearance preying on the chinch-bug.

Of these four enemies of the chinch-bug two are quite small and obscurely colored insects, belonging to the genus *Scymnus*, and might easily be confounded with a great variety of other beetles of entirely different habits by the inexperienced in such matters. It will be sufficient, therefore, to state that the larvæ of this genus are described by Dr. Harris as "clothed with short tufts or flakes of the most delicate white down," and by Westwood as "entirely clothed with a white cottony secretion." If any such larvæ are noticed amongst chinch-bugs hereafter by amateurs, it may be known what they are doing there. The two other enemies of the chinch-bug are conspicuous insects, and with the assistance of a figure may be readily identified by any person that has got two eyes in his head. They occur profusely in summer on all kinds of weeds, tall grass, shrubs, etc., and may be captured in any required numbers by simply beating the weeds, etc., backward and forward with a hoop of stout wire fastened to a staff and having a cloth bag sewn on to it. As fast as taken from the bag they may be dropped into a large bottle having an open quill running right through its cork, and filled loosely with leaves; and they may afterwards be emptied out upon any crop infested with chinch-bugs, amongst which they would, in all probability, deposit a copious supply of their eggs. It is to the larvæ proceeding from these eggs that we should look for the greatest amount of benefit; for the perfect lady-birds eat comparatively but little, while the larvæ are arrant gormandizers. Below will be found a figure and a short description of these two insects:

Figure 1st represents *Hippodamia maculata*, (DeGeer,) magnified, the adjacent line exhibiting its natural length. The colors are black and a bright blood-red, almost verging upon pink. The red in all the other species of lady-birds with which I am acquainted is not *blood-red* but *brick-red.*

Figure 2nd represents *Coccinella munda*, (Say,) magnified, with a line showing its natural length. The colors are black, white, and light brick-red. It is the only species I know that has its wing-cases red *without any black spots at all.*

Figure 3rd is copied from Westwood, and is the larva of a European species of lady-bird. There is a general resemblance amongst the larvæ of all the *Coccinellas*, and their colors are mostly brown-black with buff spots. The larvæ of No. 1 and No. 2 I have

never bred, but presume they do not differ materially from those of some other North American species, which I have bred, and which come very close to the figure.

It is only necessary to add, in conclusion, that the lady-birds (*Coccinellidæ*) may be distinguished from other beetles by having only *three* joints to their feet instead of *four* or *five*. The only family of beetles which agrees with them in this peculiarity (*Endomychidæ*) consists of a very small number of species, all of them quite rare.

BENJ. D. WALSH.

ROCK ISLAND, *January* 3, 1861.

THE ARMY-WORM AND ITS INSECT FOES—THE REMEDY.

The practical result of the following pages may be expressed in very few words: *Burn your tame grass meadows over annually, in the dead of the year, and get your neighbors to do the same, and you will never more be troubled with the army-worm.*

But there is a large class of farmers who have been fooled so repeatedly by quack prescriptions and powders Pimperlimpimp, warranted to kill every bug on the farm if you only scatter a few grains in the four corners of every field, that they have lost all faith in the possibility of counterworking to any good purpose their insect enemies. There is also another large class amongst the agricultural community, who, although they might be disposed to believe in a remedy recommended by good scientific authority, are yet laudably desirous to understand the principle upon which that remedy works. Such men read and think, as well as work and oversee. They do not know much, perhaps, of Natural History, but they do not consider it beneath the dignity of man to study the handiwork of God, however microscopically minute that handiwork may be; and, therefore, they are not too proud to listen to minute descriptions of the habits and instincts of insects, and especially of such as are injurious to their crops. It is for the use of these two classes of men that I have drawn up the following imperfect sketch of the Natural History of the Illinois army-worm. The reader will thus be enabled to judge for himself whether the remedy I have indicated be in reality a remedy, or whether it be one of those quack nostrums, generalized from a solitary experiment, which ignorant pretenders are constantly obtruding upon the agricultural world; just as the charlatan, having given a dose of calomel on the same day to a shoemaker and a tailor, and having found that it salivated the former but had no effect upon the latter, announced with great pomp, in a medical journal, that mercury salivated shoemakers, but produced no result whatever on the constitutions of tailors.

But first let me explain what facilities I have enjoyed for executing this task. Through the liberality of the Rock Island and Chicago, and the Illinois Central Railroads, in granting me a free pass, as a member of the Illinois Natural History Society,

over their roads, I was enabled to start the middle of last June for an entomological excursion, of four or five weeks, into the extreme southern point of Illinois. Stopping on my way at Bloomington, I collected there about sixty army-worms, which, as soon as I arrived at my destination, I transferred to a suitable breeding cage, and watched through their transformations. I also took every opportunity, both while traveling on the cars and while "collecting" in the country, to gather up and note down all the information on the subject I could get; and I am indebted also for many valuable hints, to sundry articles which have appeared in the *Illinois Prairie Farmer*. I make no pretension to having occupied the whole or even a large part, of my time, while resident in the South, in this task. In a scientific point of view, the army-worm is no more interesting than any one of the four or five thousand species of moths that are found within the limits of the United States. There is nothing unusual, nothing mysterious, nothing abnormal about it. But I always hate to give *nothing* for *something*, and having been obliged by the railroad companies, I endeavored, to the extent of my poor abilities, to return the obligation, by seeking a remedy for a little pest, that has this year destroyed one-fourth part of the tame hay grown within the limits of the State.

THE ARMY-WORM LARVA. FIG. I.

Like all other insects, the army-worm takes its origin from an egg, generated by the perfect insect when arrived at the winged, or imago, state. Like other insects, too, the mother takes good care to deposit her eggs in the precise locality, where instinct teaches her that they will remain in safety until they are hatched, and where the young larva, as soon as it is hatched, will have at hand a copious supply of its appropriate food. Such a locality is found in the stalks of perennial grasses, such as timothy, blue grass and red top, as near as may be to the root, where the egg will be protected from the severe frosts of winter by the old dead leaves which accumulate there. For, as we shall afterward see, the egg is deposited in June or July, and lies dormant until the following spring. In Southern Illinois, as I learn from my friend and co-laborer, Mr. Cyrus Thomas, the egg hatches out about the middle of April; in Central Illinois it must be about a month later, judging from the growth of the specimens I obtained at Bloomington. Four or five weeks may be given as about the time that it takes the newly hatched larva to arrive at its full larva growth; and it is in this state only that it forces itself upon the attention of the farmer by devouring his meadows, sometimes so completely as to kill the whole field dead. Not only the leaves, but the heads, and even a portion of the stalks are eaten; and I was informed by a lad, who resides near Tamaroa, that fields of red top grass attacked by them often seemed transformed into timothy, on a cursory view, each stalk being surmounted by a caterpillar, gnawing away at it, and looking like a head of timothy. So soon as food is beginning to be

THE ARMY-WORM IN ITS THREE STATES.

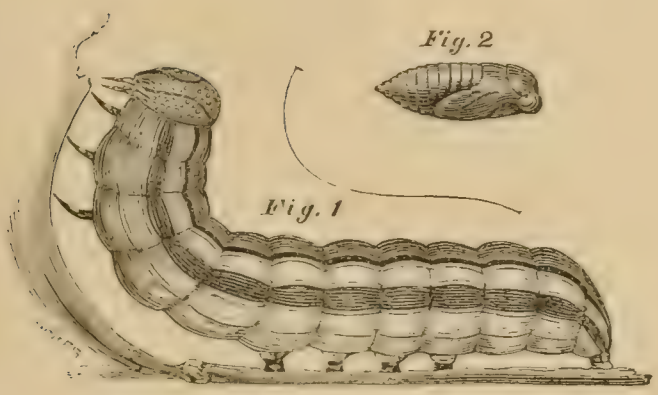

Fig. 1—Leucania unipuncta, (Haworth;) larva state.
Fig. 2—Leucania unipuncta, (Haworth;) pupa state.
Fig. 3—Leucania unipuncta, (Haworth;) imago state.

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scarce, then is developed the instinct of traveling in large troops or armies in search of better quarters, from which the insect derives its popular name. This habit, however, is by no means peculiar to this species, but is found in many other insects—the locusts of Scripture and of modern Europe, for example, which belong to the family commonly known as grasshoppers in this country, and are altogether distinct from what is here popularly called a "locust." Those army-worms which I saw myself at Bloomington, were in a small patch of timothy, attached to a gentleman's garden in the outskirts of that city, and not being sufficiently numerous to more than eat up one-third part of the leaves, had never manifested any disposition to travel, although they were almost all full grown. I noticed that they had not attacked a blade of some wild prairie grass, which immediately adjoined the timothy. On the subject of their migrations, which I have never been fortunate enough personally to witness, I cannot do better than quote the words of B.——, an accurate observer, hailing from Pesotum, Ill., as recorded in the *Prairie Farmer*, of July 4th, 1861:

"An army of them was observed to travel sixty yards in two hours, in an effort to go around a ditch. They began to travel from the infected districts between two and three o'clock, P. M. Toward sundown the tide of travel was retrograde. They did not travel at night. They fed chiefly at night and in the forenoon. As to their number, they have been seen moving from one field to another, THREE TIERS DEEP. A ditch has been filled with them to the depth of THREE INCHES IN HALF AN HOUR."

When they leave the meadows in which they originate, they travel on—sometimes as far as half a mile—until they meet with wheat, rye, oats, corn, sorghum, or Hungarian grass. Oats appear but very little to their taste, and they seldom damage them much; neither do they relish clover; corn they almost invariably destroy so as to necessitate its being replanted, which, as every farmer knows, involves a loss always of ten or fifteen bushels to the acre, and sometimes, when the season is unfavorable, of the entire crop. Of wheat, they generally devour nothing but the blades, which does not seem to injure, and in the opinion of some farmers, benefits the crop by keeping off the "rust." I ascertained a most remarkable fact from Capt. Post, of Decatur, and on inquiry in Southern Illinois, found that the same thing had occurred there. In passing through a wheat field they devour bodily every spear of "chess"—not merely the leaves, but the stalk and the head—and thereby actually confer a benefit on the farmer. For "chess," or "cheat," as it is sometimes called, is a species of grass, the seeds of which make the flour blue, and are peculiarly difficult to screen out, from their resembling in shape and weight a shrunken kernel of wheat. As an instance of the rapidity with which they work, Mr. Gilbert, of Vermilion county, states that "a friend of his having a piece of timothy near his house, (about one acre,) left home for church about nine or ten o'clock, A. M. On returning home, after dining on the way, he found the whole piece had been riddled, and appeared as if fire had been over it;" and Mr. G. W. Miller, of Indiana, states

that "he hears of their eating up twenty acres in a day very frequently." Many instances are on record of the great difficulty with which they have been kept out of houses which happened to lie in their path.

Ditching has been extensively employed in Illinois to stop the army-worm in his travels; but it is necessary to make the further side of the ditch plumb, or a little undermining; and even then, if the soil is stiff and clayey, so as not to crumble off when seized by the little claws of their feet, they contrive to climb the obstacle. At the best, all that is thus effected is to confine the damage to the meadows where it originated, and prevent it from spreading into the cereal crops. But the most preposterous of all conceivable methods to stop the depredations of this insect upon wheat, is one which has been practiced by many farmers, and which is gravely stated by several of them to have been the means of saving the crop! They drag long ropes over the heads of the grain, thus causing all the worms to fall to the ground, as most kinds of plant-feeders will do when disturbed. They then jump to the conclusion that the worms will not climb up again to feed—which is much like supposing that a colt will not come back again to a pile of good oats after you have once driven him away—and having satisfied themselves on this point, they jump to the further conclusion that this sapient method of circumventing the army-worm was the cause of their getting good wheat; whereas no fact is better established than that the army-worm did no injury to the wheat crop of 1861 by passing through it, and that—rope or no rope—they would have had an equally good crop. It is certainly possible that if the blades of the wheat are pretty nearly consumed, this causing the caterpillars to fall to the ground simultaneously may start them on their travels. I was told by Col. Dougherty, that firing a cannon as often as two or three times, has a similar effect. But what can be gained by causing them to shift their quarters from the wheat, which they actually benefit, to the corn, which they utterly ruin? There is an old Greek joke, more than two thousand years old, about a foolish fellow shaking the boughs of a tree to make the birds fall to the ground, so that he might catch them; but this idea of shaking caterpillars to the ground, so that they may not dare to climb up again, is a trifle ahead even of Hierocles and his Facetiæ.

So little, indeed, are the laws of Natural History understood in this country, that, as I learn from Mr. Townsend Glover, the Entomologist of the Maryland Agricultural College, "a naturalist, in a western paper, gravely states that this caterpillar *may* be viviparous, and *may* give birth to living baby caterpillars, which also, in due time, follow the great law of nature, and likewise become happy mothers to another caterpillar brood." Yes, and lambs *may* produce lambs, and calves *may* generate calves, and little girls of five years old *may* be the mothers of fine thriving families. One event is every whit as likely, and every whit as possible, as the other.

As we might expect from the laws governing the development of insect life, the army-worms make their appearance in noticeable numbers in different years in different parts of the State. I have no doubt that they exist in small numbers in every part of the State from year to year; for although they have never appeared till 1861 in the neighborhood of Rock Island, in such numbers as to attract attention, yet I myself captured a single specimen of the army-worm moth in Rock Island county, in each of the three years, '58, '59 and '60. At Okaw they are recorded to have appeared in 1850; in the south part of Vermilion county, in 1835; and Mr. Joseph Bragshaw, of Perry county, says that they visited that county in '25, '26, '34, '39, 41 and '42. Colonel Dougherty, of Jonesboro, in Union county, one of the oldest and most respected citizens of Southern Illinois, informed me that about 1818 or '20 they were far more numerous there than in 1861, and that in 1861 there would not be a single cock of hay put up in his neighborhood save one meadow which was part clover and part timothy, and which I can myself testify was badly "patchy," there not being more than an eighth part of it which would turn out a good swarth of clover, the timothy being "nil" throughout. In 1838 again, according to the Colonel, there were but few of them. In 1842 they were about as in 1861; and in 1856 they occurred only in small numbers.

Many suppose, from the analogy of the insect known as the seventeen year locust, that army-worms make their appearance only after the lapse of a certain definite number of years. But the cases are altogether different. The locust (*Cicada septemdecem*, Linn.) appears in one and the same neighborhood every seventeen years, because, strange as it may seem, it takes exactly seventeen years, neither more nor less, for its larva to arrive at maturity in the bowels of the earth. But the army-worm goes through the whole cycle of its transformations in a few months, and what is to become of the breed during the years that intervene before the period of its next supposed advent? People have puzzled their brains a great deal to explain why it appears in great numbers only in certain years, as if there were some wonderful mystery in the circumstance. Whereas, in reality, such periodical swarmings of particular insects are some of those common and well understood occurrences, which create no surprise whatever in the mind of any Naturalist.

I shall afterwards show how it happens that this particular insect swarms in certain years and is not noticed in others. I am almost ashamed to waste time in explaining what every child in the State ought to know; but I have been proceeding throughout on the supposition that my readers know nothing of the subject, and those who are better informed will understand perfectly well the policy of such a supposition.

Fig. I. represents an army-worm, magnified to show clearly the peculiar arrangement of the stripes. The full description of these, as of other scientific details, uninteresting to the general reader, is

reserved for the appendix. It will be sufficient to say here that the larva is a rather dingy looking caterpillar, striped with dirty white and dusky, and has a good deal the general appearance of the insect most commonly known as "the cut-worm," differing chiefly in the absence of certain shining little black humps or dots, each of which in the various species of "cut-worms" is armed with a hair.

THE ARMY-WORM PUPA. FIG. II.

So soon as the army-worm has reached its full larva growth, like all the other species of butterflies and moths comprising the great order, *Lepidoptera*, it casts its *skin*, or properly speaking, the horny external *skeleton* to which all its muscles are attached, and assumes an entirely different shape, color and appearance. All the Lepidoptera, whether this state be prolonged for eight or nine months, or whether it only last a few weeks, lie dormant the whole time, and eat nothing; and the army-worm is no exception to the rule. My specimens lay under ground about fifteen days, and all that I have known bred by others lay about the same time. The time, of course, varies with different species, each having its peculiar arrangements. In order to prepare for this change, like a great number of the larvæ of moths, it burrows under ground and by turning its body repeatedly around in the moist earth forms a hollow cell within which the change takes place. Occasionally it scarcely penetrates beneath the surface, and forms a rude cell amongst the dry herbage at the roots of the grass on which it feeds.

Fig. II shows the insect in this stage of its development. As is almost universally the case with the pupæ of moths, it is rounded at the head and pointed at the tail, the outlines and general appearance differing but slightly in the different species. Like most of them, too, it is of a shining mahogany color, with the limbs wrapped up like a "baby in swaddling cloths," which is the meaning of the Latin term *pupa*—so strangely like the Indian *papoose*. It has a single thorn at the end of the tail, in which respect it agrees with all other Lepidopterous pupæ with which I am acquainted, except that of a small undescribed Pyralide bred by me this year, which has a truncate tail with *six* thorns, like the pupa of *Tabanus* (horse-fly) among the *Diptera*.

It is a curious fact, illustrating the gross ignorance on the subject of Natural History which generally prevails in this country, that a correspondent of a popular Agricultural Journal, referring to the army-worms going under ground, should have gravely announced that "they are dying very fast!!"

THE ARMY-WORM MOTH. FIG. III.

Having passed its appointed time in the *pupa* state, the army-worm now sheds its horny skeleton once more, just as a lobster or a crawfish sheds its calcareous skeleton, and comes forth a winged moth or "miller," with no jaws fitted for mastication such as it formerly possessed, but furnished in their stead with a long tongue

or proboscis—suited for sucking the sweet juices of flowers—which is curled up when not at use under the head. This sudden change from a *biting larva* to a *sucking imago* is characteristic of the Lepidoptera, and does not occur in any other order of insects. It is in this state alone, also, as with all other insects, that its reproductive organs are fully developed; and, like them too, having arrived at this state, it dies without undergoing further change.

The remarkable metamorphosis of a groveling worm into a soaring moth or butterfly was noticed many thousand years ago by that imaginative people, the ancient Greeks; and as the same word in their language happens with a slight variation of accent, (Psyché and Psy'che,) to signify either a *soul* or a *butterfly*, they very naturally traced a fanciful analogy between the immortality of the soul and the ethereal flight of a butterfly, and embodied it in the pretty legend of Cupid and Psyche. Grave modern theologians, amongst whom Bishop Butler may be named, have been misled by the same illusion, and have adduced it seriously as a proof that the soul of man never dies. They ought to have learnt the rudiments of Natural History before they ventured on so ticklish a subject. Nothing is more certain than that—so far as there can be any analogy between a vertebrate animal like man, and an annulate animal like a butterfly or moth—the milk-feeding toothless baby is analogous to the leaf-feeding, tooth-bearing caterpillar, the flesh-and-bread-feeding tooth-bearing child is analogous to the toothless non-eating pupa, and the fully developed man or woman, with definite sexual peculiarities and perfect sexual powers, is analogous to the fully developed butterfly with all its sexual organs and sexual propensities complete. So that the analogy, such as it is, proves directly the contrary of what its authors intended it should prove; for if it be worth anything at all, it would necessarily follow, that as dies the butterfly, so dies the man.

The color of the front wings of the army-worm moth is a light reddish-brown or fawn color, marked with black and white as in the engraving. The time at which it appears varies according to the latitude from the beginning of June to the middle of July. How long each moth lives I have no definite information; but from analogy it may be roughly estimated at from three to five weeks. Many, of course, meet an untimely death from the jaws of the numerous species of *Libellulina* or dragon-flies, (popularly called snake-feeders, mosquito-hawks, and Devils' darning needles,) which are perpetually flying round seeking for their prey. Many are destroyed by other cannibal insects, and by spiders, toads, frogs, bats and birds. The residue pair and deposit their eggs where nature teaches them that those eggs will have a chance to live. Owing to the very small number of army-worms which I succeeded in raising to maturity, from causes to be hereafter explained, I could not afford to destroy a female so as to ascertain the precise number of eggs; but from analogy I should put it at about two hundred. The moths fly readily and strongly by daylight; at least they do so

when they are disturbed; and I took a specimen by night in a building into which it was attracted by a brilliant light. They may therefore be classed as semidiurnal.

Whether our Illinois army-worm be, or be not, identical with the army-worm of the southern States, is a question yet to be solved. Until this current year nobody had any scientific knowledge of the species I am now illustrating; and of the southern insect there is absolutely nothing whatever known with certainty. The probability is, that several distinct species have been confounded under this popular name in the South, and that one of them is identical with our insect. It certainly is an encouraging sign of the progress of entomological discovery in this State, that a noxious insect of primary importance should have been, for the first time, traced through all its transformations in the year 1861 by no less than four citizens of Illinois to my certain knowledge—I refer to Mr. Cyrus Thomas of Murphysboro, Mr. Emery of the Prairie Farmer, Col. Dougherty of Jonesboro, and last and least myself.

Hitherto we have been treading upon firm ground. We are now approaching debatable territory. It will be noticed that I have assumed throughout that the army-worm moth deposits its eggs in June or July, and that those eggs lie dormant until the following spring. My friend Mr. Thomas thinks that these eggs, instead of lying dormant, hatch out some reasonable time after they are laid, and that from them arises a second brood of army-worms which passes the winter in the pupa state, the moths arising from which in the following spring lay the eggs which produce the well known May and June brood. This is confessedly the arrangement with several species of moths; whether it be so with the army-worm can only be *demonstrated* by actual experiment, the time for which has not yet transpired. The point is of the utmost *practical* importance; for if the eggs of the army-worms of May and June are not laid till March or April, it would obviously be of no avail to burn over meadows in the winter, in order to destroy eggs which were not yet deposited there. I make no apology therefore for presenting the arguments on both sides at some length.

Mr. Thomas says in a letter to me: "If the moth deposits her eggs on the grass, then the eggs must hatch before the winter, as this is too precarious a situation I think for nature to adopt, though many select leaves, etc." Now the common web-caterpillar of the apple tree (*Clisiocampa Americana*, Harris,) assumes the moth state about the first of July and lays its eggs some short time afterwards in the well known cylindrical rings upon apple twigs. Yet although those eggs are exposed on high to the heat of summer and the cold of winter, they do not hatch out till the following May, and they are never, that I have heard of, killed by the cold weather. I might quote other instances, but one such seems enough. It is but candid to add that originally, before I had closely looked into the matter, I inclined towards Mr. Thomas's opinion.

The following are my reasons for thinking that it is impossible

that our species should be double-brooded—at least in Illinois; for certain species which are single brooded in the northern States are double-brooded down south:

First—They are never found in tame grass meadows the year after seeding; yet if the moth deposits her egg in the spring, there can be no reason why she should invariably select old meadows. This fact is well known, and I was assured of the truth of it by Col. Dougherty.

Second—They are scarcely ever found on wheat or rye, except where tame grass meadows exist from which they have traveled. Yet as the caterpillar eats rye and fall wheat greedily, why should the moth, if she lays her eggs in the spring, pass over these crops? I inquired of a great number of farmers in the army-worm country, and they all agreed that wheat and rye were never taken except where there were meadows in the vicinity. It is but fair however to add that F. Beatty of Knox county, in the Prairie Farmer of June 27, states that the army-worm in his neighborhood "in every instance first originated or appeared in a field of rye." But perhaps Mr. Beatty was mistaken.

Third—No man in the army-worm country ever heard of a second brood of them making their appearance. I inquired particularly of Col. Dougherty as to this point, and he said he had never known such a thing. Besides, what could such a second brood find to eat, say in July or August? The tame grass and the oats and the wheat and the rye are all then cut, or at all events to tough and hard for the jaws of a youthful caterpillar; and if they got on uncut grass or uncut grain, or even on the corn, they certainly could not escape notice at harvest time.

Fourth—As a general rule the group of moths to which the army-worm belongs (the *Noctuæ* or owlet moths) are single-brooded. I cannot at present call to mind a single exception.

Such are the grounds upon which I had based my conclusion; and before I left Southern Illinois, I had already expounded to several of my friends the method of counterworking the army-worm which is based upon that conclusion, viz: burning meadows over every winter to destroy the eggs. Judge of my surprise and gratification, then, when on going home in the cars I fell in with Mr. Kirkham, an intelligent produce buyer of Gallatin county, and learnt from him that what Lord Bacon would call a complete *experimentum crucis* of the truth of my theory had been accidentally tried in his own neighborhood. The case was this: Mr. Wellington Wood, of the same county, was burning brush heaps near his timothy meadow, and by chance letting the fire get away from him had one half of his meadow burned over, while the other half remained unburned. The latter portion was afterwards "completely taken" by the worm; the former had no worms at all on it, and was saved without much difficulty, by ditching between it and the infected district.

Mr. Kirkham could not recollect the precise month when the

above occurrence took place, but as farmers do not burn brush-heaps in plowing time, it must have been some time in the dead of the year. It is but right that I should add that I obtained these facts from Mr. Kirkham *before* I expounded my theory to him.

Now if you still cling to the belief that the army-worm moth does not lay its eggs for the June crop till the spring, upon what supposition can you explain the above facts? Why should the moths have selected uniformly the unburnt timothy to lay their eggs on, and uniformly have passed over the burnt portion, which would then be far more green and inviting?

The western naturalist above referred to as arguing that army-worms bred from army-worms, and not from moths, was led to adopt his strange theory from the circumstance of finding them abundant on one side of a brook, and entirely absent on the other. Such a case might be easily accounted for, on my theory, by supposing that fire had run into the meadow, and had been stopped by the brook.

Mr. Glover himself says, "he has himself seen a large clover and grass field, near Columbus, Georgia, which was divided by a wagon road into two parts, one side of which was entirely consumed by the grass worm, [a species of analogous habits to the army-worm, figured by Mr. Glover in an unpublished plate kindly communicated to me,] while the other half was not touched." This remarkable phenomenon may be explained on the same hypothesis. Mr. Glover himself shows why the *caterpillars* did not cross the road, for he says "it was colonized by thousands of ants, that seized every caterpillar that dared to cross their imaginary Mason and Dixon's line, dragged them to their nests or forts, and confiscated them to their own use as *contraband of war*."

It is certainly possible that a few of the army-worm moths, instead of coming out at the normal time, in June or July, may lie in the pupa state till the following fall or spring. Nature makes such provisions for the permanent continuance of species with many of the *Lepidoptera*, as, for example, with the *Geometer*, or span-worm moth, commonly known as the canker-worm, (*Anisopteryx vernata*, Peck,) a few of which come out in the fall and winter, and the main bulk of them the next March. To quote a case more in point. Some years ago I bred fifty or sixty of the common *nocturidæ*, or owlet-moth, (*Acronycta oblinita*, Guénée,) and I distinctly remember that some two or three of them came out in the moth state in the fall, and the remainder not till the following spring. But this is the exception and not the rule, and in a practical point of view can make little or no difference in the case of the army-worm moth.

It will be noticed that I lay no stress whatever upon the numerous assertions by unscientific men of the appearance of army-worm moths in large flocks in the spring of the year. There are hundreds of moths which an ordinary observer could not distinguish from our insect, even if they were placed side by side; and one

witness, who is quite positive as to the identity of his "miller" with the army-worm moth, clearly shows, out of his own mouth, that he was mistaken, for he describes it as about "*three quarters of an inch across the wings.*"

Mr. T. Hull, of Bond county, recollects having seen, when a boy, army-worms invade the farm of his uncle, in Madison county, somewhere about '26, there being no tame grass meadows in the neighborhood, and the prairie being always in those days burned over. But out of the many dozen species of native grasses, there may possibly be some one on which they feed, and as there was an old salt lake one and a half miles off in the timber, there may have been an old Indian camp there, and consequently a sward of blue grass.

On the whole, I think we may safely come to the conclusion that the army-worm is not double-brooded, and if so, we know that the main crop of eggs must be deposited sometime in June, July, or August, and generally, at the present day, in the localities where the caterpillars make their first appearance, viz: in tame grass meadows. It is not impossible that some eggs are laid on uncut wheat or rye, but the plow comes along before the following spring, when in the course of nature they would hatch out, and buries them so that even if they should hatch out, unless the farmer should injudiciously grow two successive crops of small grain, the minute caterpillars have no suitable food close at hand, and, consequently, being too small and weak to travel, perish of starvation. They could never be deposited on newly sown fall grain, except in the case before referred to, of a few pupæ hatching out months after their usual time. The practical inference to be drawn is, that IF THE MEADOWS ARE BURNT OVER IN THE WINTER THE GREAT BULK OF EGGS MUST PERISH, and of course, "FEW EGGS, FEW ARMY-WORMS."

PARASITES OF THE ARMY-WORM.

The following passages are extracted from the "Origin of Species," by my old college acquaintance, Mr. Charles Darwin. The whole chapter in which they occur is well worth the perusal of every student of Natural History, and well illustrates the battle for life which is constantly waging all around us:

"A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase. Every being which, during its natural lifetime, produces several eggs or seeds, must suffer destruction during some period of its life; otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support the product. * * * There is no exception to the rule that every organic being naturally increases at so high a rate, that, if not destroyed, the earth would soon be covered by the progeny of a single pair. Even slow-breeding man has doubled in twenty-five years; and at this rate, in a few thousand years, there would literally not be standing room for his progeny. * * * In looking at Nature, it is most necessary to keep the foregoing considerations always in mind—never to forget that every single organic being around us may be said to be striving to the utmost to increase in number; that each lives by a struggle at some period of its life; that heavy destruction inevitably falls either upon the young or old, during each generation, or at recurrent intervals. *Lighten any check, mitigate the destruction ever so little, and the number of the species will almost instantaneously increase to any amount*"

I now propose to show from my own very limited experince, that these general principles apply also in the case of the army-worm. I have obtained from army-worm larvæ no less than four distinct species of parasitic insects, which burrow into their living flesh and finally occasion their death. All of these occurred in very large numbers, and in various parts of the State. I have also obtained two other distinct species, which are parasitic upon the parasites, burrowing in turn into their flesh, and feeding upon their vitals. Wonderful as it may seem to those not familiar with the beautiful science of Natural History, there can actually exist three living animals, each moving, breathing and eating inside the bodies one of the other, the innermost one, of course, becoming the triumphant survivor of his two living envelops. Nor is this anything unusual or abnormal—it is almost the everyday experience of every one who has paid much attention to the breeding of insects, and watching them through their transformations.

But in so complicated a system, parasites preying upon and checking the army-worms, and secondary parasites preying upon and checking the primary ones, we might, *a priori*, reasonably expect that considerable fluctuations would occasionally occur. If, for example, from some peculiarities of weather, the appearance of one of the primary parasites is delayed a few weeks in the spring of the year, the army worm will escape its attacks for that one season and multiply far beyond the average. The same thing will happen if the secondary parasites have been more than usually numerous in the preceding season, so as to diminish the numbers of the primary ones. If, on the other hand, the primary parasites are unusually numerous, the army-worm will be diminished in numbers beyond the average, and the same result will happen if the secondary parasites have become unusually scarce. And this is the actual experience of farmers: in particular years army-worms swarm; in other years there is not one to be seen.

So far from being astonished at such a result, the miracle would be, if each individual species of insect of the thirty thousand which exist in the United States, uniformly maintained the same exact numbers. The scheme of Nature may be compared to a vast system of vibrating springs, interlacing and pressing upon one another in every direction. You cannot lighten the pressure of a single spring without reacting upon all the others, and occasionally causing some one of them to fly upwards with a sudden jerk. And this is the actual experience of every collector of insects. Not a year elapses but several dozen insects, which in ordinary years are scarce, appear in great numbers.

As to the question whether or not army-worms will occur in considerable numbers next year, within the limits of the State, it is impossible to arrive at any definite conclusion. If parasites worked on them everywhere as extensively as they did at Bloomington, they could not abound, so as to do much injury, in 1862. But I can only give the statistics of their parasites for this single point,

PRIMARY AND SECONDARY PARASITES OF THE ARMY-WORM.

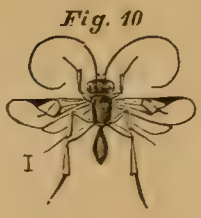

Fig. 4—Senometopia militaris. New species. Parasite of the Army-worm.
Fig. 5—Its puparium.
Fig. 6—Pezomachus minimus. New species. Parasite of the Army-worm.
Fig. 7—Mass of its cocoons.
Fig. 8—Chalcis albifrons. New species. Parasite of Pezomachus minimus.
Fig. 9—Mesochorus vitrens. New species Parasite of the Army-worm.
Fig. 10—Microgaster militaris. New species. Parasite of the Army-worm.
Fig. 11—Glyphe viridascens. New species. Parasite of some undetermined parasite of the Army-worm.

To face page 175.

and no private individual can be expected to do more. If the State had seen fit to appoint a Board of Entomologists, to visit every county in the Sta e and collect reliable information as to the relative numbers of the *eaters* and the *eatees*, we should then be able to forsee the future. At present it is all guess work.

We will now take up, in as much detail as our space permits, the separate species of parasites above referred to. Full notices of each will be found in the Appendix, intended for the use of those only who study entomology as a science. Probably the general reader will consider descriptions such as these needlessly minute. The naturalists of the last century were of the same opinion, and the consequence is that their brief descriptions often apply equally well to four or five entirely distinct species.

RED TAILED TACHINA FLY. FIG. IV. ITS PUPA. FIG. V.

This insect is not a *hyme opterous* or four-winged fly, like the great majority of parasites, but is a *dipterous* or two-winged fly, belonging to the same order as the musketoes, horse flies, house-flies and bot-flies. It is not furnished with a piercer at the end of its tail, like the *hymenopterous* ichneumon-flies, adapted to penetrate the flesh of its victim and lay its eggs in it, but nature has provided it with a cement, with which it glues its eggs on to the shoulders of the caterpillar, externally. Of fifty or sixty army-worms which I brought with me from Bloomington, all but two had these eggs, from one to six in number, fastened on the upper surface of the two or three anterior segments of the body. Instinct appears to teach the mother fly that if she places her eggs further back, the little maggots, as they hatch out and begin to penetrate the flesh, will be felt by the victim and seized by its powerful jaws, as I have seen wood-feeding caterpillars seize, and worry like a dog, ants that attacked them. These eggs are much about the shape and color of those of the common blow fly or flesh-fly; and some species of these last resemble the Tachinas a good deal, but are distinguishable by the little fine hair or bristle which springs from the middle of the last joint of their club-shaped horns, or antennæ, being *feathered*, and not *naked* as shown in the engraving. By holding up a common house-fly to the light, this *feathering* may be easily seen, even without a glass. Now if Nature had been a dunce, she would have manufactured the cement with which these eggs are attached of *gum*, and then the first heavy dew or shower of rain would have washed them off; but as she always understands her business, she has composed it of some *resin* which is perfectly insoluble in water. Wishing to free some of my specimens from these parasitic eggs, so as to procure a greater number of moths, I tried in vain to detach them with warm saliva; and from the wriggling of the ungrateful worms, I was unable to puncture the eggs with a fine pin and let out their contents, without puncturing the worms too, and thereby destroying them.

From the fifty or sixty army worms obtained in Central Illinois I bred exactly fifty-four Tachinas and two moths. Now these army-worms averaged about three eggs apiece, and consequently two-thirds of the eggs of the Tachina must have perished without arriving at maturity. The first that hatched out would get the start of its neighbors and starve them to death. I once observed in the burrows of some wood-feeding beetle an ichneumon pupa, spun up in its cocoon, and by its side two or three small starved larvæ, which would necessarily perish, as the wood-boring larva on which they had fed was entirely consumed. With such exuberant profusion does Nature sometimes provide for the carrying out of her wise and benevolent intentions.

My Tachina eggs, so far as I noticed, did not hatch till the larva had gone underground; but from information received from Mr. Emery, I have reason to believe that, under certain circumstances, this, or an allied species, hatches out above ground, adhering externally, and "growing rapidly while its victim decreases in size." They uniformly devoured the larva before it transformed into the pupa state. The time for the entire transformation of such as I experimented upon from egg to fly, was from fifteen to nineteen days. Meat-flies and house-flies breed with similar rapidity.

Before I had bred these Tachinas to maturity, I was informed by my friend and brother naturalist, Dr. Short, of Union county, that "Jefferson Russell, an intelligent farmer, of Williamson county, had repeatedly, on damp cloudy mornings, watched a large, bluish green fly, about the size of a blow-fly, attacking the army-worm, and depositing its eggs on the shoulders of the victim, as he ascertained by a double lens. As they were attacked, the army-worms kept dropping to the ground and gathering in clusters, or hiding under clods, until finally the wheat on which they occurred was entirely free from them." Mr. Frick also, the Mayor of Jonesboro, to whom I am under obligations generally, for his kind assistance in furthering my objects, told me that he had himself noticed similar flies, similarly occupied. Thus it is proved that this, or some other species of the Tachinas, infested the army-worm this year in Williamson, Union and McLean counties, and, as our species has also attacked the army-worm in Ohio,* probably throughout the State. It is the same thing in Maryland, for my friend, Dr. John G. Morris, of Baltimore, the distinguished American Lepidopterist, writes me word that "he has on several occasions employed all his logic and knowledge, (but in vain,) in trying to convince some farmers in the lower counties that the *big black fly* which came forth from the [army] worm was not the real mother insect." It seems that the fools are not all dead yet, even in Maryland; and in our western backwoods we have still many men who believe that the grasshoppers are the mothers of the army-worms.

The species depicted in Fig. IV, in magnified dimensions—the

*I am indebted for this fact to my friend Baron Osten Sacken, the learned Russian Dipterologist.

line showing its real length—is colored black and gray, with a satiny lustre upon the hinder part of the body, and the last abdominal joint of a dull brick red, whence I have given it the English name of "red tailed." Fig. V shows the way in which the dark mahogany colored pupa-skin splits open to admit the exit of the perfect fly. Tachina-flies may often be noticed flying low among herbage, with a loud buzzing noise, like that of a bee, seeking caterpillars to fasten their eggs on. There are two very common species which are nearly twice the length of the red-tailed Tachina, and no species known to me is much smaller than the house-fly.

PARASITIC ICHNEUMON-FLIES AND THEIR PARASITES. FIGURES VI TO XI.

This article has already been extended to so unreasonable a length, that it must suffice to say that the remaining illustrations all represent four-winged flies of the great *Ichneumon* family, or of the almost equally extensive *Chalcis* family, which agrees generally in its habits with the Ichneumons, but differs in having wings almost destitute of nervures and in spinning no cocoons. Hence, when a chalcis is bred from a cocoon of white silk, such as the ichneumon-flies generally spin, we know that it is parasitic on the ichneumon; just as we should know, if we found a snake in a bird's nest, that the snake did not build the nest, but was a mere intruder there.

It is the general habit of larvæ infested with ichneumon-flies to attach their claws firmly in death to the substance on which they stand. It is also the general habit of the ichneumons to spin their cocoons on or close to the carcass of their victim. Hence if an ichneumonized army-worm happens to perish on a stalk of wheat or grass far above the surface of the ground, the parasites, for the better security of their cocoons, attach them together in symmetrical form—as shown in Fig. VII—around or upon the grass stem. The very same species, if their victim happen to die on the ground, will either build their cocoons on his shrunk and shrivelled body, or spin them separately amongst the surrounding rubbish, attaching them by the same flossy kind of silk as that with which the common silk-worm surrounds its cocoon. When a symmetrical mass of cocoons is built, this superabundant flossy material, as shown in Fig. VII, forms a milk-white cottony envelope, entirely covering the cocoons. In the figure this is stripped off in front, to show the arrangement.

Unlike the *Tachina* family, the Ichneumon-flies vary greatly in size, according to the species, some being nearly five inches long, including the piercer of the female, and some so small as to be barely visible to the nakod eye. I have bred as many as ninety-nine individuals of a species of chalcis from a single lepidopterous pupa, but little larger than that of the army-worm. The larger species of Ichneumons deposit a single egg in a single larva, or, if they deposit more, the stronger outgrow and overpower the weaker.

Fig. VI represents an undescribed ichneumon-fly—the left figure being the female and the right the male—remarkable for both sexes

being entirely wingless. They have somewhat the appearance of ants, but may be readily distinguished by their antennæ not being elbowed in the middle. They occurred at Centralia, and as Mr. Emery thinks, from whom I obtained the cocoons, also in Champaign county. Fig. VII shows a mass of their cocoons, enveloped in floss, with one cocoon detached. I have bred precisely the same species at Rock Island, from cocoons not symmetrically built together, and with no floss surrounding them.

Fig. VIII is a chalcis, parasitic on the above, and therefore from the same localities. The species occurs sparingly at Rock Island.

Figures IX and X are two species of ichneumon-flies, from cocoons loose, or but slightly connected together, forwarded to me by S. Doyle. Schuyler county.

Fig. XI is one of the great *Chalcis* family, bred from two masses of ichneumon cocoons enveloped in floss, received from S. Doyle, of Schuyler county. The mother chalcis-fly had been so diligent in depositing her eggs in the numerous ichneumon larvæ living inside the army-worm, that not a single one arrived at maturity to tell me what species he belonged to.

Col. Dougherty, of Jonesboro, in Union county, informed me that from eight army-worms, which he attempted to rear, he raised only two moths, the remainder, from his description, having evidently been eaten up by ichneumon-flies, that afterwards spun their cocoons on the shriveled skins. I arrived in Southern Illinois so long after the army-worms had gone underground, that I was unable myself to find any ichneumon cocoons in the intected fields, although I searched diligently. But the above fact proves that they were there, although the species cannot be determined.

The object of the above very imperfect sketch of the insect foes of the army-worm will be attained, if I succeed in impressing upon the minds of intelligent agriculturists the real nature of the battle which their friends, the cannibal and parasitic insects, are perpetually waging in their behalf against their foes, the plant-feeders. There have now been introduced to the notice of the reader no less than four distinct parasitic insects, which prey on the army-worm in prodigious numbers; and doubtless a more thorough investigation would discover many other species. While the farmer is in bed and asleep, these tiny creatures are doing more for him than the united labors of a million of men could accomplish. It is on the same principle and through similar agencies that other noxious insects are kept within reasonable limits. There are very few plant-feeding insects that do not produce as many as a hundred eggs, and if a wise Providence did not take care that the great bulk of these should perish before arriving at maturity, the world in twelve months would be a desert.

BENJ. D. WALSH.

ROCK ISLAND, *July* 31, 1861.

APPENDIX.

The science of Entomology in this country is at present drowned in a flood of synonyms. Half a dozen different authors often describe the same insect under half a dozen different names, until the result to the neophyte is utter confusion and bewilderment. Much has been done towards obviating these difficulties by the publication of the Smithsonian Catalogues; but much still remains to be done. I should not now venture to name and describe the few species below referred to as new, if it had not happened that the smaller species of the very extensive group of insects to which they belong—although of the utmost importance in an economic point of view—are almost entirely neglected by writers on American Entomology. I have had recourse, so far as the very brief time at my disposal allowed me, to the assista ce of eastern correspondents, whose favors I have duly noticed in the proper place, and whom I take this opportunity to thank for their kind attentions. My own private Library, however, is very limited; and I can certify only that the species named by me are not to be found in Harris on Inj. Insects, in Dr. Fitch's five valuable Reports, or in any of the works of Thomas Say.

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ORDER LEPIDOPTERA.

FAMILY NOCTUADÆ.

LEUCANIA UNIPUNCTA, Haworth. THE ARMY-WORM MOTH. Fig. III, afterwards described as *L. extranea*, by Guenee. For the identification of our species with Guenee's, I am jointly indebted to Dr. John G. Morris, of Baltimore, author of the Smithsonian Catalogue of Lepidoptera, and to Dr Asa Fitch, the Entomologist of the N. Y. State Agricultural Society. It is to Dr. Fitch, however, that we western "bug-hunters" are exclusively obliged for disentangling the intricate synonyms of the species, and identifying the *L. unipuncta* of Haworth with the *L. extranea* of Guenee. According to the established scientific etiquette, Haworth's name and description, being prior in time, take precedence of Guenee's. The following details are from Dr. Fitch's able article in the "Country Gentleman" of July 25th, kindly forwarded to me by the author:

Long ago, a preserved specimen of this moth found its way into the then celebrated collection of Mr. Francillon in London. Upon the breaking up and sale of that collection, this specimen passed into the possession of Mr. Haworth, who, not doubting but that it had been captured in England, described it very briefly, in the year 1810, in his *Lepidoptera Brittannica*, page 174, naming it *Noctua unipuncta*, or the white speck, by which name it has ever since been referred to by English authors and collectors, save that a new generic name, *Leucania*, replaces that of *Noctua*. It appears to have been through inadvertency that Mr. Stephens changed this name to *impuncta*, when he came

to describe the species in 1829, in his British Entomology, Hausteilata, Vol. III, page 80. Later, in 1850, he refers to it under its original name, in the List of Lepidoptera in the British Museum, p. 289, it having now been ascertained that it was a North American and not a British insect. Guenee appears to have overlooked this species of the English authors. In his valuable work on the Lepidoptera, (Vol. V, p. 77—Paris, 1852,) he regards it as a new species, naming it *Leucania extranea.*

It is possible, however, after all, that Francillon's specimen may have been actually captured in England, for the insect has recently been met with there in two several instances, as I learn from the following extract from Stanton's Entomological Annual for 1859, which has been obligingly communicated to me by Dr. Morris. The article is accompanied by a figure:

"At the October meeting of the Entomological Society Mr. Bond exhibited a specimen of this insect, [L. extranea, G.,] from the Isle of Wight, and Dr. Allchin exhibited a specimen taken near Lewes on the 9th of September. The insect had not previously been recorded as European. * * * A specimen has occurred at Madeira this summer, and curiously enough was forwarded to this country to be named. This certainly confirms the idea that the unusual flight hitherwards of this *extraneous* noctua has not been confined to our own shores.

The author of the above evidently leans to the idea that the *winged insect* has been carried alive across the Atlantic by the prevailing westerly winds. It would seem more probable that the *eggs* have been transported in the transhipment of living botanical specimens, or in some analagous way.

For the benefit of those who, like myself, do not possess a copy of Guenee, I subjoin his generic and specific characters of our insect, which have been most obligingly furnished to me by my friend Dr. Morris. I translate from the original French, adding in brackets [ ] such further particulars as are applicable to our species:

Gen. Leucania, Ochs. Caterpillars cylindrical, smooth, pale, with fine longitudinal lines, and a sub-globular head, living on grasses and hiding by day either in tufts [of grass] or in the interior of cut stems, without eating the pith of them. [Feed by night and also in the forenoon.] Chrysalises ordinarily contained in cocoons underground. [Spin no cocoon.] Antennæ [of the imago] pretty short, pubescent, with two stronger ciliations upon each joint of the male, sometimes serrate with whorls of ciliations. Palpi pretty thick, connivent, with furry hairs and with the last joint very short. [The two first joints embracing the front; the third decidedly descending.] Thorax smooth, subquadrate. Abdomen smooth, pretty long, garnished with hairs at its base above, and sometimes on its sides, [and also at the tip in both sexes.] Legs more or less hairy. Tongue well developed. Front wings entire, with the tip more or less pointed, seldom having the "lines" and "spots" very distinct; the latter being almost always reduced to a cellular point (a un point cellulaire.) In repose the upper wings are roofed at a very steep angle.

L. extranea, Guenee. The front wings [on the upper side] are very pointed at the tips, of a gray more or less reddish, sometimes whitish, much specked with black atoms, [the basal half of the costal margin being lighter.] The two ordinary "spots" are distinguished in the cellule by a color brighter or less tinged with reddish. Under the "kidney-shaped" spot is a white point, indistinctly surrounded by blackish. There are no visible traces of "lines," but the series of black points which follows the cubitus,"* is often very distinct. An oblique black streak, [shaded off gradually towards the ter-

*In Guenee's peculiar nomenclature, as I learn from Dr. Morris, the *cubitus* (*Coudée* or *ligne coudée*) is one of several curved "lines" of color which are supposed to exist in the normal noctuade wing, so called from its being strongly elbowed. It must be carefully distinguished from what is generally known by authors as the *cubitus* or *sub-costal nervure.* In our insect the "series of black points" referred to may be seen more dis-

minal margin,] starts from this "line," and ascends to the apex [of the wing.] and with the form of the wings principally characterizes this species. [All the nervures—but especially what in the Neuroptera is called the *Median* by my friend Dr. Hagen, (Monogr. Libellul. vol. I, plate 1, and vol II, plate 22,)—are more or less white, and very distinctly so towards their tips. Just inside the fringe there is a series of eight black dots, one between every two nervures. The white spot before referred to is always on the trifurcation of the "median" nervure, and generally of an irregular rhomboidal form.] The hind wings are a little transparent, gray, with the terminal border and the nervures blackish, [the blackish border shading gradually into the gray. The fringe of both pair of wings is pale, with a narrow dusky band inside of its middle.] The sexes scarcely differ.

The under side of the wings, which Guenee does not notice, is of an opalescent yellowish-white, with the terminal margin widely freckled with numerous confluent dusky specks, so as to give the appearance of a broad dusky band with a definite outline. The costal margins are also lightly freckled with similar specks. The basal half of this band in the front wing is darker than the terminal half, except towards the costa, where there is a roundish dusky spot. The basal edge of the band in the hind wing has a small longitudinal dusky spot on the costal and on the bifurcations of the sub-costal nervure, on the principal or middle "sector" of the "arc," the two exterior sectors of which are often, one or both of them, obsolete, and also on the trifurcations of the median nervure—making in all seven spots. The nervures in both wings are of the same color as the portion of the wing which they traverse, except the "arc" or semicircular transverse nerve in the hind wing, connecting the sub-costal with the median, which is widely dusky. The fringe of both wings is yellowish-white, with a few dusky dots, especially towards the tips. Inside the fringe there is in the front wing a series of eight, and in the hind wing a series of six black dots, commencing from the tips, and placed one between every two nervures, including only the principal "sector," of the lower wing.

The thorax, head, palpi and antennæ are of the same color as the general upper surface of the front wings, the antennæ towards the base being lighter. The eyes are hairy and of a dull greenish color. The thorax has a narrow band of a lighter tint in front, much curved forwards in the middle, and separated from the darker tint behind it, by two very distinct narrow bands or lines—the anterior very light, the posterior very dark. The abdomen above is of the same gray color as the hind wings above. Beneath, the prothorax is dusky-gray; the thorax and abdomen of an ash-gray, the latter speckled with a few black atoms, and with a row of three black spots on each side of it, which are sometimes confluent. The wings expand from one and one-half to one and three-quarter inches. Length of body, when dried, three-quarter inch or less. The above description applies to seven individuals, from Union county, Centralia, Bloomington and Rock Island, which exhibit no

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tinctly in the right wing of the engraving, starting in either direction from the discoidal white spot. Guenee acknowledges the incompleteness of his specific descriptions, as Dr. Morris informed me, and lays the blame on his publishers, who restricted him to *seven* volumes, when he claimed *ten* or *eleven*.

material variation, except that in one specimen the median nervure is edged with dusky from the white spot to its base.

Guenee states it to be very commonly received in France from Brazil, Columbia and North America. In the Mississippi Valley it has apparently extended this year as far north as Wisconsin, and on the Atlantic slope Dr. Fitch and Dr. Morris have both received specimens from Maryland, which appears there to be its northern limit, as with many other southern insects which extend in the valley of the Mississippi to a high northern latitude. What Guenee considers a variety destitute of the white spot, but Dr. Fitch thinks a distinct species, occurs in the East Indies, Java and Australia.

LEUCANIA UNIPUNCTA, Haw. THE ARMY-WORM LARVA. FIG. I.

The head is yellowish-brown, of a diameter as great as that of the first segment, speckled with confluent fuscous dots. It is marked longitudinally by two dark lines that commence at the corners of the mouth, approach each other towards the center, and again recede behind. Over the mouth, between and on each side of these lines, is a short dark longitudinal line, and outside these again a dark dot. The mouth is dusky. The body is marked for its entire length, as follows: On the back a broad dusky stripe darker in the middle and fading towards the borders: then a narrow black line; then a narrow white line; then a yellowish stripe; then a narrow subobsolete white line; then a dusky stripe; then a narrow white line; then a yellowish stripe; then a narrow subobsolete white line. Beneath, all is of a pale obscure green. By holding the insect to the light, a very few scattering hairs become visible above. Legs six, slightly marked at their tip and base with fuscous. Prolegs ten, normal, marked on their exterior middle and on their tip with black, the anal ones less obviously so.

The above description was taken from an average *living* specimen, from Bloomington, as it appeared to the unassisted eye. Individuals occur considerably darker and lighter. The length does not exceed one and a quarter inches. The pupa, (Fig. II,) offers nothing remarkable.

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ORDER DIPTERA.

FAMILY MUSCADÆ. DIVISION TACHINARIÆ.

I am indebted for the generic determination of the following species to my friend and fellow-laborer, Dr. Wm. Le Baron, of Geneva, Ill., who has paid particular attention to this order. I name it specifically with the less hesitation, as Dr. Le Baron, to whom I had sent a specimen, says that "he does not know that any American species of the genus has been described." In the Smithsonian Catalogue of the Diptera of North America, by Baron Osten

Sacken, several other genera, recognized by authors as distinct, are included in the great typical genus *Tachina*.

SENOMETOPIA MILITARIS. Fig. IV. New species. Length, .25 to .40 inches, or from 6 to 10 millimetres, the females not exceeding .30 inch. Face silvery, with lateral black hairs only on the cheeks, at the top of which is a black bristle. Front, golden olive, with a black central stripe, and lateral black convergent hairs. Occiput, dusky. Labium, brown, with yellowish hair. Maxipalps, rufous. Eyes, cinnamon brown, covered with very short dense whitish hair. Antennæ, two basal joints, black, with black hairs; third joint, flattened, dusky, and from two and a half to three times the length of the second joint; seta, black. The entire hinder part of the head covered with dense whitish hair. Thorax glabrous, bluish gray, lighter at the sides, with four irregular black vittæ, and black hairs and bristles. Scutel, reddish brown, whitish behind, glabrous, with black hairs and bristles. Pectus, black, glabrous, with hairs and lateral bristles. Legs, black, hairy; thighs, dark cinerous beneath; pulvilli, cinerous. Wings, hyaline; nervures, brownish; alulæ, opaque greenish white. Abdomen, first joint black; second and third, opalescent in the middle with black and gray, and at the sides with rufous and gray; last joint, rufous, slightly opalescent at the base with gray; all with black hairs and lateral bristles. Beneath, the first joint is black, the others black, margined with rufous, all with black hairs. In the male the space between the eyes at the occiput is one-seventh of the transverse diameter of the head; in the female it is one-fourth. The colors of the abdomen sometimes "grease" and fade in the dried specimen.

Bred fifty-four specimens from about the same number of army-worms. Described from eight males and six females. Two species, similarly marked with rufous, but generally distinct, occur at Rock Island.

[After the above was in type, I received a letter from Baron Osten Sacken, to whom I had forwarded a specimen of our insect, with a request that he would let me know whether it was rightly referred to *Senometopia*, and whether it was a described species. He says:

This Tachina is, I believe, an *Exorista*, Meigen. *Senometopia*, Macquart, is almost synonymous with it, but this generic determination seems to have been abandoned by Macquart himself in his later works, as I do not find any mention of it in the seven volumes of his Dipteres Exotiques. Unfortunately, I possess only a fragment of Macquart's work on the Tachinadæ, and that fragment does not include these genera. The family requires a thorough revision, as no less than three classifications, independent of each other, have been introduced into it, (Meigen's, Macquart's and Robineau Desvoidy's.) * * * * I advise you to describe it, without troubling about ascertaining if it is really new or not. * * * * The same Tachina has been sent to me by Mr. Kirkpatrick, editor of an agricultural paper, in Cleveland, Ohio.

I have thought it best not to disturb Dr. Le Baron's generic determination, as Baron Osten Sacken allows *Exorista* (Meigen) and *Senometopia* (Macquart) to be nearly synonymous, and the respective claims of these two European authors are not yet finally adjusted.

Possibly the reason *Senometopia* is not recognized in Macquart's work on *Exotic* Diptera is that the genus has not hitherto been discovered in the New World. Similarly the *Glaphyrus* family (Coleoptera) and the *Rhaphidia* family (Neuroptera) were formerly supposed to be restricted to the Old World, but have now occurred in North America—the European *Rhaphidia media* being met with here, as I learn from Dr. Hagen. The characters of *Exorista*, as given by Westwood, are altogether inapplicable to our insect. But in the Diptera, this author is not always reliable, although he has done his best to reconcile and systematize the conflicting arrangements of the three authors named by Baron Osten Sacken.

It will be observed that I write Tachin*a*dæ for the Tachin*a* family, Musc*a*dæ for the Musc*a* family, on the analogy of Noctu*a*dæ, Arcti*a*dæ, as written by Dr. Morris. Otherwise there is li ble to be confusion with the Muscus family (mosses) in Botany, and the Tachin*us* subfamily in the Coleoptera. I am well aware that the termination *idæ* would be more classically correct; but when the whole scientific world is cold-blooded enough to stand calmly by, and allow modern Naturalists to murder King Otho's Greek in the most diabolical manner—omitting aspirates worse than any London cockney (*I*matidum, *A*ltica, *O*plocephala, *O*malium, *Y*ponomenta, *E*rpetogomphus, *O*maloplia, etc., etc., etc.,) and inventing barbarous Greek compounds, which neither Homer nor Aristotle nor Aristophanes could possibly have guessed the meaning of—it is not good to be particular about trifles.]

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ORDER HYMENOPTERA.

FAMILY ICHNEUMONES GENUINI.

I am not sure that I am right in referring the following species to *Mesochorus*, Gravenhorst. Westwood says, "abdomen pedunculed, *oblong*." Viewed from above it is as drawn in the figure; viewed in profile, it curves considerably, especially at base, and is quite narrow, except toward the tip, where it expands suddenly. The appendiculated abdomen of the male is, however, I believe, a character found in no other genus of genuine ichneumons.

Mesochorus vitreus. Fig. IX. New species, parasitic on *L. unipuncta*, Haw. Length of body .08 inch., (two millimetres,) to .13 inch, (three millimetres;) the small specimens being parasitic on the army-worm and the large ones captured in Rock Island county. Male, general color light rufous. Eyes and ocelli, black; antennæ fuscous, except toward the base. Upper surface of thorax in the larger specimen fuscous; intermediate and posterior tibiæ with spurs equal to one-fourth of their length; posterior knees slightly dusky; tips of posterior tibiæ distinctly dusky. Wings hyaline; nervures and stigma, dusky. Abdomen, a translucent yellowish white in its central one-third; the remaining two-thirds

piceous black, with a distinct narrow yellowish annulus at the base of the third joint. In the larger specimen, which seems to be immature, the basal abdominal joint, and the articulations of the terminal joints are light rufous. Appendiculum of the abdomen composed of two extremely fine setæ, thickened at their base, whose length slightly exceeds the extreme width of the abdomen.

The female differs from the male in the head from the mouth upwards being piceous. The thorax and pectus, in all three specimens, are also piceous black. Abdomen as in the smaller male. Ovipositor, which is dusky, slightly exceeds in length the width of the abdomen.

Bred from the army-worm one small male and two small females. Captured in Rock Island county one large male and one large female, The discrepancy in size is considerable, but I can find no distinguishing specific characters.

Pezomachus minimus. Figures VI and VII. New species. Length of the body .07 to 1 inch., (2 to 2½ millimetres.) Male, general color, piceous. Eyes black; antennæ, black, except toward the base, where they are light rufous. Legs, rufous; hind legs a little dusky. Abdomen narrowed; second and sometimes the third joint annulate with rufous at tip. The female differs from the male in the thorax being almost invariably rufous, and in the first three abdominal joints being generally entirely rufous, with a piceous annulus at the base of the third, which is sometimes absent. The abdomen is also fuller and wider. Ovipositor dusky, equal in length to the width of the abdomen. No vestige of wings in either sex, and the thorax contracted and divided as in *Formica*.

I have referred the above to *Pezomachus* (Gravenhorst,) although Westwood, in his synopsis, says of that genus, "wings rudimental, not fitted for flight." Dr. Fitch has obligingly informed me by letter that Brullé, in his great work on the Hymenoptera, which I do not at present possess, says that "the species of this group are recognized immediately, either by *the complete absence of wings*, or by their rudimentary state when they exist."

I possess a very similar species, of nearly double the length, which is so closely allied, that I hesitated to separate it as distinct, until after examining many specimens, I found no intermediate size, and ascertained also that its cocoons, which are constructed inside certain flattened cocoons of spiders' eggs, differ altogether from those of the smaller species, which are constructed in the open air. Of the larger species I bred in '60 and '61 from fifty to seventy individuals, and out of that number *four winged males*, true genuine ichneumons, with a normal thorax, an elevated scutel and a pentagonal areolet.

Westwood notices a similar occurrence of winged individuals in the apterous *Chalcidid* genus *Choreius*, and says that "he is not aware of any analogous case in the order." (Intr. II, page 155.)

Bred from army-worm cocoons, arranged in a symmetrical mass, eleven females. Bred from cocoons, found loose in Rock Island

county, four males and seven females, one pair of which was sent to M. De Saussure, in 1860, together with apterous specimens of the larger species above referred to.

FAMILY ICHNEUMONES ADSCITI. DIVISION AREOLARII.

I place the following in Latreille's genus Microgaster, although it does not exactly agree with his circumscription "Areola submarginali secunda minima." (Gen. Or. and Ins., IV, page 11.) Say has done the same with the allied *M. xylina* and five other species. Probably modern writers have cut up this extensive genus, of which I possess over thirty species, into several new ones.

Microgaster militaris. Fig. X. New species. Length of body, .07 inch, or two millimetres. Head, black; palpi, whitish; antennæ, fuscous above, light brown beneath toward the base. Thorax, black, polished, with very minute punctures. Wings hyaline; nervures and stigma, fuscous; lower nervure of marginal and exterior nervure of second submarginal cellule entirely obsolete. Lower nervure of third or terminal submarginal cellule hyaline. Legs, light rufous, posterior pair with knees and tips of tibiæ fuscous. Abdomen black, glabrous, highly polished. Ovipositor not exserted.

Bred from army-worm cocoons nine specimens. I have not met with the species as yet in Rock Island county.

FAMILY CHALCIDIDÆ. SUBFAMILY CHALCIDES.

Chalcis albifrons. Fig. VIII. New species. Length of body, .08 inch, or two millimetres. General color black. Head, (which is very incorrectly given in the engraving, probably through the fault of my pencil,) punctured; antennæ brown, lighter toward the tips. On the face a greenish-white triangle, the apex of which commences a little above the insertion of the antennæ, extends to the outer corners of the mouth, and incloses on its lower margin, immediately above the clypeus, a round black spot. Clypeus greenish-white, fuscous on its basal margin, and with a black spot at tip. Thorax densely punctured. Wings hyaline; subcostal nerve fuscous for three-fourths of the distance to the tip, as also its ramus. Costal nervure of the lower wing also fuscous for two-thirds of its length; all the other nervures hyaline. Posterior coxæ incrassated; spurs obsolete; knees, tibiæ and tarsi of anterior and intermediate legs, greenish-white. In the posterior legs, the trochanters, a spot on the thighs above, an annulus near the base of the tibiæ, the tips of the tibiæ, and also the tarsi, are greenish-white. Extreme tips of all the tarsi fuscous. Abdomen glabrous, polished, equal in length to its peduncle.

Obtained four specimens from the army-worm cocoons of *Pezomachus minimus*, mihi. I have not met with it in Rock Island county, although I possess, from that locality, seven species undescribed by Say, one of which is closely allied to *C. ovata*, Say.

FAMILY CHALCIDIDÆ. SUBFAMILY PTEROMALIDES.

It is with some hesitation that I refer the following species in this very extensive and difficult family, to *Glyphe*, Wilkinson. It is one of three remarkable congeneric species in my cabinet, which are all characterized by the last joints of the antennæ, when viewed from above, being elongate-acuminate, but when viewed in profile, being reduced to one-fourth the width of the penultimate joint, and attached on one side of it like a tarsal claw. In *Glyphe* the last joint is said simply to be "elongate acuminate." In other respects the characters agree tolerably well. In one of my three species, parasitic on *Microgaster xylina*, Say, the antennæ are notably moniliform. The other one of the three is the well known parasite of the Hessian-fly, which, at the commencement of Say's entomological career, he arranged by mistake under the Proctotrupid genus *Ceraphron*, (*C. destructor*, Say;) which Westwood, subsequently, misled by Say's figure, declared "must be evidently one of the *Eulophides*," the fifth subfamily of the Chalcididæ, (Westwood's Intr., II, page 160,) which Harris afterwards erroneously called a *Eurytoma*, the typical genus of the second subfamily of Chalcididæ, (Harris, Inj. Ins., page 432;) but which I have no doubt, from the structure of the prothorax, etc., ought to be arranged somewhere among the *Pteromalides*, the third subfamily of Chalcididæ. Whether or not we choose to refer it to *Glyphe* is another matter. Perhaps a new genus will have to be founded for the reception of these three species.*

GLYPHE VIRIDASCENS. Fig. XI. New species. Length of body, .07 inch, or not quite two millimetres. General color, dark green, verging on black. Head finely and densely punctured; palpi whitish; eyes black; antennæ light brown, the basal joint received in a shallow, wide, longitudinal depression. Thorax finely and densely punctured; legs yellowish-white; tips of tarsi, dusky; wings hyaline; subcostal nervure brown and prolonged on the costa to the extreme tip of wing; abdomen black, glabrous, polished, flat above, convex beneath, so as in those individuals with acuminate anus—which I take to be females, but which Wilkinson takes to be males—to appear almost triangular when viewed in profile.

Bred five specimens from a mass of the army-worm cocoons of some unknown ichneumon. I have not met with it in Rock Island county. Four of the five have the antennæ still covered with the transparent pupal membrane, which we often find on the antennæ of immature Cerambycids, but the structure of the apical joint of the antennæ is distinctly visible even in these.

B. D. W.

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* Since the above was in type, I have noticed that Dr. Fitch, as well as Dr. Harris, refers *Ceraphron destructor*, Say, to *Eurytoma*. Perhaps my insect, which I bred from pupæ of *Cecidomyia destructor*, found in Union county, is a distinct species, although it agrees with Say's description in the remarkable character of "the segments of the base of the abdomen being sometimes pale yellowish."

Postscript.—The following April after the Essay on "Insects Injurious to Vegetation" was written, I received specimens of *Hippodamia maculata* from La Moille, Ill., with a statement that they "were completely overrunning" Mr. Roth of that place. I subsequently ascertained that they were "observed by him on apple trees infested with bark-lice, and among wild rye." Now it has been already said that this insect depredates on the bark-louse of the willow. Hence, putting this and that together, I conclude that at La Moille they had been depredating on the bark-louse of the apple tree; and I further conjecture that it is in a great measure owing to the good offices of this pretty little lady-bird, that our apple trees in Illinois have for some years suffered comparatively little from bark-lice.

Some time after the article on the army-worm was in the hands of the printer, my friend, Mr. Cyrus Thomas, published in the Prairie Farmer the following "facts," which I will proceed to notice in the order in which they stand:

Fact 1. In one field, last harvest, the straw was scattered over a small portion of the field and burnt. The same field was again planted in wheat, and this season was overrun with the army-worm, except the burnt district, which they left untouched. This occurred on a neighboring farm, four miles north of here.

In this case the moth must have laid its eggs "on uncut wheat," which on page 173 I distinctly stated to be "not impossible." The field of course must have been plowed before it was again seeded to wheat; and yet the eggs were not destroyed by being buried, which is certainly not what I should have anticipated in land at all on the wet order. In the burnt district the eggs were killed by the fire; and, therefore, there were no army-worms there next year. If the wheat had been rotated by corn, as it ought to be, the caterpillars hatching out in April would have perished of hunger. On Mr. Thomas's hypothesis of the eggs of the May and June crop of army-worms being laid in the spring, I do not see how this "fact" can be possibly explained.

Fact 2. Another farmer, during the winter, carried out some manure on a field and left it in spots, not well spread. The field was planted in oats; the army-worm eat up the oats where the manure was placed and left the rest untouched.

It is difficult to explain the above very curious "fact" without knowing fuller particulars. Was the field wet or dry land? What crop preceded the oats? Was it small grain? Was there any meadow within half a mile from which the worms could have traveled? When was the field plowed? Was the manure that of stock fed on tame hay or on prairie hay? There are no prairies in the southern extremity of Illinois and consequently no prairie hay; and, therefore, it is barely possible that army-worm eggs deposited on uncut timothy may have been carted out in the dung and preserved until spring. It is possible also, that if wheat preceded the oats, the eggs were laid upon that crop and destroyed by the plow, except where the dung kept them warm and dry through the winter. Lastly, it is quite probable that if the army-

worms traveled from a meadow on to the oats, they would eat only the ranker and tenderer portion of the crop, as they do not like oats very well. I know of a similar case in Northern Illinois where chinch-bugs took only the "back-cast" in every "land" of a field of wheat, the grain having probably been sown thicker in that particular part—as often happens in a high wind—and consequently better suiting their fastidious palates.

FACT 3. A few months back, when the army-worm appeared in this county, after disappearing, they were again seen on some farms, late in the fall, in considerable numbers. In one place they were in such numbers that they cut out all the grass in a corn field and even attacked the hard leaves of the ripening corn.

It must have been some other species of grass-worm that was mistaken for the army-worm. The species before referred to as having been seen in great numbers in Georgia, by Mr. Glover, might be easily mistaken for it by incurious observers; and Mr. Glover speaks also of some grass-worms which occur in Maryland *in the fall of the year*, but which he had not succeeded, at the time of his writing, in breeding to the moth state.

FACT 4. At another place, this spring, after the moth had made its appearance in a meadow, a portion of the meadow was burnt over, by means of straw and dry grass. Soon afterwards the worms were hatched out in abundance over every part of the meadow, except the burnt district—there, none were to be seen.

I said before (p. 172) that these "moths" that are stated to have appeared in various places in the spring are not scientifically identified with the army-worm moth. Neither Mr. Thomas, nor myself, nor any other man upon the face of God's earth was aware that *Leucania unipuncta*, (Haworth,) was the army-worm moth until this current summer; and no one knows better than Mr. Thomas how unsafe it is to identify species of so difficult a family as the owlet-moths, without first capturing and examining them. I believe the identification, in this instance, rests solely upon the authority of an aged lady, who said that she knew that we were going to have army-worms this year, because the "millers" were so thick in the spring. But several other aged ladies said, they knew the same thing, because *grasshoppers* were so plenty in 1860; and, therefore, if all elderly females are good scientific authority, we are bound to believe that the grasshoppers are the mothers of the army-worms.

The non-appearance of the worms in the "burnt district" is just what might have been anticipated. But I learnt on good authority, in Southern Illinois, that timothy meadows there would burn as readily as prairie, without any help from "straw and dry grass." The case of Mr. Wellington Wood's meadow burning by accident certainly seems to prove this.

FACT 5. In this (Jackson) county the worm made its appearance in the wheat almost, if not quite as often, as in the meadows. In some instances they first appeared in the wheat and traveled from it to the adjoining meadow.

Army-worms are not generally noticed until they attain a considerable size. If a field of wheat adjoins a meadow, who is to tell

with certainty where they originated? B—, of Pesotum, says that at certain hours of the day their progress is retrograde. If they were observed at those hours, it would be supposed that they were traveling from the wheat to the meadow, when in reality it would be just the reverse. Nevertheless, I believe, from fact No. 1, that where small grain is followed by small grain, the worm sometimes may and does originate in small grain. But, as a general rule, they originate in meadows.

Mr. Thomas concludes by quoting a newspaper article about the army-worms appearing in New England--apparently at Newport, R. I. It must have been some other allied species. If our insect commonly occurred, in reality, in the eastern States, it is impossible that it could have escaped the scientific researches of Dr. Harris and Dr. Fitch, the former of whom paid special attention to the Lepidoptera of the United States. Yet Dr. Fitch, as he tells us himself, only knew it from specimens received from Maryland, Iowa and Illinois. As to the *eggs* of this Yankee army-worm being "inclosed in a substance strongly resembling cotton," the "Scientific Gardener" who makes the assertion probably mistook a mass of ichneumon cocoons (see fig. VII.) for a mass of eggs. Many persons in Illinois have made precisely the same mistake.

It is to be hoped that other persons in the army-worm district will follow Mr. Thomas's good example, and give to the public, with full details, such well authenticated facts on this subject as they become personally acquainted with. B. D. W.

[From the Illinois Prairie Farmer.]

Postscript No. 2.—After the article on the army-worm had been printed in the Transactions of the Illinois State Agricultural Society, several facts—one of the highest importance—came to my knowledge, which I take this opportunity to present to the notice of the Agricultural community.

First. I learn by a paper in the Boston Cultivator, of August 31, from the able pen of Dr. Fitch, that the veritable army-worm of Illinois has actually appeared this year in Massachusetts, contrary to what I had anticipated, on page 40 of my article. Dr. Fitch supposes it to be identical with the larva, which has long been known in that region by the name of the "black-worm," but which he had previously imagined to be a species of *Leucania*, distinct from *L. unipuncta*, the Illinois army-worm. He also thinks that it is identical with the worm which is recorded to have swarmed in various parts of the northern States in 1743, '70, '90, and 1817, destroying the grass and the corn.

I must confess that I consider it a great piece of presumption on the part of the New England States, and a gross infringement of our western privileges, to pretend to have true gennine army-worms. They will fancy after a while that they live in a warm

climate, and perhaps eventually be insolent enough to grow as many bushels of chinch-bugs to the acre as we do in Illinois.

Second. While I was attending the State Fair, I made the acquaintance of Mr. Rob. Dory, an intelligent fruit grower of St. Clair county, in the southern part of the State. Mr. Dory told me that he had for several years back been trying to persuade his neighbors to burn over their tame grass meadows every winter, not with any idea of destroying the eggs of the army-worm moth, but simply for the sake of facilitating the action of the scythe or mowing machine, the fire of course destroying the old "fuz," which, as every mower knows, clogs up and dulls the edge of the scythe. This year he burnt his own meadow over, and persuaded one or two farmers in his neighborhood to do the same; and just as I should have expected, THE BURNT MEADOWS HAD NO ARMY-WORMS ON THEM, WHILE UNBURNT MEADOWS ALL AROUND THEM WERE BADLY INFESTED. Mr. Dory could not recollect the precise month when the burning took place, but he thinks it was February. At all events, he says it was BEFORE THE FROST WENT OUT OF THE GROUND, and he very judiciously recommends that the operation should not be delayed till a later period, for fear of injuring the crop.

This fact appears to me to finally settle the question between Mr. Cyrus Thomas and myself, as to the army-worm moth, that lays the eggs for the May and June crop of army-worms, not coming out of the ground until the opening of the spring. If this were actually the case, as Mr. Thomas supposes, the burning over meadows WHILE THE FROST WAS IN THE GROUND, could in no possible way have prevented a moth, which did not appear till March or April, from depositing its eggs on them; whereas, if, as I firmly believe, the army-worm eggs are laid some time in June, July or August, on the stems of the tame grass close to the ground, and lie dormant there till next spring, burning the meadows in the dead of the year, would be certain to destroy them.

Third. I obtained from Mr. Emery, at the State Fair, a little gun-cap box brim full of the cocoons of ichneumons parasitic on the army-worm, and of flies which had hatched out from them in the box, and died there. The contents were collected, as I understood, in Champaign county. On a careful examination after I got home, I found there were in the box 118 specimens of *Microgaster militaris*, (see fig. X) 26 of *Glyphe viridascens*, (fig. XI,) and one of a beautiful new species of *Hockeria*, a genus closely allied to *Chalcis*, but differing in not having the abdomen mounted on a long footstalk, and in some other particulars. Of this genus I had not previously met with any representative in this country. Small as it was, I gleaned from this little box several most interesting scientific facts. 1st. *Glyphe viridascens* is parasitic on *Microgaster militaris*, whereas before, although I knew it to be a secondary parasite of the army-worm, I did not know what was the primary parasite upon which it depredated. 2d. We learn that *Microgaster militaris* depredated extensively on the army-

worm not only in Schuyler county, from which locality my former specimens were obtained, but also in Champaign. 3d. We become acquainted with a new secondary parasite of the army-worm, which I have named *Hockeria perpulcra.* 4th. Not merely a new species, but a new genus of *Chilcidides*, *Hockeria*, is added to the North American Fauna. For the benefit of those interested in such matters, a full description of this unique insect will be found in the foot note.* And *lastly*, we are enabled now to give the statistics of one of the secondary parasites of the army-worm. It was shown before, with regard to one of its primary parasites, that of about 56 army-worms indiscriminately captured, 54, or 96 per cent., perished by the *Tachina* fly. We now know that of 145 inchneumon-flies, promiscuously taken, that had depredated on the army-worm, 27, or *only* 18 per cent., perished by *Chalcis* flies.

Fourth. In the text (p. 176) it was shown that Tachina-flies had largely depredated on the army-worm in Williamson, Union and McLean counties. We may now add Jackson and Cook counties to the list. I obtained several specimens of the army-worm captured in Cook county, from Mr. C. T. Chase, at the State Fair, and I now find that one of them has several Tachina eggs, still firmly fastened to the three anterior segments. As to Jackson, Mr. Thomas says in a recent article that some of his parasitic pupæ obtained in that county, "were inclosed in a cocoon shaped case, divided into rings, and were about one-fourth of an inch long, and

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* HOCKERIA PERPULCRA—New species. Length, .09 inch, general color black. Head covered with dense largish punctures, which in certain lights show a golden silvery radiance; deeply emarginate behind, at an angle of 90 deg. so that its longitudinal is scarcely one-fifth of its transverse diameter. Antennæ, which are inserted immediately above the mouth, have their first joint equal to one-half the sum of their other joints, and received in a narrow, deep longitudinal depression. Eyes black. Thorax punctured like the head above and beneath, with the mesothoracic scutel large, much rounded above, and obtusely pointed behind. Prothorax transverse before and behind, with the anterior angles a little rounded, and the posterior ones acute, slightly prolonged backwards. Wings hyaline, subcostal nervure brownish, extending more than three-fourths of the way to the tip; ramus very short and widely colored; legs with the tips of the tibiæ and the tarsi obscure whitish; the posterior coxæ over one-half the length of the posterior femora, which last are incrassated so that the transverse diameter equals one-third the longitudinal; both coxæ and femora of the posterior legs have the appearance on them of a short dense whitish hair. Posterior tibiæ truncate at tip, with no vestige of spurs. Abdomen ovate, glabrous, first joint equal to three-fifths of its entire length, and highly polished; intermediate joints very narrow, with the appearance of short whitish hairs; the last joint, acutely pointed behind, and at its base, when viewed in profile, only one-half the diameter of penultimate joint, but set on in a line with it above.

Obtained a single specimen from an army-worm cocoon, probably of *Microgaster militaris*, mihi. It may be here stated that many specimens of *Glyphe viridascens*, mihi, taken in company with it, do not exceed .05 in length, and range from that up to .08 inch. I am now convinced that the peculiar formation of the last joint of the antennæ, noticed in this species and in the two others referred to on page 187, is not a generic character, as I formerly supposed, but a peculiarity of the immature individual. All my specimens of these three species, as we stated in the text, were bred; and, as has hitherto been my custom, they were all killed shortly after they came out of the pupa. In the twenty-six additional specimens of *Glyphe viridascens* which I now possess, all of which had perished of old age in their little pasteboard gaol, I can detect this peculiar antennal character only in a single individual, and even in that one it is but partially developed.

half as broad, very dark walnut color." These could not have been ichneumon cocoons, as my friend supposes, because these last being spun of silk, are never "divided into rings;" whereas, the cocoon of the Tachina-fly is nothing but the shrunken skin of the larva, and is therefore necessarily so divided. The description suits exactly the cocoon of our red-tailed Tachina-fly.*

There is one other matter connected with this subject, upon which it is proposed to subjoin a few remarks. I write now, not as a Naturalist, but as a farmer. And perhaps I am as well qualified as most men to give an opinion on the subject of burning grass, seeing that during the twelve years I carried on a farm in Henry county, I had annually two miles of worm fence to burn round, in order to protect it from the prairie fires.

It is well known that if prairie is burnt in the summer—and of course it will not burn then unless the old grass of the preceding season has been allowed to remain unburnt—it has a tendency to kill out, and run to weeds. On the same principle, if you burn a tame grass meadow after the frost is out of the ground, and consequently after the grass has more or less commenced to start, you injure it permanently. The reason is simple. In both cases the living shoots of grass are destroyed by the fire down to the very root, and a certain per centage of the grass plants being unable to survive such harsh usage, are permanently killed. It may be laid down, therefore, as a general rule, that meadows ought to be burnt while the frost is still in the ground. I am inclined to attribute a belief, which I find prevails in Madison county, that burning meadows injures them to the extent of one-third of the crop, to the neglect of this salutary precaution, which, as was before stated, practical men like Mr. Dory, of St. Clair county, have found it expedient to adopt.

Of course, if you have worm fences round your meadow, there is some trouble in keeping the fire out, especially in a timbered country like South Illinois. But on the open prairie, the snow generally forms drifts in the winter, along every worm fence, and these drifts remain long after the field is bare. By taking advantage, therefore, of the first dry time, after your meadow is bare, you

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* My friend Dr. Kirtland, of Cleveland, Ohio, has described this same Tachina-fly in the *Ohio Agricultural Reports*, under the name of *Exorista leucaniæ*. His specific name, having been published before mine, will consequently take precedence of mine; and the insect will be correctly designated for the future as *Exorista leucaniæ*, Kirtland. The genus *Senometopia* must be finally abandoned, as Baron Osten Sacken writes me word that Macquart himself, the author of that genus, says in his work on the Tachinariæ, under the head of *Exorista*, "this genus contains the species which I formerly placed in the genera *Senometopia* and *Lydella*. As their only difference was in the form of the abdomen, I reunite them again under the name of *Exorista*, Meigen, which has the priority," etc.

Baron Osten Sacken adds that Dr. Kirtland "describes besides a smaller Tachina—reared from the same caterpillars—as *Exorista Osten Sackenii*;" but says that "he does not think there is any difference between this species and the other besides the size." The Doctor is rather unfortunate in his complimentary specific names. His new butterfly, *Libythea Bachmani*, turns out, as I learn from Mr. Edwards, to be nothing but the old *Libythea motya* of Boisduval and Leconte.

may burn it with very little danger to your fence; and where some few fence corners have thawed bare, it is but a few hours work to shovel enough snow upon them to protect them.

As to the question whether it would answer equally well to burn over meadows late in the fall, instead of early in the spring, I believe that it can make no difference to the crop when the operation is performed, provided the frost is in the ground, and vegetation consequently dormant. So far as the army-worm is concerned, it certainly can make no difference whatever. B. D. W.

ROCK ISLAND, *September* 19, 1861.

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