THE

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OF

# SCIENCE AND ARTS.

CONDUCTED BY

PROFESSOR SILLIMAN

AND

BENJAMIN SILLIMAN, Jr.

VOL. XLII.—APRIL, 1842.

(TO BE CONTINUED QUARTERLY.)

NEW HAVEN:

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## ERRATA.

Page 162, l. 11, for *is* read *are*.
308, l. 7, for *outward* read *onward*.
" bottom line, for *parts* read *posts*.

Vol. 40, p. 352, l. 27, for *Saturday* read *Friday*.
Vol. 41, p. 155, l. 24, for *hundredths* read *thousandths*.

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VOL. XLII.—No. 1.—JANUARY, 1842.

FOR OCTOBER, NOVEMBER, AND DECEMBER, 1841.

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...LER & MELLE.

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PRINTED BY B. L. HAMLEN.

Published at New Haven, January 1, 1842.

## TO CORRESPONDENTS.

Papers will be published in our next, from Prof. C. Dewey, Prof. T. Strong, John Locke, W. J. Lewis, Dr. Smith, J. H. Blake, Esq., and the conclusion of abstract of the Proceedings of the British Association.

Communications have been received from Mr. Josiah D. Bangs, J. P. Hall, Wm. M. Carpenter, S. S. Olcot, M. D., E. P. Huntington, Dr. Feuchtwange[r], Alexander Jones, M. D.

The titles of communications and of their authors, must be fully given.

Authors should always specify at the head of their MSS. the number of copies of their communications which they may wish to have printed.

Return proofs, not to be sealed, or inscribed with any thing except correctio[ns].

Notice always to be given when communications sent to this Journal, have or are to be, published also in other Journals.

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## NOTICES.

The public are cautioned not to make payment for subscriptions to thi[s] except to such persons as are authorized to receive it. This work is sent . See the Prospectus on the third page of this cover.

Messrs. C. W. and J. E. James are now collecting for this Journal, and authorized to receive all dues from our subscribers.

JANUARY, 1842.

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OF THE

AMERICAN JOURNAL OF SCIENCE.

## Geological Map of Nova Scotia.

Messrs. LITTLE & BROWN have recently published a new Map of the Peninsula of Nova Scotia, intended as a Topographical Guide for travellers, and to illustrate its geological structure, constructed according to the observations and discoveries of Messrs. Jackson and Alger, and conforming topographically to the most recent surveys. The map is done up in pocket form, and is accompanied with directions as to the routes, &c. Price 62½ cts.

## AUTOBIOGRAPHY,

*Reminiscences, and Letters, of John Trumbull, from* 1756 *to* 1841.

New York and London: Wiley & Putnam. New Haven: B. L. Hamlen, 1841.

This volume of 450 pages, on a beautiful paper with a large type, is illustrated by a frontispiece portrait of the author, drawn by his own hands, and by more than twenty other prints of scenery, costume, portraits, military plans, &c.

This work is for sale by Wiley & Putnam, New York, and by B. L. Hamlen, New Haven, and by their agents.—Price $3, in cloth covers.

## ASSOCIATION OF AMERICAN GEOLOGISTS.

Prof. Edward Hitchcock's Address before this Association at their second meeting in Philadelphia, in April last, has been published by the subscriber in an 8vo. pamphlet of fifty pages, on fine paper, in accordance with the resolution of the meeting.

Members of the Association and others who wish this address, can have it forwarded to them by mail, or as they may direct, by informing the subscriber of the number of copies they want.

The subscriber has also published in 8vo. on fine paper, pp. 82, a small edition of the Address, *with the proceedings* of the Association at their two meetings, (viz. in Philadelphia, April, 1840, and April, 1841,) as they are published by the Secretaries in the American Journal of Science, with a list of the members of the Association: these two under one cover.

Prof. Hitchcock's address will be sold to members at one dollar for six copies; to non-members at one dollar for four copies, or 25 cents each. It is expected that the money will accompany the orders. The Address and Proceedings, under one cover, will be sold at one dollar for three copies, or singly, at fifty cents each.

Either of the above may be ordered through any of the booksellers who act as agents for the American Journal of Science.

B. Silliman, Jr., *One of the Assistant Secretaries.*

authentic sources. Richard C. Taylor, Esq., a gentleman well known for his talents and accuracy in research, has promised his valuable assistance.

It is also intended to give abstracts of the most important recent patents relating to Iron, accompanied with critical remarks—the whole forming the most complete work on the subject that has yet been published in any country—and the only one of the kind in the English language.

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## *American Journal of Science and Arts.*

The following numbers of this Journal are wanted by the Editors, who will pay for them $1 each, or give in exchange current numbers as they appear.

| Vol. | XI. | XIII. | XIV. | XV. | XVI. |
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B. & B. Silliman.

New Haven, June 23, 1840.

## *Association of American Geologists.*

This body holds its Third Annual Meeting at Boston, commencing on Monday, the 25th of April, 1842.

Officers for the meeting in Boston:

SAMUEL GEORGE MORTON, M. D., &c., *Chairman.*
CHARLES T. JACKSON, F. G. S., (France,) M D. &c., *Secretary.*
Prof. EDWARD HITCHCOCK, LL. D.,
Dr. CHARLES T. JACKSON,
Mr. MOSES B. WILLIAMS, } *Local Committee.*
Prof. B. SILLIMAN, LL. D., &c. to deliver the opening address.

## *Notice to Agents of the American Journal of Science.*

HEREAFTER one dollar per number is all that will be allowed on account, for numbers of this Journal returned in good order from agents, except by special agreement.

*Entire sets of the American Journal of Science and Arts,* from its commencement to the present time, can be had of the subscribers in numbers or bound. B. & B. SILLIMAN.

New Haven, June 23, 1841.

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## ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

*Remarks.*—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books, pamphlets, &c., which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from us, that we may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still our endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, in part, retrospective.—*Eds.*

### SCIENCE.—FOREIGN.

On the composition of Chalk Rocks and Chalk Marl by invisible organic bodies, from the observations of Prof. Ehrenberg; with an appendix touching the researches of MM. Alcide and D'Orbigny; by Thos. Weaver, Esq., F. R. S., F. G. S., M. R. I. A. &c. From the L. & E. & D. Phil. Mag. for May and June, 1841. London. Pamphlet, pp. 48. From the Author.

Report of the Tenth Meeting of the British Association for the Advancement of Science, held at Glasgow, in August, 1840. 8vo. pp. 250. Published by John Murray, London. From the Association.

Transactions of the Royal Society of Edinburgh. Vol. 14, part second; pp. 359–754. From the Society.

Description of a series of Geological Models; by T. Sopwith, F. G. S. Newcastle-upon-Tyne, 1841. 12mo. pp. 84. From Dr. Buckland.

Catalogue of Fossil Fish in the Collections of the Cure of Enniskillen and Sir Philip Grey Egerton, Bart. From Mr. Lyell.

On the General and Local Causes of Magnetic Variation; by P. Cunningham, Surgeon, R. N. London, 1841. From the Author.

Proceedings of the Royal Society of Edinburgh, Nos. 17, 18. 1840, 1841. From the Society, forwarded by the politeness of Mr. J. Vaughan, Phil.

Remarks on some Fossil and Recent Shells collected by Capt. Bayfield in Canada; by Charles Lyell, Esq., V. P. G. S., F. R. S. 1839, 4to. pp. 6. From the Author.

On the Cretaceous and Tertiary Strata of the Danish Islands of Iceland and Moen; by Charles Lyell, Esq. 4to. pp. 13. From the Author.

Account of the Fall of a Meteoric Stone in the Cold Bokkeveld, Cape of Good Hope; by Thos. Maclear, Esq., F. R. S. London, 1839. 4to. pp. 4.

Further particulars of the Cold Bokkeveld Meteorite; by Thos. Maclear, Esq., F. R. S. London, 1840. 4to. pp. 6. From Isaac Chase, U. S. C.

Observations on the Loamy Deposit called "Loess," of the basin of the Rhine; by Charles Lyell, Esq. 1834. From the Author.

On the Shells of the genus Conus, in the Lias of Normandy; by Charles Lyell, Esq. From the Author.

Transactions of the Royal Society of Edinburgh. Vol. 15, part second, 1841. Edinburgh. From the Society.

Note sur la temperature de l'Eau de Puits, par H. White, Sec. de la Soc. Meteorologique de Londres. From the Author.

On the Theories of the Weather Prophets; by W. H. White, M. B. S. London, 1841. From the Author.

Coup d'œil sur l'etat actuel de nos connaissances en Electricité, par M. A. de la Rive, Prof. de Physique a l'Academie de Genève.

On the Heat of Vapors, and Astronomical Refractions—On the Theory of the Moon, and Perturbations of the Planets—Note on the Calculation of the Distance of a Comet from the Earth—And on Currency. All presented by the Author, Sir J. W. Lubbock, Treas. R. S., F. R. A. S., F. L. S.

The Archæologist and Journal of Antiquarian Knowledge, No. 1, Sept. 1841. From J. F. Hallinswall.

Annuaire Magnetique et Meteorologique du corps des Ingenieurs des Mines de Russe, publies par ordre de S. M. l'Empereur Nicolas, et sous les auspices de M. le Comte Cancrine, chef du corps des Ingenieurs, et Ministre des Finances, par A. T. Kupffer. 1839. From M. le Comte Cancrine.

Die Infusionsthierchen als Vollkommene Organismen ein blick in das tiefere Organische leben der natur. Von D. Christian Gottfried Ehrenberg. Zu Berlin nebst einem atlas von coloroiten kupfertalen gezeichnet vom verfassen Leipzig. Verlag von Leopold, Voss. 1838. Purchased for Yale College Library.

Encyclopedia Britannica, Vol. I, containing Dissertations. From John Dunlop, Esq.

Lectures on the Application of Chemistry to Agriculture and Geology; six Nos. By Prof. J. F. W. Johnston, Durham, England. From the same.

Geology of Fife and the Lothians; by Charles Maclearen, Esq. From the same.

SCIENCE.—DOMESTIC.

Geology of Georgia; by J. R. Cotting. A specimen from the Author.

Transactions of the American Philosophical Society, held at Philadelphia, for promoting useful knowledge, Vol. 6, new series, Part 1st, 4to. pp. 300. Vol. 7, Part 2d, 4to. pp. 160. Vol. 7, Part 3d, 4to. pp. 356. From the Society.

Fifth Geological Report to the twenty third General Assembly of Tennessee, made Nov. 1838, by G. Troost, M. D. Nashville. Pamphlet, pp. 75. From the Author.

A Monograph of the Limniades of North America; by S. Stehman Haldeman. No. 3, July, 1841. Phil. J. Dobson. $1 to subscribers, single Nos. $1 25.

Boston Journal of Natural History, Vol. 3d, No. 4.

Description of an entire head, and various other bones of the Mastodon; by Wm. E. Horner, M. D., and Isaac Hays, M. D. Read before the Am. Phil. Soc. Oct. 2, 1840. 2d series, Vol. 8. Quarto pamphlet, pp. 48. From the Authors.

A practical description of Herron's patent trellis railway structure; by James Herron. Phil. 1841. Quarto pamphlet, pp. 58. From the Author.

Observations to determine the magnetic intensity at several places in the United States, with some additional observations of the magnetic dip; by Prof. Loomis. Nov. 6, 1840. From the Author.

Observations made at the Hudson Observatory, Lat. 41° 14′ 40″ N. and Lon. 5h. 25m. 45s. W.; by Prof. Loomis. April, 1841.

Researches concerning the periodical meteors of August and November; by Sears C. Walker, A. P. S. Jan. 15, 1841. From the Author.

Account of some parhelia observed at Milford and Camden, Delaware, March 14, 1841; by A. D. Chaloner, M. D. From the Author.

Elementary Geology, by Prof. Hitchcock, with an introductory notice, by John Pye Smith, D. D., F. R. S. Amherst, Mass. 1841. Published by J. S. & C. Adams. 8vo. pp. 346. From the Author.

Final Report of the Geology of Massachusetts, in two volumes, quarto; by Prof. Hitchcock. Amherst, 1841. J. S. & C. Adams. From the Author.

Memoirs of the American Academy. An account of the magnetic observations made at the observatory of Harvard University, Cambridge; by Prof. Lovering and W. Cranch Bond. Communicated by Prof. Lovering. pp. 84, 4to. Boston, 1841. Presented by Prof. Lovering.

Transactions of the Albany Institute, Vol. II, Parts 2, 3, 4, 5. From the Institute.

Papers on Practical Engineering. Published by the Engineer Department, for the use of the Officers of the U. S. corps of Engineers. Part 1st, on Asphaltum. From Col. J. J. Abert, Top. Bureau. 2 copies.

Syllabus to Lectures on Chemistry; by Prof. C. U. Shepard, M. D. 1831. pp. 204. From the Author. 2 copies.

Lyell's Elements of Geology, (2d American from the 2d London edition.) 2 vols. 12mo. Hilliard, Gray & Co. Boston, 1841. From the Author.

Principles of Geology, or the modern changes of the earth and its inhabitants, considered as illustrative of Geology, (2d American from the 6th London edition;) by Charles Lyell, F. R. S. In 3 vols. 12mo. Hilliard, Gray & Co. Boston, 1842.

Notes on the use of Anthracite Coal in the Manufacture of Iron, &c.; by Prof. Walter R. Johnson. Boston, Little & Brown. 12mo. 1841. From the Author.

A Memoir of Wm. Maclure, Esq. late President of the Academy of Natural Sciences, Philadelphia; by S. G. Morton, M. D. one of the Vice Presidents of the Institution. Phil. 1841. From the Author.

## SPECIMENS.—DOMESTIC.

A mass of supposed native iron, (origin unknown,) Staten Island. From Dr. James R. Chilton, N. Y.

Mass of native Copper, from Milwaukie, Wis. Terr. From Mr. Pierce.

Sulphuret of Iron, Galena, Mo.

Six cells of porcelain, used in the construction of Grove's Battery. From Dr. R. Hare.

## SPECIMENS.—FOREIGN.

Fossils of the Oxford Clay, Wiltshire, England, and Minerals from the vicinity of Bristol. From Wm. Stutebury, Esq., Eng.

Chalk Fossils. From Dr. G. A. Mantell.

Minerals from Faroe, Sweden, and Norway. From Prof. George Forchhammer, Copenhagen.

A meteoric stone, weight 2 lbs., fallen in 1821 at the Sandwich Islands. From Rev. Mr. Bingham.

A recent Echinus, (species unknown,) West Indies. From Capt. Sheffield, of New Haven.

MISCELLANEOUS.—DOMESTIC.

Catalogue of John Vaughan's wines, for sale at Phila., Nov. 14, 1841.

Address before the American Institute; by General James Tallmadge, President of the Institute. New York, Oct. 28, 1841.

Address before the Society of the Alumni of Williams College, Williamstown, Mass., August 19, 1835; by Wm. H. Dillingham. From Mr. C. Chauncey.

Twenty First Annual Report of the American Board of Commissioners for Foreign Missions. Boston, Sept. 1840.

Twenty Fourth Annual Report of the American Colonization Society. Washington, 1841.

Annual Report of the Medical College of South Carolina; by Dr. Dickson. From Prof. C. U. Shepard.

Proceedings of the Mason Street Sabbath School, on the departure and return of the Superintendent. From Mr. S. H. Walley.

Catalogue of Wabash College, 1841. Indianapolis. From Rev. Edmund O. Hovey.

Catalogue of the Members of the Society of Brothers in Unity, Yale College, 1841. From the Society. Do. from W. E. Robinson.

Catalogue of Middlebury College. Middlebury, Vt. From Prof. C. B. Adams. 1841–42.

Catalogue of Amherst College. Amherst, Mass. From Prof. E. Hitchcock.

Catalogue of the Berkshire Medical Institution, 1841.

Address to the Alumni Society of the University of Nashville on the study of Theology, delivered at Nashville, Tenn., Oct. 5, 1841, by the Rev. Le Roy J. Halsey, A. M. From J. Hamilton.

Report of a Committee of the First Ecclesiastical Society of New Haven, on the subject of ventilating their meeting-house.

Circular of the Fourteenth Annual Fair of the American Institute of the city of New York, Oct. 11, 1841.

Official Register of the Officers and Cadets of the U. S. Military Academy, West Point. New York, June, 1841. From Major Delafield.

Minutes of the Western Literary Institute and College of Professional Teachers. Cincinnati, 1840. From M. G. Williams, Esq.

Report of the New Haven County Medical Society on the expediency of repealing that section of the medical laws of this state which excludes irregular practitioners from the benefits of laws in the collection of fees. 1837.

Hunt's Merchants' Magazine and Commercial Review. Nos. 23 and 25, for May and July, 1841; with an article on Weights and Measures. By and from D. J. Browne, Esq. C. E.

American Antiquarian Society's Fifty Third Semi-Annual Report, with a catalogue of officers and members. Worcester, 1842. For the Yale Natural History Society, and also for the Library of the Connecticut Academy. Bye-laws of the Am. Ant. Society. 1831. From Dr. Jacob Porter.

A portion of Catlin's Narrative of his residence among the Indians, from pp. 97 to 128. From Wiley & Putnam.

Second Annual Circular of the Rutger's Female Institute. Nov. 1840. From Charles E. West, A. M.

Message from the President of the United States to the two houses of Congress at the commencement of the first session of the 27th Congress. Washington, June, 1841. From Hon. J. Trumbull, M. C.

Letters on the College of Physicians and Surgeons; by Graviora Manent. New York, 1841.

A discourse on the study of natural science as a means of intellectual culture; by Prof. George D. Armstrong of Washington College, Va. Lynchburg, 1841. From the Author.

The Monthly Lecturer, published by Theodore Foster, New York. No. 2, Vol. 1. May, 1841.

An address on the agriculture of the United States, delivered before the American Institute in New York, April 14, 1841; by Henry Coleman, commissioner for the Agricultural Survey of Massachusetts. From the Author.

Proceedings of the President and Fellows of the Connecticut Medical Society, in convention, May, 1841, with a list of the Members of the Society. Hartford.

Third Annual Report of the Board of Commissioners of Common Schools in Connecticut, with the Third Annual Report of the Secretary of the Board. Hartford, May, 1841. From Henry Barnard, Esq.

American Magazine and Repository of Useful Literature. Published at Boston, New York, Philadelphia, and Albany. Vol. I, No. 1, 1841; also No. 2 and No. 5, Aug. 1841. From the Editors.

Examination of a review contained in the British and Foreign Medical Review of the Medical and Physiological Commentaries; by the author, Martyn Paine, M. D. New York, 1841. pp. 56, pamphlet. From the Author.

Rev. Mr. White's Sermon before the Charleston Union Presbytery, in Orangeburg, S. C. Charleston, 1841. From T. H. Legare.

Catalogue of the officers and students of the College of New Jersey, for 1840–41. Princeton. From Eli Whitney, A. B.

An Examination of Beauchamp Plantagenet's description of the Province of New Albion; by John Pennington. Philadelphia, 1840.

Scraps, Osteologic and Archæological, read before the council of the Historical Society of Pennsylvania; by John Pennington. Philadelphia, 1841.

Charter, Constitution, Bye-Laws, and Rules of Order of the Maryland Institute of Education. Baltimore, 1841.

Report of the Joint Standing Committee on Education respecting the expense of the Board of Commissioners of Common Schools, May Session, 1841. Read by order of the Senate; by Henry Barnard, Esq., Secretary of the Board.

Stone's Life and Times of Red Jacket or Sago-ye-wa-tha. 8vo. pp. 484. New York, 1841. From the Publishers, Wiley & Putnam.

Report of the Executive Committee of the American Temperance Union. New York, 1841. From J. March.

An Address on the study of Natural History, delivered before the Philomathean Society of Pennsylvania College; by Rev. J. G. Morris. From the Author.

Catalogue of the Middetown Preparatory School, and of the Middletown Female Seminary. July, 1841.

Announcement of the Annual course of Lectures in the Medical Department of the University of New York.

Announcement of the Annual course of Lectures in the Medical College of Louisiana. Eighth Session. New Orleans, 1841. From J. L. Riddell.

Fifth Annual Report of the Managers of the Bangor Lyceum. April 13, 1841. Bangor. From J. A. Poor.

Catalogue of the Brainerd Academy, Haddam, Ct., 1840–41.

Second Annual Report of the Foreign Evangelical Society, May 11, 1840.

Speech of Mr. Huntington, of Connecticut, on the Amendment to the Bill to incorporate the subscribers to the Fiscal Bank of the United States, delivered in the Senate, July 3d, 1841. From Wm. W. Boardman, M. C.

Speech of Mr. Marshall of Kentucky, on the Bill to Appropriate the Proceeds of the Sales of the Public Lands, and to grant Preemption Rights, delivered in the House of Representatives of the U. S., July 6, 1841. Washington. From J. Trumbull, M. C.

Address before the Philomathian Society of Mt. St. Mary's College, near Emmetsburg, Maryland, June 30, 1841; by Prof. Aikin. From the Author.

Annual Announcement of Lectures of Jefferson Medical College, Philadelphia, 1841–42.

Constitution of the National Institution for the Promotion of Science. May, 1840. Washington. 2 copies.

Valedictory Oration before the Brothers in Unity of Yale College; by Wm. E. Robinson. July 6, 1841. From the Author.

Catalogue of Bacon Academy, Colchester. Sept. 1841. From Myron N. Morris, Principal.

Speech of Mr. Trumbull of Connecticut, on the Bankrupt Bill, delivered in the House of Representatives, August 11th, 1841. Washington. From the Author.

Historical Collections of the State of New York; by J. W. Barber and Henry Howe. New York, 1841, 8vo. pp. 608. From the Compilers.

Catalogus Collegii Neo Cæsariensis, 1839. From Eli Whitney.

Congress Document, No. 122. Commerce and Navigation of the United States. From Hon. Wm. W. Boardman, M. C.

Catalogue of the Officers and Students of Dartmouth College. 1841–42. From Prof. Hubbard.

Rev. C. Van Rensselaer's Discourse on Old Age, with a tribute to the Memory of Joseph Nourse. From the Author.

Prof. Maffit's Address before the Literary Societies of the Wesleyan University, Middletown.

Introductory Lecture on the opening of his course on Materia Medica, in the Pennsylvania College of Medicine; by Dr. Bird. From E. B. Gardette, Esq.

MISCELLANEOUS—FOREIGN.

A Catalogue of old books in all Languages, consisting chiefly of Foreign Theology; for sale by D. Nutt, London, 1841.

Letter to the Hon. Henry Clay, President of the American Colonization Society, and Sir Thomas Fowle, Chairman of the General Committee of the African Civilization Society, on the Colonization and Civilization of Africa; by R. R. Gurley. London, 1841. From the Author.

Notice of a series of Encyclopedias and Dictionaries, each complete in one volume. Printed for Longman, Orme & Co. London, May, 1839.

Catalogue of works in all branches of Education, for sale by Longman, Orme & Co. London, May, 1839.

A Manual of Photography, by N. Whittock, London.

Catalogue of Books for sale by Longman, Orme & Co. London, 1841.

An Analytical Catalogue of Dr. Lardner's Cabinet Cyclopedia. London.

Catalogue des Livres de Commerce, et Autres qui se trouvent chez Renard, Libraire. Rue Sainte, No. 71. Paris, 1841.

Livres d'Histoire Naturelle. Paris, 1840. J. B. Balliere.

Libraire Medicale de Bechnel Jne et Labi. Paris, 1840.

Catalogue des Livres qui se trouvent chez J. B. Balliere. Paris, 1839.

Catalogue des Livres des Librairies d'Anselin et de Gautier-Lagnione. Paris, 1839.

Bulletin Bibliographique de la Librarie, de L. Hachette. Paris. No. 5.

Principales Publications de Firmin Didot, Freris Imprimeurs Libraires de l'Institut de France. Paris, 1840.

Libraire d'Ab. Cherbulier et Cie à Paris, et à Geneve.

Catalogue des Libraire de Parent-Desbarres. Paris, 1839.

Catalogue des Principaux Livres en depot et en Commission cher L. Lachette. Paris, 1838.

Catalogue des Livres qui se trouvant cher Mathias Augustin. Paris, 1839.

Catalogue et Prix des Instrument qui se trouvent chez Rochette. Paris, 1er Mai, 1839.

Librarie Medicale et Scientifique de Crochard et Cie. Paris.

Prospectus des Publications des W. Coonebirt. Paris.

Christian Spectator. London, June 16th, 1841.

Bookseller's Catalogue. From Wiley & Putnam.

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THE

# AMERICAN

# JOURNAL OF SCIENCE, &c.

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## Art. I.—*Notes of a Botanical Excursion to the Mountains of North Carolina, &c.; with some remarks on the Botany of the higher Alleghany Mountains, (in a letter to* Sir Wm. J. Hooker); by Asa Gray, M. D.

The peculiar interest you have long taken in North American botany, and your most important labors in its elucidation, indicate the propriety of addressing to yourself the following remarks, relating, for the most part, to the hasty collections made by Mr. John Carey, Mr. Jas. Constable and myself, in a recent excursion to the higher mountains of North Carolina. Before entering upon our own itinerary, it may be well to notice very briefly the travels of those who have preceded us in these comparatively unfrequented regions. The history of the botany of the Alleghany Mountains, would be at once interesting, and on many accounts useful to the cultivators of our science in this country; but with my present inadequate means, I can only offer a slight contribution towards that object.

So far as I can ascertain, the younger (William) Bartram, was the first botanist who visited the southern portion of the Alleghany Mountains. Under the auspices of Dr. Fothergill, to whom his collections were principally sent, and with whom his then surviving father had previously corresponded, Mr. Bartram left Philadelphia in 1773, and after travelling in Florida and the lower part of Georgia for three years, he made a transient visit to the

Cherokee country, in the spring of 1776. In this journey, he ascended the Seneca or Keowee River, one of the principal sources of the Savannah, and crossing the mountains which divide its waters from those of the Tennessee, he continued his travels along the course of the latter to the borders of the present State of Tennessee. Finding that his researches could not safely be extended in that direction, after exploring some of the higher mountains in the neighborhood, he retraced his steps to the Savannah River, proceeding thence through Georgia and Alabama to Mobile. His well-known and very interesting volume of Travels,* contains numerous observations upon the botany of these regions, with occasional popular descriptions, and in a few cases Latin characters of some remarkable plants; as, for example, the *Rhododendon punctatum* (which he calls R. ferrugineum), *Stuartia pentagyna* (under the name of S. montana), *Azalea calendulacea* (which he terms A. flammea), *Trautvetteria*, which he took for a new species of Hydrastris, *Magnolia auriculata*, &c. He also notices the remarkable intermixture of the vegetation of the north and south, which occurs in this portion of the mountains; where *Halesia*, *Styrax*, *Stuartia*, and *Gelsemium*,† (although the latter "is killed by a very slight frost in the open air in Pennsylvania,") are seen flourishing by the side of the birches, maples, and firs of Canada.

I should next mention the name of André Michaux, who, at an early period, amidst difficulties and privations of which few can now form an adequate conception, explored our country from Hudson's Bay to Florida, and westward to the Mississippi, more extensively than any subsequent botanist. A few of his plants have not yet been rediscovered, and a considerable number remain among the rarest and least known species of the United States; it may therefore be useful to give a somewhat particular account of his peregrinations, especially through the mountain region which he so diligently explored, and in which he

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* *Travels through North and South Carolina, Georgia, East and West Florida, the Cherokee country, &c.*; by William Bartram. Philadelphia, 1791.

† Dr. Torrey has directed my attention to an unaccountable mistake into which the learned Endlicher must have fallen, in describing the fruit of *Gelsemium*, particularly in the supplement to his *Genera Plantarum* (p. 1396), where it is established as a new tribe of *Apocynaceæ*, and a fruit of two follicles, as well as comose seeds, attributed to it! So far as they extend, the characters given by Jussieu and Richard are correct.

made such important discoveries. For this purpose, I am fortunately supplied with sufficient materials, having had the opportunity of consulting the original journals of Michaux, presented by his son to the American Philosophical Society. I am indebted for this privilege, to the kindness of John Vaughan, Esq., the Secretary of the society, who directed my attention to these manuscripts, and permitted me to extract freely whatever I deemed useful or interesting. The first fasciculus of the diary is wanting; but we learn from a chance record, as well as from published sources,* that he embarked at L'Orient on the 29th of September, 1785, and arrived at New York on the 13th of November. The private journal from which the following information is derived, commences in April, 1787; prior to which date he had established two gardens, or nurseries, to receive his collections of living plants, until they could be conveniently transported to France—one in New Jersey, near the city of New York; the other about ten miles from Charleston, South Carolina. Into the latter, it appears, he introduced some exotic trees, which he thought suitable to the climate; and the younger Michaux, who visited this garden several years afterwards, mentions two *Ginkgos* (*Salisburia adiantifolia*), which in seven years had attained an elevation of thirty feet; also some fine specimens of *Sterculia platanifolia*, and a large number of young plants of *Mimosa Julibrissin*, propagated from a tree which his father had brought from Europe. From this stock, probably, the latter has been disseminated throughout the Southern States, and is beginning to be naturalized in many places.

I have no means of ascertaining what portions of the country Michaux had visited previously to April, 1787, when he set out from Charleston on his first journey to the Alleghany Mountains, by way of Savannah, ascending the river of that name to its sources in the Cherokee country, and following very nearly the route taken by Bartram eleven years before.† He reached the

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* Vide *Michaux, Flora Boreali-Americana;* Introd. See also *A Sketch of the progress of Botany in Western America, by* Dr. Short, in the *Transylvania Journal of Medicine, No.* 35; and in *Hooker's Journal of Botany*, for November, 1840. I am informed that an interesting notice of Michaux is contained in the 8th volume of the *Dictionnaire Encyclopedique de Botanique*, (under the head of *Voyageurs;*) a work which unfortunately I am not able at this moment to consult.

† In this journey he was accompanied by his son, who shortly afterwards returned to Europe. Before they reached Augusta, their horses were stolen, a mis-

sources of the Keowee River on the 14th of June, and was conducted by the Indians across the mountains to the head of the Tugaloo, (the other principal branch of the Savannah,) and thence to the waters of the Tennessee. After suffering much inconvenience from unfavorable weather and the want of food, he returned to the Indian village of Seneca by way of Cane Creek, descended along the Savannah to Augusta, and arrived at Charleston on the first of July. His notes, in this as well as subsequent journeys to the mountains, often contain remarks upon the more interesting plants he discovered; and in some cases their localities are so carefully specified, that they might still be sought with confidence. On the 16th of July he embarked for Philadelphia, which he reached on the 27th; and, after visiting Mr. Bartram, travelled to New York, arriving at the garden he had established in New Jersey about the first of August. Returning by water to Charleston the same month, he remained in that vicinity until February, 1788, when he embarked for St. Augustine, and was busily occupied, during this spring, in exploring East Florida. His journal mentions several sub-tropical plants, now well known to be indigenous to Florida, but which are not noticed in his Flora; such as the *Mangrove*, *Guilandina Bonduc*, *Sophora occidentalis*, two or three Ferns, and especially the *orange*.* Leaving Florida at the beginning of June, he returned by land to Savannah and Charleston, where he was confined by sickness the remainder of the summer. Late in the autumn, however, he made a second excursion to the sources of the Savannah, chiefly to obtain the roots and seeds of the remarkable plants he had previously discovered. He pursued the same route as before, except that he ascended the Tugaloo, instead of the Seneca or Keowee River, crossing over to the latter; and, climbing the higher mountains about its sources in the inclement month of December, when they were mostly covered with snow, he at length found some trees of *Magnolia cordata*, to obtain which was the principal object of this arduous journey.

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fortune which, it appears from Michaux's remarks, was of no uncommon occurrence in those days; and they were obliged to pursue their journey to that place on foot. On the way, he discovered 'a shrubby Rumex,' which he terms *Lapathum occidentale*; doubtless the *Polygonella parvifolia* of his Flora, and also the *Polygonum polygamum* of Ventenat.

* "Les bois etoient remplis d'oranges aigres," etc. *Michaux, Mss.*—See also *Bartram's Travels*; and *Torr. & Gray, Flor. of North America*, I, p. 222.

Retracing his steps, he reached Charleston at the end of December, with a large collection of living trees, roots, and seeds. The remainder of the winter Michaux passed in the Bahama Islands, returning to Charleston in the month of May. Early in June he set out upon a journey to a different portion of the mountains of North Carolina, by way of Camden, Charlotte, (the county seat of Mecklenburg,) and Morganton, reaching the higher mountains at "*Turkey Cove*, thirty miles from Burke Court House," (probably the head of Turkey Creek, a tributary of the Catawba,) on the 15th of June. From this place he made an excursion to the *Black Mountain*, in what is now Yancey County, and afterwards to the *Yellow Mountain*, which Michaux at that time considered to be the highest mountain in the United States. If the *Roan* be included in the latter appellation, as I believe it often has been, this opinion is not far from the truth; since the *Black Mountain* alone exceeds it, according to Prof. Mitchell's recent measurements. Descending this elevated range on the Tennessee side, and travelling for the most part through an unbroken wilderness, near the end of June he reached the *Block House* on the Holston, famous in the annals of border warfare. Several persons had been killed by the Indians during the preceding week, and general alarm prevailing, Michaux abandoned his intention of penetrating into Kentucky, and resolved to botanize for a time in the mountains of Virginia. He accordingly entered that State, and arrived on the first of July at "Washington Court House, premiere ville dans la Virginie que l'on trouve sur la cote occidentales des montagnes, en sortant de la Carolinie Septentrionale." To this he adds the following note: "*Premiere ville*, si l'on peut nommer ville une Bourgade composée de douze maisons, (*log-houses.*) Dans cette ville on ne mange que des pain de Mays. Il n'y a viande fraiche, ni cidre, mais seulement du mauvais *Rum.*" Abingdon, the county seat of Washington County, is now a flourishing town; but Michaux's remarks are still applicable to more than one *premiere ville* in this region. From this place he continued his course along the valley of Virginia throughout its whole extent, crossing New River, the Roanoke, and passing by Natural Bridge, Lexington, Staunton, and Winchester; thence by way of Frederick in Maryland, and Lancaster, Pennsylvania, he arrived at Philadelphia on the 21st of July, and at New York on the 30th. In August and September he returned to Charleston by way of Baltimore, Alexandria, Richmond, and Wilmington, North Carolina. In November, he revisited the mountains explored early in the preceding summer, passing through Charlotte, Lincolnton, and Morganton, to his former head-quarters at *Turkey Cove;* from whence he visited the north branch of Catawba, [North Cove, between Linville Mountain and the Blue Ridge ?] the Black Mountain, Toe River, &c.; and returned to Charleston in December, with two thousand five hundred young trees, shrubs, and other plants. From January until April, 1791, this indefatigable botanist remained in the vicinity of Charleston; but his memoranda for the remainder of that year are unfortunately wanting. The earliest succeeding date I have been able to find, is March 27th, 1792, when he sold the '*Jardin du Roi*' at Charleston, and going shortly afterwards by water to Philadelphia, he botanized in New Jersey and around New York until the close of May. In the beginning of June, he visited Milford, Connecticut, to procure information from a Mr. Peter Pound, who had travelled far in the northwest; and at New Haven took passage in a sloop for Albany, where he arrived on the 14th of June, (having botanized on the way at West Point, Poughkeepsie, &c.;) on the 18th, he was at Saratoga; on the 20th, he embarked at Skenesborough, (Whitehall,) botanized more or less on both shores of Lake Champlain, reaching Montreal on the 30th of June, and Quebec on the 16th of July.* The remainder of this season was devoted to an examination of the region between Quebec and Hudson's Bay; the botany of which, as is well known, he was the first to investigate. His journal comprises a full and very interesting account of the physical geography and vegetation of that inclement district.

Leaving Quebec in October, and returning by the same route, we find our persevering traveller at Philadelphia early in December. It appears that he now meditated a most formidable journey, and made the following proposition to the American Philosophical Society:—"Proposé à plusieurs membres de la Société Philosophique les avantages pour les Etats-Unis d'avoir

* Among the plants collected in this journey, he particularly mentions having found *Aconitum uncinatum* near Quebec; but in the Flora no other locality is given than the high mountains of North Carolina. Major LeConte found it several years ago in the southwestern part of New York, and Mr. Lapham has recently detected it in Wisconsin.

des informations geographiques des pays à l'ouest de Mississippi, et demandé qu'ils aient à endosser mes traites pour la somme de £3600, si je suis disposé à voyager aux sources du Missouri, et même rechercher les rivieres qui coulent vers l'ocean Pacifique. Ma proposition ayant été accepté, j'ai donné à Mr. Jefferson, Secretaire d'Etat, les conditions auxquels je suis disposé à entreprendre ce voyage. . . . . J'offre de communiquer toutes les connoisances et informations geographiques à la Société Philosophique; et je reserve à mon profit toutes les connoisances en histoire naturelle que j'acquirerai dans ce voyage." Remaining at Philadelphia and its vicinity until the following summer, he set out for Kentucky in July, 1793, with the object of exploring the Western States, (which no botanist had yet visited,) and also of conferring with Gen. Clarke, (at Mr. Jefferson's request,) on the subject of his contemplated journey to the Rocky Mountains, &c. He crossed the Alleghanies in Pennsylvania, descended the Ohio to Louisville, Kentucky, traversed that State and Western Virginia to Abingdon, and again travelled through the Valley of Virginia to Winchester, Harper's Ferry, &c., arriving at Philadelphia on the 12th of December of the same year. Conferences respecting his projected expedition were now renewed, in which Mr. Genet, the envoy from the French republic, took a prominent part; but here the matter seems to have dropped, since no further reference is made to the subject in the journal; and Michaux left Philadelphia in February, 1794, on another tour to the Southern States. In July of that year, he again visited the mountains of North Carolina, travelling from Charleston to *Turkey Cove* by his usual route. On this occasion he ascended the *Linville Mountain*, and the other mountains in the neighborhood; but having "differé à cause du manque des provisions," he left his old quarters, (at Ainsworth's,) crossed the Blue Ridge, and established himself at *Crab Orchard* on Toe River. From this place he revisited the *Black Mountain*, and, accompanied by his new guide, Davenport, explored the *Yellow Mountain*, the *Roan*, and finally the *Grandfather*, the summit of which he attained on the 30th of August.* Returning to the house of his guide, he

* His earlier journals are full of expressions of loyalty to the king under whose patronage his travels were undertaken; but now transformed into a republican: "*Montée au sommet de la plus haute montagne de toute l'Amerique Septentrionale, chanté avec mon compagnon-guide l'hymne de Marseillois, et crié, Vive la Liberté et*

visited *Table Mountain* on the 5th of September, and proceeded, (by way of Morganton, Lincolnton, Salisbury, and Fayetteville, North Carolina,) to Charleston, where he passed the winter.

On the 19th day of April, 1795, our indefatigable traveller again set out, reached the Santee River at Nelson's Ferry, ascended the Wateree, or Catawba, to Flat-Rock Creek, visited *Flat Rock*,* crossed Hanging-Rock Creek, and ascended the Little Catawba to Lincolnton. In the early part of May he revisited *Linville Mountain*, the *Yellow Mountain*, the *Roan*, and some others, and then descended Doe River and the Holston to Knoxville, Tennessee. Thence, crossing the Cumberland Mountains, and a wilderness one hundred and twenty miles in extent, he arrived at Nashville on the 16th of June, at Danville, Kentucky, on the 27th, and at Louisville on the 20th of July. In August he ascended the Wabash to Vincennes, crossed the country to the Illinois River, and devoted the months of September, October, and November, to diligent herborizations along the course of that river, the Mississippi, the lower part of the Ohio, and throughout the country included by these rivers. In December, he descended the Mississippi in a small boat to the mouth of the Ohio, and ascended the latter and the Cumberland to Clarksville, which he reached on the 10th of January, 1796, after a perilous voyage in the most inclement weather. Leaving that place on the 16th, he arrived at Nashville on the 19th of January; and after making a journey to Louisville and back again, he started for Carolina at

*la Republique Française.*" If this enthusiasm were called forth by mere elevation, he should have chanted his pæans on the *Black Mountain* and the *Roan*, both of which are higher than the *Grandfather*.

* I believe this is the only instance in which the name of *Flat Rock* occurs in Michaux's journal; it is in *South Carolina*, not far from Camden. Here, without doubt, he discovered *Sedum pusillum*, (Diamorpha, *Nutt.*) the habitat of which is said to be "in Carolina Septentrionali, loco dicto *Flat Rock*." Mr. Nuttall, who subsequently collected the plant at the same locality, inadvertently continued this mistake, by assigning the habitat, "Flat Rock near Camden, *North* Carolina," as well in his *Genera of N. American plants*, as in a letter to Dr. Short on this subject. (Vide, *Short on Western Botany*, in the *Transylvania Journal of Medicine*, and in *Hooker's Journal of Botany*, for Nov. 1840, p. 103.) Hence some confusion has arisen respecting the locality of this interesting plant, since there is both a *Flat Rock*, and a village named Camden in North Carolina, although the two are widely separated. After all, Pursh's habitat, "on flat rocks in North Carolina, and elsewhere," proves sufficiently correct, since Mr. Nuttall himself, and also Mr. Curtis, and others, have subsequently obtained it in such situations near Salisbury in that state, and Dr. Leavenworth found it abundantly throughout the upper district of Georgia.

the close of February, crossed the Cumberland Mountains early in March, reached Knoxville on the 8th, Greenville on the 18th, Jonesborough on the 19th, and on the 22nd, crossed the Iron Mountains into North Carolina, descended Cane Creek [which rises in the Roan,] and spent several days in exploring the mountains in the vicinity, with his former guide, Davenport. In April he returned to Charleston by his usual route; and on the 13th of August embarked for Amsterdam in the ship Ophir. This vessel was wrecked on the coast of Holland, on the 10th of October, and Michaux lost a part of the collections he had with him: on the 23rd of December, 1796, he arrived at Paris with the portion he had saved. This notice of the travels of Michaux on this continent, will suffice to show with what untiring zeal and assiduity his laborious researches were prosecuted; it should however be remarked, that greater facilities were afforded him, in some important respects, than any subsequent botanist has enjoyed; the expenses of his journey having been entirely defrayed by the French government, under whose auspices and direction they were undertaken.

The name of Fraser, so familiar in the annals of North American botany, ought, perhaps, to have preceded that of Michaux in our brief sketch; since the elder Mr. Fraser, who had visited Newfoundland previous to the year 1784, commenced his researches in the Southern States as early as 1785; and Michaux, on his first expedition to the mountains in 1787, speaks of having travelled in his company for several days. We believe, however, that he did not explore the Alleghany Mountains until 1789. Under the patronage of the Russian government, he returned to this country in 1799, accompanied by his eldest son, and revisited the mountains, ascending the beautiful *Roan*, where, "on a spot which commands a view of five States, namely, Kentucky, Virginia, Tennessee, North Carolina and South Carolina, the eye ranging to a distance of seventy or eighty miles when the air is clear, it was Mr. Fraser's good fortune to discover and collect living specimens of the new and splendid *Rhododendron Catawbiense*, from which so many beautiful hybrid varieties have since been obtained by skillful cultivators."* The father and son re-

* *Biographical Sketch of* John Fraser, *the Botanical Collector*, in *Hooker's Companion to the Botanical Magazine*, 2, *p.* 300; an article from which I have derived nearly all the information I possess respecting the researches of the Frasers in this

visited the Southern States in 1807; and the latter, after the decease of the father in 1811, returned to this country, and continued his indefatigable researches until 1817.

Many of the rarest plants of these mountains were made known, especially to English gardens and collections, by Mr. John Lyon, whose indefatigable researches are highly spoken of by Pursh, Nuttall and Elliott. It is very probable that he had visited the mountains previous to his assuming the charge of Mr. Hamilton's collections near Philadelphia, which he resigned to Pursh in 1802. At a later period, however, he assiduously explored this region, from Georgia as far north at least as the Grandfather Mountain; and died at Asheville, in Buncombe Co., North Carolina, sometime between 1814 and 1818. I am informed by my friend, the Rev. Mr. Curtis, that his journals and a portion of his herbarium were preserved at Asheville for many years, and that it is probable they may yet be found.

Michaux the younger, author of the *Sylva Americana*, who accompanied his father in some of his earlier journeys, returned to this country in 1801, and crossed the Alleghany Mountains twice; first in Pennsylvania on his way to the Western States, and the next year in North Carolina, on his return to the sea-board. In crossing from Jonesboro', Tennessee, to Morganton, by way of Toe River, (not *Doe River*, as stated in his Travels,) he accidentally stopped at the house of Davenport, his father's guide in these mountains. The observations of the younger Michaux on this part of the Alleghany Mountains, in a chapter of his Travels devoted to that subject, are mainly accurate.

"In the beginning of 1805," Pursh, as he states in the preface to his Flora, "set out for the mountains and western territories of the Southern States, beginning at Maryland and extending to the Carolinas, (in which tract the interesting high mountains of Virginia and Carolina took my particular attention,) and returning late in the autumn through the lower countries along the sea-coast to Philadelphia." This plan, however, was not fully carried out, since he does not appear to have crossed the Alleghanies into the great Western Valley, nor to have botanized along these mountains farther south than where the New River

country, and to which the reader is referred for more particular information. A full list of the North American plants introduced into England by the father and son, is appended to that account.

crosses the Valley of Virginia. At any rate, it is certain that the original tickets of his specimens in the herbarium of the late Prof. Barton, under whose patronage he travelled, as well as those in Mr. Lambert's herbarium, furnish no evidence that he extended his researches into the mountainous portion of North Carolina; but it appears probable (from some labels marked Halifax or Mecklenburg, Virginia,) that he followed the course of the Roanoke into the former State. His most interesting collections were made at Harper's Ferry, Natural Bridge, the *Peaked Mountains,* (which separate the two principal branches of the Shenandoah,) the *Peaks of Otter*, in the Blue Ridge; also, *Cove Mountain, Salt-Pond Mountain*, and *Parnell's Knob*, (with the situation of which I am unacquainted,) the region around the *Warm Sulphur Springs*, *Capon Springs*, the *Sweet Springs*, and the mountains of Monroe and Greenbrier Counties.

Early in the present century, Mr. KIN, a German nurseryman and collector, resident at Philadelphia, travelled somewhat extensively among the Alleghany Mountains, chiefly for the purpose of obtaining living plants and seeds. He also collected many interesting specimens, which may be found in the herbaria of Muhlenberg and Willdenow, where his tickets may be recognized by the orthography, and the amusing mixture of bad English and German, (with occasionally some very singular Latin,) in which his observations are written.

In the winter of 1816, Mr. NUTTALL crossed the mountains of North Carolina from the west, ascending the French Broad River (along the banks of which he obtained his *Philadelphus hirsutus*, &c.) to Asheville, passing the Blue Ridge, and exploring the *Table Mountain*, where he discovered *Hudsonia montana*, &c., and collected many other rare and interesting plants.*

As early as 1817, the mountains at the sources of the Saluda River were visited by the late Dr. MACBRIDE, the friend and correspondent of Elliott; who, in the preface to the second volume of his *Sketch*, renders an affecting and most deserved tribute to

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* The spur of the Blue Ridge from which the picturesque *Table Mountain* rises like a tower, is called by Mr. Nuttall, the *Catawba Ridge*. I am informed, however, by my friend Mr. Curtis, who is intimately acquainted with this interesting region, that it is not known by that name, but is called the *Table Mountain Ridge*. Its base is not washed by the Catawba River, but by its tributary the Linville.

his memory, and acknowledges the important services which he had rendered to that work during its progress.

The name of Rafinesque should also be mentioned in this connexion; since that botanist crossed the Alleghanies four or five times between 1818 and 1833, (in Pennsylvania, Maryland, and the north of Virginia,) and also explored the Cumberland Mountains.

A few years since, the *Peaks of Otter*, in Virginia, were visited by Mr. S. B. Buckley; and still more recently the same botanist has explored the mountains in the upper part of Alabama and Georgia, and the adjacent borders of North Carolina. Among the interesting contributions which the authors of the Flora of North America have received from this source, I may here mention the *Coreopsis latifolia* of Michaux, which had not been found by any subsequent botanist, until it was observed by Mr. Buckley in the autumn of 1840.

No living botanist, however, is so well acquainted with the vegetation of the southern Alleghany Mountains, or has explored those of North Carolina so extensively, as the Rev. Mr. M. A. Curtis; who, when resident for a short time in their vicinity, visited as opportunity occurred, the Table Mountain, Grandfather, the Yellow Mountain, the Roan, the Black Mountain, &c., and subsequently (although prevented by infirm health from making large collections) extended his researches through the counties of Haywood, Macon, and Cherokee, which form the narrow southwestern extremity of North Carolina. To him we are indebted for local information which greatly facilitated our recent journey, and, indeed, for a complete itinerarium of the region south of Ashe County. But, as the latter county had not been visited by Mr. Curtis, nor so far as we are aware by any other botanist, and being from its situation the most accessible to a traveller from the north, we determined to devote to its examination the principal part of the time allotted to our own excursion.

Intending to reach this remote region by way of the Valley of Virginia, we left New York on the evening of the 22d of June, and travelling by rail-road, reached Winchester, a distance of three hundred miles, before sunset of the following day. At Harper's Ferry, where the Potomac, joined by the Shenandoah, forces its way through the Blue Ridge, in the midst of some of the most picturesque scenery in the United States, we merely stopped to dine, and were therefore disappointed in our hope of collecting *Sedum telephioides*, *S. pulchellum*, *Paronychia dichotoma*, and *Draba ramosissima*, all of which grow here upon the rocks. We observed the first in passing, but it was not yet in flower. On the rocky banks of the Potomac below Harper's Ferry, we saw for the first time the common Locust-tree (*Robinia Pseudacacia*) decidedly indigenous. It probably extends to the southern confines of Pennsylvania; and from this point south it is every where abundant, but we did not meet with it east of the Blue Ridge. From Winchester, the shire-town of Frederick County, we proceeded by stage-coach directly up the *Valley of Virginia*, as that portion of the State is called which lies between the unbroken Blue Ridge and the most easterly ranges of the Alleghanies. From the Potomac to the sources of the Shenandoah, it is strictly speaking a valley, from twenty to thirty miles in width, with a strong, chiefly limestone soil of great fertility. It is scarcely interrupted, indeed, up to where the Roanoke rises; but a branch of the Alleghanies intervenes between the latter and New River, as the upper part of the Great Kenhawa is termed, from which point it loses its character in some degree, and is exclusively traversed by the western waters. The same valley extends to the north and east through Maryland and Pennsylvania, and even into the state of New York, preserving throughout the same geological character and fertile soil. Our first day's ride was to Harrisonburg, in Rockingham County, a distance of sixty nine miles from Winchester. From the moment we entered the valley, we observed such immense quantities of *Echium vulgare*, that we were no longer surprised at the doubt expressed by Pursh whether it were really an introduced plant. This "vile foreign weed," as Dr. Darlington, agriculturally speaking, terms this showy plant, is occasionally seen along the road-side in the Northern States; but here, for the distance of more than a hundred miles, it has taken complete possession, even of many cultivated fields, especially where the limestone approaches the surface, presenting a broad expanse of brilliant blue. It is surprising that the farmers should allow a biennial like this so completely to overrun the land. Another plant much more extensively introduced here than in the north, (where it scarcely deserves the name of a naturalized species,) is *Bupleurum rotundifolium*, which in the course of the day we met with abundantly. The *Marubium* *vulgare* is every where naturalized; and *Euphorbia Lathyris* must also be added to the list of naturalized plants. The little *Verbena angustifolia* is also a common weed. We collected but a single indigenous plant of any interest, and one which we by no means expected to find, viz. *Carex stenolepis* of Torrey,* which here, as in the Western States, to which we supposed it confined, takes the place of the northern *C. retrorsa.* We searched for its constant companion, *C. Shortii*, and the next day we found the two growing together. During the day's ride, we observed that the bearded wheat was almost exclusively cultivated, and were informed that it had been found less subject to the ravages of the "Fly," than the ordinary varieties; which may be owing to the recent introduction of the seed of the bearded variety from districts unmolested by this insect.

The following day we travelled only sixteen miles on our route, but from Mount Sidney made an interesting excursion on foot to *Weyer's Cave,* one of the largest, and certainly the most remarkable grotto in the United States. It has been so often described as to render any account on our part superfluous. Near the cave we saw some trees of *Tilia hetorophylla*, *Vent.* (T. alba, *Michx. f. sylv.* ?) and collected a few specimens with unopened flower-buds. It appears to be the most abundant species along the mountains.

Our ride next day offered nothing of interest. Near Staunton, we saw some patches of *Delphinium Consolida,* where it was

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* It is the *C. Frankii* of Kunth (1837,) and of Kunze's Supplement to Schkuhr's Caricography, where it is well figured: it was distributed among Dr. Frank's plants under the name of *C. atherodes*, and with the locality of *Baltimore in Pennsylvania!* I had always supposed it to be derived from some part of the Western States; but since it abounds in the Valley of Virginia, it may have been collected near Baltimore, Maryland! By the way, we hope the excellent collections distributed from time to time by the *Unio Itineraria* are in general, more correctly ticketed than poor Frank's small collection from the United States. Not to venture beyond the Carices, we may remark that the plant distributed under the name of *C. blanda* is *C. Careyana*, *Dewey;* their *C. plantaginea* is *C. anceps*, and their *C. Vleckii* is a variety of the same; their *C. tribuloides*, *Wahl.*, a variety of *C. festucacea;* their *C. depauperata* var. *Americana* (*C. Hitchcockiana* of Dewey) is a large form of *C. oligocarpa*, *Schk.* (the true *C. oligocarpa* of Schkukr, but not of other authors, being a small state of Prof. Dewey's *C. Hitchcockiana;*) and that the *C. Ohiotica*, (formosa, *Dewey?*) *Hochst.*, is *C. Shortii.* This last, we may add, is the *C. formosa* of Kunth's Cyperographia, which will account for the discrepancy between his description and that of Dewey's *C. formosa.* The *C. juncea* of Willdenow and of Kunth is, I am confident, only *C. brachystachys*, and not of American origin.

pretty thoroughly naturalized in the time of Pursh. We did not observe *Spiræa lobata*, which Michaux first met with in this vicinity, and which Pursh, as well as later botanists, found in various parts of the valley. Passing the town of Lexington in the evening, we arrived at the Natural Bridge towards morning, where we remained until Monday, and had an opportunity of botanizing for a short time before we left. On the rocks, we found plenty of *Asplenium Ruta-muraria*, *Sedum ternatum*, and *Draba ramosissima* with ripe fruit: in the bottom of the ravine, directly under the stupendous natural arch, (the point which affords the most impressive view of this vast chasm,) we collected specimens of *Heuchera villosa*, *Michx.*, in fine flower on the 28th of June; although, in the higher mountains of North Carolina, where it also abounds, the flowers did not appear until near the end of July. This species is excellently described by Michaux, to whose account it is only necessary to add, that the petals are very narrow, appearing like sterile filaments. Although a smaller plant than *H. Americana*, the leaves are larger, and vary considerably in the depths of the lobes. It is both the *H. villosa* and *H. caulescens* of Pursh, who probably derived the latter name from the strong elongated rhizoma, often projecting and appearing like a suffrutescent stem, by which the plant is attached to the rocks; since he does not describe the scape as leafy, nor is this at all the case in the original specimens. The *H. caulescens α.* of Torrey and Gray's Flora,* with the synonym, must also be united with *H. villosa*, which in that work is chiefly described from specimens collected by Dr. Short in Kentucky, where every thing seems to grow with extraordinary lux-

* The specimen from Mr. Curtis, the only one from the mountains of North Carolina which these authors had before them, and which they correctly enough considered as the *H. caulescens* of Pursh, is in too advanced a state, and had lost from age most of the shaggy rusty hairs which so copiously clothe the petioles and lower part of the scape; and the leaves being smaller and more sharply lobed, it was not recognized as the same species with the luxuriant Kentucky plant; but was partly confounded with a different and larger-flowered species, the *H. caulescens β. Torr. & Gray, l. c.* from Buncombe county. The latter (H. CURTISII, *Torr. & Gray, ined.*) has flowers quite as large of those of *H. Americana*, spatulate-lanceolate petals (apparently purple) which scarcely exceed the lobes of the calyx; and the filaments, which are less exserted than the styles, are pubescent under a lens. The aid of its discoverer, however, is needed to complete the character of this species, the radical leaves being imperfect in our solitary specimen, and the cauline pair which it presents may very probably not be of usual occurrence.

uriance. With these, the plant we collected entirely accords, except that the leaves are mostly smaller, and more deeply lobed; but this character is not constant.* Soon after leaving Natural Bridge, we observed indigenous trees of the Honey Locust, (*Gleditschia triacanthos,*) also *Æsculus Pavia?* and, in crossing valley of James River, we noticed the Papaw (*Uvaria triloba,*) and *Negundo.* The road-side was almost everywhere occupied with *Verbesina Siegesbeckia*, not yet in flower; and in many places with *Melissa* (*Calamintha*) *Nepeta*, which Mr. Bentham has not noticed as an American plant, although Pursh has it as a native of the country. It was, however, doubtless introduced from Europe, but is completely naturalized in the Valley of Virginia, in Tennessee, and in North Carolina east of the Blue Ridge.

On Tuesday, the 29th of June, we crossed the New River, arrived at Wytheville, or Wythe Court House, towards evening; and at Marion, or Smythe Court House, on the Middle Fork of the Holston, early the next morning. The vegetation of this elevated region is almost entirely similar to that of the Northern States. The only herbaceous plants we noticed, as we passed rapidly along, which we had not seen growing before, were *Galax aphylla*, and *Silene Virginica:* the showy deep red flowers of the latter, no less than the different habitus, caused us to wonder how it could ever have been confounded with the Northern *S. Pennsylvanica.* The only forest-tree with which we were not previously familiar, was the large Buckeye, (*Æsculus flava,*) which abounds in this region, and attains the height of sixty to ninety feet, and the diameter of two to three feet or more at the base.

At Marion, we determined to leave the valley road, and to cross the mountains into Ashe county, North Carolina; the morning was occupied in seeking a conveyance for this purpose. With considerable difficulty we at length procured a *carry-all,*

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* Much to our disappointment we did not meet with *Heuchera hispida*, although I have since learned from an inspection of Barton's herbarium, that we passed within a moderate distance of the place where Pursh discovered it. The habitat given on the original ticket, "*High Mountains between Fincastle and the Sweet Springs, and some other similar places,*" we here cite, with the hope that it may guide some botanist to its re-discovery. The habitat in Pursh's Flora, "High mountains of Virginia and Carolina," is probably a mere guess, so far as relates to the latter State.

(a light covered wagon with springs, drawn by a single horse,) capable of conveying our luggage and a single person besides the driver, a simple shoemaker who had never before undertaken so formidable a journey, and who accordingly proved entirely wanting in the skill and tact necessary for conducting so frail a vehicle over such difficult mountain tracks, for roads they can scarcely be called. We had first to ascend the steep ridge interposed between the Middle and the South Forks of the Holston, called *Brushy Mountain*, during the ascent of which we commenced botanizing in earnest. The first interesting plant we met with was *Saxifraga erosa* of Pursh, but only with ripe fruit, and even with the seeds for the most part fallen from the capsules. The same locality also furnished us with a few specimens of the pretty *Thalictrum filipes, Torr. & Gr.* (to which the name of *T. clavatum, DC.* must be restored,) a plant which abounds along all the cold and clear brooks throughout the mountains of North Carolina; where it could not well have escaped the notice of Michaux, in whose herbarium DeCandolle found the specimen (with no indication of its habitat) on which his *T. clavatum* was established. The authors of the *Flora of North America*, having only an imperfect fruiting specimen of their *T. filipes*, and not sufficiently remarking the discrepancies between the *T. clavatum, Hook. fl. Bor.-Am.* and the figure and description of De Candolle's plant, in regard to the length of the styles, assumed the former to be the true *T. clavatum*, and described their own plant as a new species. But our specimens accord so perfectly with the figure of DeLessert, (except in the greater, but variable length of the stipes to the fruit, and in the veining of the carpels, which, doubtless by an oversight of the artist, is omitted in the figure,) as to leave no doubt of their identity. The subarctic plant may be appropriately called *T. Richardsonii*, in honor of its discoverer; and some few particulars should be added to DeCandolle's character of our own plant.* The flowers of this species are

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* THALICTRUM CLAVATUM (*DC.*): glaberrimum, floribus hermaphroditis laxe corymbosis, filamentis clavatis, antheris ellipticis muticis, carpellis (5—10) stipitatis stellatim patentibus clavato-lunulatis compressis leviter nervosis stylo brevissimo vix rostellatis, caule gracili inferne nudo, foliis biternatis petiolatis, foliolis rotundis crenato-incisis lobatisve subtus glaucis.—T. clavatum, *DC. syst.* 1. *p.* 171; *DeLess. ic.* 1. *t.* 6, non *Hook.* T. filipes, *Torr. & Gray, fl. N. Am.* 1. *p.* 38.

Hab. ad fontes umbrosos rivulosque montium Virginiæ (comitatu Grayson) et Carolinæ Septentrionalis frequens.

uniformly perfect, as indeed they are figured by DeLessert, although DeCandolle has otherwise described them. It is a slender, delicate plant, from eight to twelve, or rarely exceeding eighteen inches in height, with pure white flowers. During this ascent we collected *Galium latifolium, Michx.*, just coming into flower; and we subsequently found this species so widely diffused throughout the mountains of North Carolina, that we were much surprised at its remaining so little known since the time of Michaux. On a moist rocky bank by the road-side, we gathered some specimens of a *Scutellaria*, which did not again occur to us. It proves to be a species mentioned by Mr. Bentham under *S. serrata*, and subsequently described by Dr. Riddell with the name of *S. saxatilis*,* which apparently is not of uncommon occurrence westward of the Alleghany Mountains. It is a slender plant, from six to twenty inches high; and the stems often produce slender subterranean runners from their base. We here also collected *Asarum Virginicum, Linn.* in similar situations. In the higher mountains, the northern *A. Canadense* takes the place of the former species, while *A. arifolium, Michx.* seems to be confined to the lower country.† The banks of the shady

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* S. SAXATILIS (*Riddell, suppl. cat. Ohio plants*, 1836, *p.* 14): pilosiuscula vel subglabra, caule adscendente, foliis petiolatis membranaceis cordato-ovatis grosse crenatis superioribus cordato-oblongis obtusis, floralibus ovato-oblongis breviter petiolatis integerrimis pedicellos plerumque superantibus, racemis laxis, floribus oppositis subsecundis, corolla breviter bilabiata, galea rectiuscula.

Ab *S. serrata* diversa tam floribus quam foliis: ad *S. violaceam* (Ind. Orient.) accedere videtur, ut dixit cl. *Benth.* (*Lab. gen. et sp. p.* 434, adnot. sub *S. serrata.*) Corolla semipollicaria, labio inferiore tubo superne amplissimo triplo breviore, galea vix incurva. Achenia valde tuberculosa.

† If Decaisne's *Heterotropa* be retained as a distinct genus, which it probably should be, the character must be somewhat modified, and two of our American species referred to it; although the name will be unmeaning as applied to the latter. According to this view, the differential characters of the two genera may be presented as follows:

ASARUM. *Tourn., Linn.* excl. spec.

Perigonium campanulatum, tubo cum ovario connato, limbo tripartito. Stamina 12: filamenta subulata, libera, vel basi styli subadnata: antheræ breves, extrorsæ, connectivo longe subulato superatæ. Ovarium perigonio adnatum: styli in columnam crassam apice breviter 6-lobam concreti, stigmatibus papillosis desinentes. (Herbæ Europeæ et Boreali-Americanæ.)

1. A. EUROPÆUM (*Linn.*): filamentis liberis stylum æquantibus.

2. A. CANADENSE (*Linn.*): filamentis imis styli basi adnatis eoque brevioribus. —Quid est *A. Canadense*, Thunbergii?

and cool rivulets which we crossed every few minutes during our ascent, were in many places covered by the prostrate or creeping *Hedyotis serpyllifolia, Torr. & Gr.* (Houstonia serpyllifolia, *Michx.*,) which continues to flower sparingly throughout the summer. This pretty plant has quite the habit of *Arenaria Balearica;* and the root is certainly perennial. We found it very abundant in similar situations, throughout this mountain region. Towards the summit of this ridge, we first met with the *Magnolia Fraseri,* (M. auriculata, *Bartr.*,) which resembles the Umbrella-tree (*Magnolia Umbrella,*) in the disposition of its leaves at the extremity of the branches. This, as well as *M. acuminata* (the only other species of Magnolia that we observed,) is occasionally termed *Cucumber-tree;* but the people of the country almost uniformly called the former *Wahoo;* a name which in the lower part of the Southern States is applied to

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HETEROTROPA. (*Morr. et Decaisne.*)

Perigonium ventricosum, trilobatum, fere liberum. Stamina 12: filamenta brevissima vel subnulla, dilatata, ovario accreta: antheræ (loculi lineares) extrorsæ, quandoque alternæ subintrorsæ; connectivum muticum, vel appendice brevi auctum. Ovarium basi imo perigonii tubo adnatum: styli 6, discreti, in appendicem bilobum ultra stigmata extrorsa plus minus producti. (Herbæ Japonicæ et Boreali-Americanæ. Folia sæpius variegata.)

§ 1. *Perigonium urceolatum, fauce constricta. Stamina 6 stigmatibus opposita filamentis triangularibus, antheris subintrorsis; 6 alterna sessilia, antheris extrorsis.*—HETEROTROPA, *Morr. & Decaisne, in ann. sci. nat. (n. ser.) 2. p. 314. t. 10.*

1. H. ASAROIDES (*Morr. & Decaisne, l. c.*): perigonii lobis late ovatis subcordatis patulis, staminibus 6 ad stigmata respondentibus appendiculo brevissimo reflexo, alternis 'appendiculo ovato erecto ovario affixo,' stylis obcordatis.—Asarum Virginicum, *Thunb. fl. Jap. p.* 190.

§ 2. *Perigonium breviter trilobatum, fauce aperta. Stamina consimilia, filamentis brevissimis: antheræ omnes extrorsæ.*—HOMOTROPA.

2. H. ARIFOLIA: perigonio tubuloso-urceolato limbo brevissimo, antheris appendiculo brevi crasso superatis, alternis eodemque stigmatibus adhærentibus, stylis brevibus crassis cornibus ultra stigmata breviter aut vix productis, foliis hastato-cordatis.—Asarum arifolium, *Michx.; Hook. exot. fl.* 1. *t.* 40.

3. H. VIRGINICA: perigonio breviter ventricoso-campanulato, antheris muticis, stylis ultra stigmata longe rostratis apice bifidis, foliis rotundato-cordatis glabris.—Asarum Virginicum, *Linn.*

The line of dehiscence of the cells of the alternate anthers in *Heterotropa asaroides,* is said to be nearly lateral, or slightly introrse; so that this character is not strongly marked, and probably will not be deemed of sufficient consequence to separate generically our two species from the Japanese plant. On the other hand, if it should be thought inexpedient to divide a genus so well marked by habit as Asarum, my two sections of Heterotropa would form subgenera of the former.

*Ulmus alata*, or often to all the elms indifferently. The bitter and somewhat aromatic infusion of the green cones of both these Magnolias in whiskey or apple-brandy, is very extensively employed as a preventive against intermittent fevers; an use which, as the younger Michaux remarks, would doubtless be much less frequent, if, with the same medical properties, the aqueous infusion were substituted.

Nearly at the top of this mountain we overtook our awkward driver, awaiting our arrival in perfect helplessness, having contrived to break his carriage upon a heap of stones, and to overthrow his horse into the boughs of a prostrate tree. So much time was occupied in extricating the poor animal, and in temporary repairs to the waggon, that we had barely time to descend the mountain on the opposite side, and to seek lodgings for the night in the secluded valley of the South Fork of the Holston. In moist shady places along the descent of this mountain, and in similar situations throughout the mountains of North Carolina, we found plenty of the northern *Listera convallarioides*, in fine state, entirely similar to the plant from Vermont, Canada, Newfoundland, and the Northwest Coast, and agreeing completely with the figure of Swartz, (in *Weber & Mohr, Beiträge zur Naturkunde* 1. (1805) *p.* 2. *t.* 1,) and the recent one of *Hook. Flora Boreali-Americana.* It is difficult to conceive why Willdenow should cite the *Ophrys cordata* of Michaux under the *Epipactis convallarioides* of Swartz, while there is so little accordance in their characters; but this has not prevented Pursh from combining the specific phrase of the two authors into one, while he assigns a locality for the plant, (New Jersey,) where the *Listera convallarioides* certainly does not grow. The Rev. Mr. Curtis, I believe, first detected the plant in these mountains.

The next day, (July 1,) we crossed the *Iron Mountains* (the great chain which divides the states of North Carolina and Tennessee, and which here forms the northwestern boundary of Grayson County, Virginia,) by Fox-Creek Gap, and traversing the numerous tributaries of the North Fork of New River, which abundantly water this sequestered region, we slept a few miles beyond the boundary of North Carolina, after a journey of nearly thirty miles. It must not be imagined that we found hotels or taverns for our accommodation; as, except at Ashe Court House, we saw no house of public entertainment from the time we left the Valley of Virginia until we finally crossed the Blue Ridge and quitted the mountain region. Yet we suffered little inconvenience on this account, as we were cordially received at the farm-houses along the road, and entertained according to the means and ability of the owners; who seldom hesitated either to make a moderate charge, or to accept a proper compensation for their hospitality, which we therefore did not hesitate to solicit, from time to time. On the Iron Mountains, we met with nearly all the species we had collected during the previous day, and with a single additional plant of much interest, viz. the *Boykinia aconitifolia*, *Nutt.* We found it in the greatest abundance and luxuriance on the southern side of the mountain, near the summit, along the rocky margins of a small brook, which for a short distance were completely covered with the plant. It here attains the height of two feet or more; the stems, rising from a thick rhizoma, (and clothed below, as well as the petioles, with deciduous rusty hairs,) are terminated by a panicle of small cymes, which at first are crowded, but at length are loose, with the flowers mostly unilateral. The rather large, pure white petals are deciduous after flowering, not marcescent as in *Saxifraga* and *Heuchera.* We did not again meet with this plant; but Mr. Curtis collected it several years ago near the head of Linville River, and Mr. Buckley obtained it in the mountains of Alabama. It also extends farther north than our own locality; for, although not described in his Flora, Pursh collected it on the Salt-Pond Mountain in Virginia.* I have little doubt that the *Saxifraga Richardsonii* would be more correctly transferred to *Boykinia*, as well as the *S. ranunculifolia;* and, since the *S. elata* of Nuttall, in Torrey and Gray's Flora, is referred to *Boykinia occidentalis*, in the supplement to that work, no pentandrous Saxifrage remains, except the ambiguous *S. Sullivantii, Torr. & Gr.* But the authors of the Flora, having received fruiting specimens of this interesting plant, do not hesitate to remove it from the genus to which it was provisionally appended, and to dedicate it

* The specimen in Prof. Barton's herbarium (in fruit), is ticketed by Pursh: "*Heuchera villosa, Michx.?* Salt-Pond Mountain under the naked knob, near a spring. This spring is the highest I have seen."—I know not the exact situation of this mountain, from which Pursh obtained many interesting plants. The *Boykinia aconitifolia*, I may remark, would be a very desirable plant in cultivation, and might be expected to endure the winter of New York or Philadelphia: it would certainly flourish in England.

to their esteemed correspondent, the promising botanist who discovered it.*

While descending the mountain on the opposite side, we met with *Clethra acuminata,* a very distinct and almost arborescent species, which is well characterized by Michaux. The flowers were not yet expanded; but towards the end of July we obtained from other localities specimens in full flower, while the racemes and capsules of the preceding year were still persistent. The conspicuous bracts, it may be remarked, are as caducous in the wild, as they are said to be in the cultivated plant; usually falling before the flower-buds have attained their full size. We also saw *Campanula divaricata, Michx.,* not yet in flower; and obtained fruiting specimens of the *Convallaria umbellulata, Michx.,* (Clintonia, *Raf.,* not of *Dougl.*) While the character in Michaux is drawn from this species, the 'planta Canadensis' there mentioned is the nearly allied *Dracæna borealis* of the Hortus Kewensis. The two species are mixed in Michaux's herbarium; and, although the latter is almost exclusively a northern plant, we found the two species growing together on the *Grandfather, Roan,* and other high mountains of North Carolina. Towards the base of the mountain we saw for the first time the *Pyrularia* of Michaux (*Oil-nut, Buffalo-tree, &c.* Hamiltonia oleifera, *Muhl.*); a low shrub which is not of unfrequent occurrence in rich shady soil. Its geographical range extends from the Cherokee country on the confines of Georgia, (where the elder Mi-

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* SULLIVANTIA. *Torrey & Gray, fl. N. Amer. suppl. ined.*

Calyx inferne imo ovario adnatus, limbo quinquefido. Petala 5, spathulata, unguiculata, integra, summo calycis tubo inserta, marcescentia. Stamina 5, laciniis calycinis breviora: antheræ biloculares. Styli 2, breves; stigmatibus simplicibus. Capsula calyce inclusa, bilocularis, birostris, polysperma, rostris intus longitudinaliter dehiscentibus. Semina adscendentia, scobiformia; testa membranacea, relaxata, utrinque ultra nucleum ovalem alatim producta. Embryo cylindricus albumine vix brevior.—Herba humilis, in rupibus calcareis Ohionis vigens; radice fibrosa perenni; foliis plerisque radicalibus, rotundato-reniformibus, inciso-dentatis sublobatisve, longe petiolatis; scapo gracili, decumbente; floribus parvis, (corolla conspicua, alba,) cymuloso-paniculatis, post anthesin in apicem pedicellorum arcte deflexis.

S. Ohionis.—Saxifraga? Sullivantii, *Torrey & Gray, fl. N. Amer.* 1. *p.* 575.

Genus a *Saxifraga* præcipue diversum staminibus petalis isomeris, et seminibus scobiformibus; a *Boykinia* calyce fere libero, atque seminibus; ab *Heuchera* capsula biloculari, etc.; a *Leptarrhena* staminibus 5, antheris bilocularibus, et seminibus alato-marginatis, nec utrinque subulatis.

chaux discovered it on his earliest visit to the mountains, and where Mr. Curtis has recently observed it,) to the western ranges of the Alleghanies of Pennsylvania in lat. 40°, where it was found by the younger Michaux.* It flowers early in the season, and the oleaginous fruit in the specimens we collected had attained the size of a musket ball.

In wet places, on the very borders of North Carolina, but still within Virginia, we first met with *Trautvetteria palmata* and *Diphylleia cymosa;* the former in full flower, the latter in fruit. *Trautvetteria,* which I doubt not is more nearly allied to Thalictrum than to Cimicifuga or Actæa, was collected by Pursh in Virginia, both on the Salt-Pond Mountain and the Peaks of Otter. The *Diphylleia* is confined to springy places, and the margin of shaded mountain brooks, in the rich and deep alluvial soil which is so general throughout these mountains, never occurring, perhaps, at a lower elevation than three thousand feet above the level of the sea. It is a more striking plant than we had supposed; the cauline leaves (generally two, but sometimes three in number,) being often two feet in diameter, and the radical, which are orbicular and centrally peltate as in *Podophyllum,* frequently still larger; so that it is not easy (at this season) to obtain manageable specimens. The branches of the cyme are usually reddish or purple, and the gibbous, deep blue and glaucous berries are almost dry when ripe. The latter often contain as many as four perfect seeds; and it is proper to remark that the embryo is not 'very minute,' as described in the *Flora of North America;* but, in the ripe seeds recently examined, is one-third the length of the albumen, as stated by Decaisne, or even longer. The cotyledons are elliptical, flattish, and nearly the length of the thick, slightly club-shaped radicle. The whole embryo is also somewhat flattened; so that when the seed is longitudinally divided in one direction, the embryo, examined in place, appears to be very slender, and to agree with DeCandolle's description. The albumen is horny when dry, and has a bitter taste. Along the road-side, we shortly afterwards collected the equivocal *Vaccinium erythrocarpum* of Michaux, or *Oxycoccus erectus* of Pursh; a low, erect, dichotomously branched shrub, with the habit, foliage, and fruit of *Vaccinium,* but the flowers of *Oxycoccus.* It here oc-

* *Travels to the Westward of the Alleghany Mountains, &c.,* Engl. Ed. p. 57, etc.

curred at a lower elevation than usual, scarcely more than three thousand feet above the level of the sea, and in a dwarfish state (about a foot high): subsequently we only met with it on the summit of the Grandfather and other mountains which exceed the altitude of five thousand feet, where it is commonly three or four feet high. We were too early for the fruit, a small, red or purplish berry, which does not ripen until August or September. It has an exquisite flavor, according to Pursh, who found the plant on the mountains of Virginia: but our friend Mr. Curtis informs us that is rather insipid, and entirely destitute of the fine acidity of the Cranberry.

On the 2nd of July we continued our journey (11 miles) to Jefferson or Ashe Court-House, a hamlet of twenty or thirty houses, and the only village in the county. Intending to make this place our head-quarters while we remained in the region, we had the good fortune to find excellent accommodations at the house of Col. Bower, who evinced every disposition to further our inquiries, and afforded us very important assistance. We may remark, indeed, that during our residence amongst the mountains, we were uniformly received with courtesy by the inhabitants; who for the most part wanted the general intelligence of our obliging host at Jefferson, and could scarcely be made to comprehend the object of our visit, or why we should come from a distance of seven hundred miles, to toil over the mountains in quest of their common and disregarded herbs. Curiosities as we were to these good folks, their endless queries had no air of impertinence, and they entertained us to the best of their ability, never attempting to make unreasonable charges. A very fastidious palate might occasionally be at a loss; but good corn-bread and milk are everywhere abundant; the latter being used from preference quite sour, or even curdled. Sweet milk appears to be very generally disliked, being thought less wholesome, and more likely to produce the 'milk sickness,' which is prevalent in some very circumscribed districts; so that our dislike of sour, and fondness for sweet milk was regarded by this simple people as one of our very many oddities. Nearly every farmer has a small dairy-house built over a cold brook or spring, by which the milk and butter are kept cool and sweet in the warmest weather.

We botanized for several days upon the mountains in the immediate neighborhood of Jefferson, especially the *Negro Moun-*

*tain*, which rises abruptly on one side of the village, the *Phœnix Mountain*, a sharp ridge on the other side, and the *Bluff*, a few miles distant in a westerly direction. The altitude of the former is probably between four and five thousand feet above the sea; the latter is apparently somewhat higher. They are all composed of mica-slate; and we should remark, that we entered upon a primitive region immediately upon leaving the Valley of Virginia. The mountain-sides, though steep or precipitous, are covered with a rich and deep vegetable mould, and are heavily timbered, chiefly with chestnut, white oak, the tulip-tree, the cucumber-tree, and sometimes the sugar-maple. Their vegetation presents so little diversity, that it is for the most part unnecessary to distinguish particular localities. Besides many of the plants already mentioned, and a very considerable number of northern species which we have not room to enumerate, we collected or observed on the mountain-sides, *Clematis Viorna* in great abundance; *Tradescantia Virginica; Iris cristata* in fruit; *Hedyotis* (*Amphiotis*) *purpurea*, which scarcely deserves the name, since the flowers are commonly almost white; *Phlox paniculata? Aristolochia Sipho*, without flowers or fruit; *Ribes Cynosbati, rotundifolium, Michx.*, (R. triflorum, *Willd.*) and *prostratum, L'Her.; Allium cernuum*, and *tricoccum*;* *Galax aphylla; Ligusticum actæifolium*, the strong-scented roots of which are eagerly sought and eaten by boys and hogs;† the *Ginseng*, here called *sang*, (the roots of which are largely collected, and sold to the country merchants, when fresh for about twelve cents per pound, or when dried for triple that price;) *Menziesia globularis*, mostly in fruit; and the showy *Azalea calendulacea*, which was also out of flower, except in deep shade.‡ In the latter sit-

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* The latter is known throughout this region by the name of *Ramps;* doubtless a corruption of *Ramsons*, the popular appellation of *A. ursinum* in England.

† It is here termed *Angelico;* while in Virginia it is called *Nondo.* Bartram, (*Travels*, p. 45, and p. 367,) who found it in Georgia, notices it under the name of *Angelica lucida*, or *White-root* of the Creek and Cherokee traders: "Its aromatic carminative root is in taste much like that of the ginseng, though more of the taste and scent of anise-seed: it is in high estimation with the Indians as well as white inhabitants, and sells at a great price to the southern Indians of Florida, who dwell near the sea-coast, where this never grows spontaneously." *Bartram, l. c.*

‡ Bartram well describes this species, under the name of *Azalea flammea*, or fiery Azalea. "The epithet fiery I annex to this most celebrated species of Azalea, as being expressive of the appearance of its flowers; which are in general of

uations we found an arborescent tetramerous species of Prinos, (in fruit only,) with large and membranaceous ovate leaves. The same species has been collected on the Pokono Mountains in Pennsylvania, by Mr. Wolle, and on the Cattskills by Mr. S. T. Carey. We should deem it the *P. lævigatus* of Pursh, (not of *Torr., Fl. Northern States,*) on account of the solitary and subsessile fertile flowers, as well as the habitat, were not the flowers of that species said to be hexamerous.

In damp, very shady places high up the *Negro Mountain*, we saw an *Aconitum* not yet in flower; and on moist rocks near the summit, obtained a few fruiting specimens of a *Saxifraga* which was entirely new to us. In a single, very secluded spot on the north side of this mountain, not far from the summit, the rocks were covered with a beautiful small Fern, which proves to be the *Asplenium Adiantum-nigrum* of Michaux, the *A. montanum*, Willd., an extremely rare plant. It is certainly distinct from the *A. Adiantum-nigrum;* being not only a much smaller and more delicate species, (two to four inches high,) but the fronds are narrower, the pinnæ ovate and much shorter, 3–5-parted, with the pinnulæ toothed or incised at the apex.

The *Veratrum parviflorum, Michx.*, is of frequent occurrence throughout this region, but was not yet fully in flower, so that our specimens were not collected until near the end of July. The plant is excellently described in the Flora of Michaux, where it is probably with justice referred to *Veratrum* rather than to *Melanthium;* since the divisions of the perianth (yellowish-green from the first,) are wholly destitute of glands, and only differ from *Veratrum* in being stellate, and tapering at the base. I may here remark that the name *Melanthium* must un-

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the color of the finest red-lead, orange, and bright gold, as well as yellow and cream-color. These various splendid colors are not only in separate plants, but frequently all the varieties and shades are seen in separate branches on the same plant; and the clusters of the blossoms cover the shrubs in such incredible profusion on the hill-sides, that suddenly opening to view from dark shades, we are alarmed with the apprehension of the woods being set on fire. This is certainly the most gay and brilliant flowering shrub yet known; they grow in little copses or clumps, in open forests as well as dark groves, with other shrubs, and about the bases of hills, especially where brooks and rivulets wind about them; the bushes seldom rise above six or seven feet in height, and generally but three, four, or five, but branch and spread their tops greatly; the young leaves are but very small whilst the shrubs are in bloom, from which circumstance the plant exhibits a greater show of splendor."—*Bartram's Travels*, p. 323.

doubtedly be retained for *M. Virginicum* and *M. hybridum.* Some years since, in re-arranging the North American species of this family, I followed Rœmer and Schultes in adopting the genus *Leimanthium* of Willdenow, without considering that *Melanthium* was established by Clayton and Gronovius on *M. Virginicum*, and thus taken up by Linnæus, with the addition of a Siberian plant, which belongs to *Zigadenus*.* The *Melanthium Capense*, (Androcymbium, *Willd.*) was added some time afterwards.

The rocky summits of the mountains afforded us *Sedum telephioides; Heuchera villosa; Paronychia argyrocoma*, which forms dense silvery tufts on the highest and most exposed peaks; *Veronica officinalis, serpyllifolia*, and *agrestis*, (all certainly native;) *Lycopodium rupestre*, in a very beautiful state, and on the *Phœnix Mountain* we found a solitary specimen of *L. Selago; Arabis lyrata*, with perfectly accumbent cotyledons; *Potentilla tridentata*, which we only saw on the *Bluff Mountain; Woodsia ilvensis; Saxifraga leucanthemifolia*, which not unfrequently attains the height of two feet, with a large and slender effuse panicle; *Diervilla trifida*, entirely resembling the northern plant; *Pyrus melanocarpa; Sorbus Americana, β. microcarpa; Rhododendron Catawbiense*, just out of flower, while *R. maximum*, extremely abundant along the streams and mountain-sides, was only beginning to expand its blossoms.† In such situations, also, we found a marked dwarfish variety of *Hedyotis purpurea*, growing somewhat in tufts, and scarcely exceeding four or five inches in height. The flowers, which are deep pink, while in the ordinary form of this region they are nearly white, present the *dimorphism* which obtains in several sections of the genus; the stamens in some specimens being inserted in the throat of the corolla and exsert, while in others they are inserted near the base of the tube and included; in the former the style is uniformly short and included, and in the latter long and somewhat exserted. These two forms were often seen growing side by

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* The Helonias glaberrima, *Bot. Mag. t.* 1680, on which *Zigadenus commutatus*, of Schultes is founded, is *Z. glaucus;* the specimens came from Fraser's nursery, but doubtless were not derived from the Southern States. Helonias bracteata, *Bot. mag. t.* 1703, is *Z. glaberrimus, Michx.*, not fully developed.

† These shrubs here bear the name of *Laurel;* while the *Kalmia latifolia* is universally called *Ivy*, or *Ivy-bush*.

side, and appeared to be equally fertile. The *Amianthium muscætoxicum,* which is common in the low country of the Southern States, we here found only in the rich open woods of the *Bluff Mountain,* and in similar places farther south. The flowers are pure white or cream-color, in a dense and very showy raceme, at length changing to green. The cattle, which roam in the woods for a great part of the year, are sometimes poisoned by feeding, as is supposed, on the foliage of this plant during the autumn: hence its name of *Fall-poison.* The wild *Pea-vine,* which is so highly prized as an autumnal food for cattle, is the *Amphicarpæa.** The Lily of the Valley, (*Convallaria majalis,*) which we occasionally met with in fruit, appears to be identical with the European plant. It extends from the mountains of Virginia to Georgia, where it was long ago noticed by the younger Bartram. We also collected a handsome *Phlox,* of frequent occurrence in rich woods, which differs from *P. Carolina* (with which it has perhaps been confounded) in its perfectly smooth stem, and broader, less pointed calyx-teeth. The leaves are sometimes an inch in width, and four or five in length; the uppermost often ovate-lanceolate, and more or less cordate at the base.

A species of *Carex,* nearly allied to *C. gracillima,* occurs in the greatest abundance on all the higher mountains of North Carolina, forming tufts on the earth or on rocks, and flowering throughout the summer. On this account it is called *C. æstivalis* by Mr. Curtis, who discovered it several years since, and pointed out its characters.† We also met with *C. canescens,*

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* "In the large woods, the surface of the soil is covered with a species of wild peas, which rise three feet above the earth, and of which the cattle are very greedy. They prefer this pasture to every other, and when removed from it they fall away, or make their escape to return to it."—*Michaux,* (*F. A.*) *Travels,* p. 316.

† C. ÆSTIVALIS (*M. A. Curtis, ined.*): spicis 3–5 gracilibus laxifloris suberectis, infima pedunculata, cæteris subsessilibus, suprema androgyna inferne mascula, bracteis inferioribus foliaceis vix vaginantibus superioribus setaceis, perigyniis ovoideis trigonis basi apiceque acutiusculis obsolete nervosis glabris ore subintegro squamam ovatam obtusam (nunc mucronatam) duplo superantibus, stigmatibus tribus, vaginis foliorum inferiorum pubescentibus.

Hab. in montibus altioribus Carolinæ Septentrionalis ubique. Julio–Augusto floret.—*C. gracillimæ* nimis affinis; at diversa, culmis foliisque gracilioribus, vaginis infimis pubescentibus; bracteis vix vaginantibus; spicis angustioribus et laxifloris erectis, superioribus brevissime pedunculatis; acheniis oblongo-ovoideis magis stipitatis.

*Linn. ex Boott*, (C. Buxbaumii, *Wahl.*) and *C. conoidea*, *Schk.*, on the moist, grassy brow of a precipice of the *Bluff;* and towards the base of the *Negro Mountain*, we observed *C. virescens* and *C. digitalis*, *Willd.*

In a cool, sequestered brook, we found the true *Cardamine rotundifolia*, *Michx.*, growing like a Water-cress, (for which it might be substituted, as its leaves have exactly the same taste,) but producing numerous stolons two to three or more feet in length. These runners arise not only from the base of the stem, but from the axils of the upper leaves, and very frequently from the apex of the weak ascending raceme itself, which is thus prolonged into a leafy stolon, hanging down into the water or mud, where it takes root. Its habit and appearance are so unlike even the summer state of our northern *C. rhomboidea*, that we could

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The figure of *C. gracillima*, in Prof. Kunze's Supplement to Schkuhr's Carices, is excellent, except that the immature peryginia are represented with more distinct beaks than I have ever seen. To this genus, already perhaps the most extensive in the vegetable kingdom, after *Senecio*, Mr. Sullivant has recently added another species, an account of which may be appended to this note. As Dr. Boott had already dedicated it to the zealous discoverer, without being aware that he had distributed it under another name, I trust I may be allowed to publish the notes of this sedulous caricographer unchanged:

"C. Sullivantii (*Boott*): spica mascula solitaria cylindrica, fœmineis 3–5 cylindricis erectis gracilibus pedunculatis laxifloris, superioribus contiguis, infima remota longe pedunculata basi attenuata, stigmatibus tribus, perigyniis ellipticis brevi-rostratis emarginatis pellucido-punctatis apice marginibusque piloso-hispidis squamam ovatam ciliatam hispido-mucronatam subæquantibus.

"Culmus bipedalis, gracilis, triqueter, pilis albis sparsis longis scabriusculus, pars spicas gerens 2–9-uncialis. Folia 2 lin. lata, culmo breviora, marginibus nervisque scabris. Bractea infima vaginans, foliacea, culmum adæquans, reliquæ sensim breviores, superiores evaginatæ demum setaceæ. Spica mascula uncialis, vix lineam lata, sessilis vel brevi-pedunculata: squamæ muticæ, obtusæ, apice ciliolatæ, nervo scabro, pallide castaneæ. Spicæ fœmineæ 3–5, laxifloræ, 1–1½ uncias longæ, 1–1½ lineas latæ; superiores contiguæ; infima remota (uno exemplo basi composita): squamæ pellucidæ ciliolatæ, nervo viridi scabro, hispido-mucronatæ. Pedunculi scabri, superiores sensim breviores. Perigynium (vix maturum) $1\frac{5}{9}$ lin. longum, $\frac{7}{9}$ lin. latum, viride, enervium? apice hispidulum, ciliatum, brevistipitatum, squamam subæquans vel eo paululum longius. Achenium immaturum."—*Boott in litt.*

Hab. in sylvaticis prope Columbum, Ohionis, ubi detexit *W. S. Sullivant*, cum C. pubescente, C. gracillima, etc. vigens. Affinis *C. arctatæ* (C. sylvaticæ, *auct. Amer.*) ex cl. Boott.—In exemplis nuperrime receptis, perigynia satis matura sunt ovato-elliptica, lata, compresso-plana, enervia (marginibus exceptis), apice vix rostrata.

not hesitate to consider it a distinct species. The subjoined diagnostic character will doubtless suffice for its discrimination.*

On the 7th of July, we started for the high mountains farther south, having hired a cumbrous and unsightly, but convenient tilted waggon, with a pair of horses and a driver, (who rode one of the horses, according to the usual custom of this region,) for the conveyance of our luggage, and which afforded us, at intervals, the luxury of reposing on straw at the bottom, while we were dragged along the rate of two or three miles per hour.

Our first day's journey, of about twenty four miles, was somewhat tedious, as we found no new plants of any interest. We saw, however, a variety of *Lonicera parviflora?* with larger leaves and flowers than ordinary, the latter dull purplish; probably the *Caprifolium bracteosum*, var. *floribus violaceo-purpureis* of Michaux. The following morning we reached the Watauga River (a tributary of the Holston); and leaving our driver to follow up the banks of the stream to the termination of the road at the foot of the Grandfather, we ascended an adjacent mountain, called *Hanging-rock*, and reached our quarters for the night by a different route. The fine and close view of the rugged *Grandfather* amply rewarded the toil of ascending this beetling cliff, where we also obtained the *Geum* (*Sieversia*) *radiatum*, probably the most showy species of the genus. The brilliant golden flowers have a disposition to double, even in the wild state, in which we often found as many as eight or nine petals. This tendency would doubtless be fully developed by cultivation. Around the base of these mountains we saw *Blephilia nepetoides*, and another Labiate plant not yet in flower, which we took for *Pycnanthemum montanum*, *Michx.*

The next day (July 9th) we ascended the *Grandfather*, the highest as well as the most rugged and savage mountain we had yet attempted; although by no means the most elevated in

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* CARDAMINE ROTUNDIFOLIA (*Michx.*): glaberrima decumbens, stolonibus repentibus, radice fibrosa, foliis omnibus conformibus (radicalibus sæpe trisectis, segmentis lateralibus parvis,) petiolatis rotundatis plerumque subcordatis integriusculis vel repando sinuatis, siliquis parvis stylo subulatis, stigmate minuto, seminibus ovalibus.—C. rotundifolia, *Michx. fl.* 2. *p.* 30; *Hook. bot. misc.* 3. *t.* 109. (statu vernali: in exemplis Carolinianis folia caulinia magis petiolata); *Darlingt. fl. Cest. ed.* 2. *p.* 384. C. rotundifolia γ. *Torr. & Gray, fl. N. Amer.* 1. *p.* 83.

Hab. in rivulis fontibusque opaculis montium Carolinæ, Virginiæ, Kentucky, et in Pennsylvania.

North Carolina, as has generally been supposed.* It is a sharp and craggy ridge, lying within Ashe and Burke Counties, very near the northeast corner of Yancey, and cutting across the chain to which it belongs (the *Blue Ridge*) nearly at right angles. It is entirely covered with trees, except where the rocks are absolutely perpendicular; and towards the summit, the Balsam Fir of these mountains, *Abies balsamifera*, partly, of Michaux's Flora (but not of the younger Michaux's Sylva) the *A. Fraseri, Pursh*, prevails, accompanied by the *Abies nigra* or Black Spruce. The earth, rocks, and prostrate decaying trunks, in the shade of these trees, are carpeted with Mosses and Lichens; and the whole presents the most perfect resemblance to the dark and sombre forests of the northern parts of New York and Vermont, except that the trees are here much smaller. The resemblance extends to the whole vegetation; and a list of the shrubs and herbaceous plants of this mountain would be found to include a large portion of the common plants of the extreme Northern States and Canada.† Indeed the vegetation is essentially Canadian, with a considerable number of peculiar species intermixed. Under the guidance of Mr. Levi Moody, we followed the Watauga, here a mere creek, for four or five miles along the base of the Grandfather, until we reached a ridge which promised a comparatively easy ascent. In the rich soil of this ridge, at an elevation of about four hundred feet above the Watauga, we found one of the plants which of all others we were desirous of obtaining, viz. *Carex Fraseriana.* Mr. Curtis had made diligent but ineffectual search for this most singular and rarest of Carices, along the "Catawba near Morganton," and "near Table Mountain," where Fraser is said to have

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* According to Prof. Mitchell's barometrical measurements, the Grandfather attains the altitude of five thousand five hundred and fifty six feet above the sea; the Roan, six thousand and thirty eight feet; and the highest peak of the Black Mountain, six thousand four hundred and seventy six feet, which exceeds Mount Washington in New Hampshire (hitherto accounted the highest mountain in the United States,) by more than two hundred feet.—See *American Journal of Science and Arts*, Vol. xxxv, p. 377.

† Among the northern species which we had not previously observed in this region, we may mention *Carex flexuosa*, *C. plantaginea*, *C. scabrata*, *C. intumescens*, *Oxalis Acetosella*, *Streptopus roseus*, *Viburnum lantanoides*, and *Platanthera orbiculata* in the finest condition, and in greater profusion than we ever before met with this, the most striking of North American Orchidaceæ.

discovered it; and we believe that no subsequent botanist has ever met with it, except Mr. Kin, whose specimen in Muhlenberg's herbarium is merely ticketed "*Deigher walli in der Wilternus.*" Muhlenberg assigns the habitat, "Tiger Valley, Pennsylvania;" but Kin probably obtained his plant in *Tygart's Valley*, Virginia, a secluded vale among the western ranges of the Alleghanies, (in Randolph County,) not far from Greenbrier Mountains, and other localities visited by this collector, as his tickets prove. Kin cultivated the plant for some time at Philadelphia, where it was seen by several botanists, and among them by Pursh, who took it for the *Mapania sylvatica* of Aublet; a mistake which he did not discover whilst writing his Flora in Europe, although he had the cultivated *Carex Fraseriana* before him. We were too late for good specimens, but succeeded in obtaining a considerable number with the fruit still adherent. The plant grows in tufts, after the manner of *C. plantaginea;* the evergreen leaves are a foot or more in length, and often an inch and a half in width, with singularly undulate margins; the slender scapes are naked, except towards the root, where they are sheathed by the convolute bases of the leaves. To the description of the spike, fruit, &c., we have nothing of any consequence to add.

Long before we reached the summit we again met with the new *Saxifraga*,* which we had previously gathered on the mountains near Jefferson; but we now found it in great abundance, both in flower, and with mature fruit. It grew in the

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* Saxifraga Careyana (*spec. nov.*): foliis radicalibus longe petiolatis glabris (tenuibus) ovato-rotundis grosse crenato-dentatis basi truncatis vel subcordatis, scapo gracili nudo apice paniculato-cymoso, floribus effusis, pedicillis filiformibus, petalis lanceolato-oblongis sessilibus sepala recurva plus duplo superantibus, carpellis discretis turgidis demum divaricatis calyce liberis.—Variat 1, scapo petiolisque glabriusculis: 2, scapo, pedicillis, necnon pagina foliorum pilis viscosis pubescentibus: 3, scapo foliis aut bracteis foliaceis 1—2 instructo: 4, foliis ovalibus oblongisve, nunc argute dentatis, in petiolum plus minus attenuatis.

Crescit in rupibus humidis opacis altissimorum montium comitatus Ashe, præsertim ad montem *Grandfather* dictum, alt. 3500—5000 pedes. Junio floret.—Herba spithamæa, rarius pedalis. Flores parvi. Petala consimilia, sessilia, subtriplinervia, alba, immaculata. Filamenta subulato-filiformia. Carpella ovoidea, stylis brevibus apiculata, (stigmatibus subincrassatis,) basi vix aut ne vix coalita, ad maturitatem per totam suturam ventralem dehiscentia, ut in pleris Saxifragis plus minus apocarpeis. Semina ovalia, striis elevatis denticulatis (per lentem augentem) longitudinaliter notata.—Species distinctissima, habitu ad sect. *Hydaticam*, sed characteribus ad *Micranthem* accedens.

greatest profusion on the dripping face of a rocky precipice near our encampment for the night, on the northwestern side of the mountain, five or six hundred feet beneath the highest summit. The vegetation is here so backward, that the *Saxifraga leucanthemifolia* growing on the brow of this precipice was not yet in blossom, and the *Saxifraga erosa*, ***Pursh***, in the wet soil at its base was scarcely out of flower, while at the foot of the mountain it had long since shed its seeds. We were therefore enabled to satisfy ourselves that *S. erosa* belongs to the section *Hydatica*, and that the *S. Wolleana*, *Torr. & Gray*, from a mountain near Bethlehem in Pennsylvania, is only a variety of this species. Pursh gathered his plant in Virginia, "out of a run near the road from the Sweet Springs to the Union Springs, five miles from the former." But if this species be the *Robertsonia micranthifolia* of Haworth's Succulent Plants, as is most probable, and consequently the *Aulaxis micranthifolia* of this author's subsequent Enumeration of Saxifragaceous plants, it must have been introduced into the English gardens by Fraser, as early as 1810.* We know not how such a common plant could have escaped the notice of Michaux. Under the name of Lettuce, the leaves are eaten by the inhabitants as a salad. At this place we also saw an Umbelliferous plant not yet in flower, which we believe to be *Conioselinum Canadense*, *Torr. & Gray*, (Selinum Canadense, *Michx.*,) a very rare plant in the extreme Northern States and Canada, to which we had supposed it exclusively confined. We found plenty of *Cimicifuga Americana*, *Michx.*, but were obliged to content ourselves with specimens not yet in flower, and with vestiges of the last year's fruit. It should be collected in September.

We were also too early in the season for *Chelone Lyoni*, ***Pursh***, which we found in abundance between the precipice mentioned above and the summit of the mountain, with the flower-buds just beginning to appear. Mr. Curtis remarks that

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* The only important discrepancy respects Haworth's character, "Corolla irregularis, petalis 2 inferioribus elongatis divaricantibus gracilioribus," and "Flores albi, rubro minute punctati;" while the petals in our plant are very nearly equal and similar, and pure white, except the yellow spot at the base. *Aulaxis nuda*, *Haworth*, *l. c.* (of unknown origin,) appears to be the more ordinary and nearly glabrous form of this species. Mr. Don's description of *S. erosa*, probably drawn from the cultivated plant, also differs from our plant in several minor points.

Mr. Nuttall could not have met with this exclusively mountain plant near Wilmington; and also, that the *C. Lyoni* of Pursh and the *C. latifolia* of Muhlenberg and Elliott, are doubtless founded upon one and the same species. Both, indeed, are said to have been collected by Lyon, and the leaves vary from ovate-lanceolate or oval with an acute base, to ovate with a rounded, but scarcely cordate base. Pursh's character is drawn from a cultivated specimen. Here we again met with the *Aconitum* previously observed in similar situations on the *Negro Mountain*, and which, being then only in bud, we took for the *A. uncinatum*, a species collected in this region by Michaux, and recently by Mr. Curtis and other botanists. We were greatly surprised, therefore, to find that our plant, here just coming into blossom, had cream-colored flowers, very different from those of *A. uncinatum*, and more nearly resembling those of *A. Lycoctonum.** On our return to Jefferson, we obtained good specimens at our original locality, where it is very abundant. The weak stems, at first ascending, become prostrate when the plant is in flower, and frequently attain the length of seven or eight feet. As the stem does not climb, and its flowers are so different from those of *A. uncinatum*, it can hardly be the plant mentioned by Pursh under that species, which he saw at the foot of the Peaks of Otter, and about the Sweet Springs, in Virginia. It may be remarked, that the ovaries of *A. uncinatum* are often nearly glabrous, and the claws of the petals entirely so: the seeds are strongly plicate-rugose, with a wing-like margin on one side.

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* Aconitum reclinatum (*spec. nov.* § Lycoctonum): caule elongato decumbente foliisque palmatifidis glabris, lobis divaricatis cuneatis apicem versus incisis, racemis paniculisve divergentibus laxifloris (floribus albidis), bracteolis minimis, galea horizontali conico-cylindracea ore obliquo, labio cucullorum obcordato ab ungue distante, calcare adunco, filamentis edentulis, carpellis glabris 2–4-spermis, seminibus (immaturis) squamoso-rugosis.

Hab. in opacissimis sylvis ad montes *Negro Mountain* et *Grandfather* dictos, alt. 4000—5000 pedes. Julio–Augusto floret.—Caulis flaccidus, adscendens vel declinatus, denique procumbens, 3–8-pedalis, ramis gracilibus, seu paniculis laxifloris, divaricatis. Folia flaccida; inferiora longe petiolata, (circumscriptione suborbiculari,) profunde 5–7-fida; segmentis interdum 2–3-lobatis, apice inciso-dentatis, dentibus mucronatis; summa subsessilia, 3–5-partita; venis et pagina quandoque superiori tenuissime pubescentibus. Pedicelli sparsi (pedunculique puberuli,) flore longiores, bracteolis 2–3 minimis stipati. Flores minores quam in *A. Lycoctono*, albi vix flavidis tincti (in siccis leviter purpurascentes); sepalis intus pilis aureis barbatis. Galea primum adscendens, mox horizontalis, rostello brevi rectiusculo. Unguis petalorum medium cuculli adfixus: saccus angustus, ore valde obliquo in labium obcordatum expanso. Ovaria tria, 4–6-ovulata.

Near the summit of the mountain, we saw immense quantities of a low but very large-leaved *Solidago*, not yet in flower, which I take to be the *S. glomerata* of Michaux, who could not have failed to observe such a conspicuous and abundant plant, especially as it must have been in full blossom at the time he ascended this mountain. It does not, however, altogether accord with Michaux's description, nor does that author notice the size of the heads, which in our plant are among the largest of the genus. Specimens in flower were procured by Mr. Curtis, who visited this mountain at a more favorable season. With the latter, we found a *Geum*, which Mr. Curtis had formerly observed on the *Roan Mountain*, (where we afterwards met with it in great abundance,) and referred, I think correctly, to *G. geniculatum, Michx.*, although that species is said to have been collected in Canada. The lower portion of the style is less hairy in our specimens than in Michaux's plant, a difference which, if constant, is perhaps not of specific importance. In the subjoined character, I have supplied an inadvertent omission in the *Flora of North America*, where the sessile head of carpels, which so readily distinguishes this species from *G. rivale*, is not mentioned.* Here we again found *Vaccinium erythrocarpum*, as already mentioned; and obtained beautiful flowering specimens of *Menziesia globularis*, a straggling shrub which in this place attains the height of five or six feet.

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* Geum geniculatum (*Michx.*): capitulo carpellorum sessili, articulo styli superiore plumoso inferiorem pubescentem excedente, achenio hirsuto, petalis cuneato-obovatis (nunc emarginatis aut leviter obcordatis) exunguiculatis calycem æquantibus; floribus mox erectis.

β. Macreanum: articulo styli inferiore sursum glabrescente.—G. Macreanum, *M. A. Curtis, in litt.*

Crescit in Canada ex *Michaux*: an recte? Var. β. in umbrosis ad montes *Grandfather* et *Roan*, Carolinæ Septentrionalis, alt. 5500—6000 pedes, ubi imprimis detexit cl. *Curtis*. Julio floret.—Caulis 2-3-pedalis, gracilis, foliosus, inferne pilis rigidiusculis retrorsis, superne pilis mollibus patentibus crebrioribus villosus. Folia membranacea; radicalia nunc palmatim 3-secta, nunc interrupte pinnatisecta, haud rariusque indivisa vel sublobata in eodem stirpe; caulinia trisecta trilobatave, lobis acutis; superiora sessilia. Flores minores et numerosiores quam in *G. rivali*: petala albida, venis purpurascentibus. Styli pars inferior portione plumosa primum multo, postremum modice brevior, in exemplo *Michx.* manifeste, at juxta apicem parce piloso-pubescens; in var. β. superne glabrata.

Should the Carolina plant hereafter prove to be a distinct species, it will of course retain the name proposed by Mr. Curtis, in honor of his friend and former associate in botanical labors, Dr. James F. McRee, of Wilmington, North Carolina.

The only unwooded portion of the ridge which we ascended, an exposed rock a few yards in extent, presents a truly Alpine aspect, being clothed with Lichens and Mosses, and with a dense mat of the mountain *Leiophyllum*, a stunted and much branched shrub (five to ten inches high,) with small coriaceous leaves, greatly resembling *Azalea procumbens*.* The much denser growth, and the broader, more petiolate, and perhaps uniformly opposite leaves, as well as the very different habitat, would seem to distinguish the mountain plant from the *L. buxifolium* of the Pine Barrens of New Jersey, &c.; but, although I think the learned DeCandolle has correctly separated the former, under the name of *L. serpyllifolium*, (Ledum serpyllifolium, *L'Her. ined.*) it is not easy to find sufficient and entirely constant distinctive characters; since the sparse scabrous puberulence of the capsule may also be observed upon the ovary of the low-country plant, in which the leaves are likewise not unfrequently opposite; and no reliance can be placed on the length of the pedicels. The synonomy requires some correction: the *Ledum buxifolium* of Michaux (in summis montibus excelsis Carolinæ), and of Nuttall, (so far as respects the plant which "is extremely abundant on the highest summits of the Catawba Ridge," that is, on *Table Mountain*,) as well as the *Leiophyllum buxifolium* of Elliott, (from the mountains of Greenville district, South Carolina,) must be referred to *L. serpyllifolium, DC.* We were too late to obtain the plant in blossom, excepting one or two straggling specimens; but we were so fortunate as to procure a few flowering specimens of *Rhododendron Catawbiense.*

I should have remarked, that so much time was occupied in the ascent of this mountain as nearly to prevent us from herborizing around the summit for that day; since we had to descend some distance to the nearest spring of water, and prepare our encampment for the night. The branches of the *Balsam* afforded excellent materials for the construction of our lodge, the smaller twigs with large mats of moss stripped from the rocks furnished our bed, and the dead trees supplied us with fuel for cooking our supper, and for the large fire we were obliged to keep up during

* We are confident that the latter does not grow on the *Grandfather Mountain*, as is stated by Pursh, on the authority of a specimen collected by Lyon; and have little doubt that he mistook for it this species of *Leiophyllum*. Vide *Pursh, Flora Amer. Sept.* 1. p. 154, and p. 301.

the night. We re-ascended the summit the next morning, and devoted several hours to its examination, but the threatening state of the weather prevented us from visiting the adjacent ridges, or the southern and eastern faces of the mountain, and we were constrained to descend towards evening to the humble dwelling of our guide, which we reached before the impending storm commenced.

Our next excursion was to the ***Roan Mountain,*** a portion of the elevated range which forms the boundary between North Carolina and Tennessee, distant nearly thirty miles southwest from our quarters at the foot of Grandfather by the most direct path, but at least sixty by the nearest carriage road. We travelled for the most part on foot, loading the horses with our portfolios, paper, and some necessary luggage, crossed the *Hanging-rock* Mountain to Elk Creek, and thence over a steep ridge to Cranberry Forge, on the sources of Doe River, where we passed the night. On our way, we cut down a *Service-tree,* (as the *Amelanchier Canadensis* is here called,) and feasted upon the ripe fruit, which throughout this region is highly, and indeed justly prized, being sweet with a very agreeable flavor; while in the Northern States, so far as our experience goes, this fruit, even if it may be said to be edible, is not worth eating. As '*Sarvices*' are here greedily sought after, and are generally procured by cutting down the trees, the latter are becoming scarce in the vicinity of the 'plantations,' as the mountain settlements are universally called. Along the streams we met with the mountain species of *Andromeda* (*Leucothoe,*) doubtless Pursh's *A. axillaris;* but whether the original *A. axillaris* of the *Hortus Kewensis* pertains to this, or to the species of the low country, I cannot at this moment ascertain. A portion of Pursh's character seems also to belong to the low country rather than the mountain species, and the two are by no means clearly distinguished in subsequent works. The leaves, in our specimens, are oblong-lanceolate, finely acuminate, the margins closely beset throughout with spinulose-setaceous teeth; and the rather loose spicate racemes, (the corolla having fallen,) are nearly half the length of the leaves.

Hitherto we had searched in vain for the *Astilbe decandra;* but we first met with this very interesting plant in the rich and moist mountain woods between Elk Creek and Cranberry Forge, and subsequently in similar situations, particularly along the steep banks of streams, quite to the base of the *Roan*. Mr. Curtis found it abundantly near the sources of the Linville River, and at the North Cove, where it could not have escaped the notice of Michaux; and it is doubtless the *Spiræa Aruncus* var. *hermaphrodita* of that author. It indeed greatly resembles *Spiræa Aruncus*, and at a distance of a few yards is not easily distinguished from that plant, but on a closer approach the resemblance is much less striking. Michaux appears to have been the original discoverer of this plant, and from him the specimens cultivated in the Malmaison Garden, and described by Ventenat under the name of *Tiarella biternata*, were probably derived. It was afterwards collected by Lyon,* and described by Pursh from a specimen cultivated in Mr. Lambert's garden at Boynton. We noticed a peculiarity in this plant, which explains the discrepancy between Ventenat and Pursh, (the former having figured it with linear-spatulate petals, while the latter found it apetalous,) and perhaps throws some additional light upon the genus. The flowers are *diœcio-polygamous*, the two forms differing from each other in aspect much as the staminate and pistillate plants of *Spiræa Aruncus*. In one form, the filaments are exserted to twice or thrice the length of the calyx, and the spatulate-linear petals, inconspicuous only on account of their narrowness, are nearly as long as the stamens: the ovaries are well-formed and filled with ovules, which, however, so far as I have observed, are never fertilized; and the stigmas are smaller than in the fertile plant, and not papillose. In the other or fertile form, both the stamens and the petals are in an abortive or rudimentary state, and being shorter than the sepals, and concealed by them in dried specimens, are readily overlooked; the stigmas are large, truncate, and papillose, and a portion of the ovules become fertile. The Japanese species (*Hoteia Japonica, Morr. & Decaisne*, the *Spiræa Aruncus* of Thunberg,) appears to have uniform and perfect flowers;† but the species from Nepal (*Astilbe rivularis*,

* Muhlenberg's specimen was also received from Lyon. The only habitat cited in this author's Catalogue is Tennessee, and we ourselves collected it within the limits, as well as on the borders of that State. The late Dr. Macbride found it in South Carolina, near the sources of the Saluda.

† "Flores in meo Japonico specimine omnes inveni hermaphroditos, nec ullos polygamos." *Thunberg, Flora Japonica*, p. 212, sub *Spiræa Arunco*.

*Don*, the *Spiræa barbata* of Wallich, but not of Lindley,) is probably polygamo-diœcious, like our own species; at least, the flowers are apetalous in a fragment given me by Prof. Royle, and the stamens mostly equal in number to the sepals. I have no doubt that these three species belong to a single and very natural genus, for which the name of *Astilbe* must be retained; for I see neither justice nor reason in superseding the prior name, as suggested by Endlicher,* on account of the incompleteness of the character, which correctly describes one state, at least, of the plant intended, by the subsequent *Hoteia*, the character of which is equally incomplete, when applied to the whole genus.† The

* "Si, quod nunc asserunt auctores, *Hoteia* et *Astilbe*, *Don*, revera plantæ congeneres, posterius incomplete ab auctore suo descriptum supprimendum, et prius egregie stabilitum servandum erit." *Endl. Gen. Suppl. p.* 1416.

† Since the above remarks were written, I have seen in the *Annales des Sciences Naturelles* for January, 1841, M. Decaisne's additional *Note sur les genres Astilbe et Hoteia*, in which the two genera are still held to be distinct, the latter including the North American plant, as originally proposed by this author. The characters of his two genera (excluding such as are common to both) are merely these:

ASTILBE. Flores hermaphroditi, vel sæpe stam. abortu fœminei. Petala nulla. Stamina 5.

HOTEIA. Flores hermaphroditi. Petala 5, angusta. Stamina 10, quinque petalis opposita breviora.

Since, then, it appears that the *Astilbe rivularis* is more or less diœcio-polygamous, the view I had already taken is certainly confirmed; and when this acute and justly distinguished botanist becomes acquainted with the two states of the American species, and considers that the stamens of the original *Astilbe* are probably sometimes double the number of the sepals, as described by Don, he will doubtless come to the same conclusion. The diagnostic characters of the three species may be thus expressed.

ASTILBE, *Hamilton, ex Don; Torr. & Gray.* (Hoteia, *Morr. & Decaisne.*)

1. A. RIVULARIS (*Hamilton, Don*): floribus sæpe diœcio-polygamis, calyce 4–5-partito imo ovario tantum adnato, petalis (an semper?) nullis, staminibus 4–5 nunc 8 (ex *Don*.)—Spiræa barbata, *Wall. cat.; Camb. in Jacquem. bot. p.* 48. *t.* 58 *ex Decaisne*.

Hab. in montibus Nepalensibus.

2. A. DECANDRA (*Don*): floribus diœcio-polygamis, calyce 5-partito imo ovario tantum adnato, petalis anguste lineari-spathulatis (in pl. fert. subnullis), staminibus 10 (in pl. fert. abortivis).—Spiræa Aruncus *var.* hermaphrodita, *Michx.* Tiarella biternata, *Vent. hort. Malmais. t.* 34. Astilbe decandra, *Don; Torr. & Gray, fl. N. Amer.* 1. *p.* 589. Hoteia biternata, *Decaisne, in ann. sci. nat.* (*ser.* 2.) 2. *t.* 11. *f.* 11 & 12, & 7, *p.* 36.

Hab. in montibus Carolinæ et Tennessee.

3. A. JAPONICA: floribus hermaphroditis, calycis profunde quinquefidi tubo basi ovarii adnato, petalis oblongo-spathulatis, staminibus 10.—Spiræa Aruncus, *Thunb. fl. Japon. p.* 211, non *Linn.* S. barbata, *Lindl. bot. reg. t.* 2011, non *Wall.* Hoteia Japonica, *Morr. & Decaisne, in ann. sci. nat.* (*ser.* 2.) 2. *t.* 11, & 7. *p.* 36.

Hab. in Japonia.

number of genera which are either divided between North America, Japan, and the mountain-region of central Asia, or have nearly allied species in these countries or in the two former, is very considerable: in other cases a North American genus is replaced by a nearly allied one in Japan, &c., as *Decumaria* by *Schizophragma*, *Schizandra* by *Sphærostemma*, *Hamamelis* by *Corylopsis*, &c. I have elsewhere alluded to this subject, and shall probably consider it more particularly on some future occasion.

Our next day's journey was from Cranberry Forge to Crab Orchard on Doe River, in Tennessee, and up Little Doe River to 'Squire Hampton's, where we took a guide and ascended the *Roan.* While ascending the Little Doe River, about three miles from its junction with the larger stream of that name, at one of the numerous places where the road crosses this rivulet, we again met with *Carex Fraseriana.* The plant did not appear to be so abundant in this Tennessee locality as at the Grandfather, but it is doubtless plentiful on the mountain side just above. We ascended the north side of the *Roan*, through the heavy timbered woods and rank herbage with which it is covered; but found nothing new to us, excepting *Streptopus lanuginosus*, in fruit; and among the groves of *Rhododendron maximum* towards the summit, we also collected *Diphyscium foliosum*, a moss which we had not before seen in a living state. In more open moist places near the summit, we found the *Hedyotis* (*Houstonia*) *serpyllifolia*, still beautifully in flower, and the *Geum geniculatum*, which we have already noticed. It was just sunset when we reached the bald and grassy summit of this noble mountain, and after enjoying for a moment the magnificent view it affords, had barely time to prepare our encampment between two dense clumps of *Rhododendron Catawbiense*, to collect fuel, and make ready our supper. The night was so fine that our slight shelter of Balsam boughs proved amply sufficient; the thermometer, at this elevation of about six thousand feet above the level of the sea, being 64° Fahr. at midnight, and 60° at sunrise. The temperature of a spring just under the brow of the mountain below our encampment we found to be 47° Fahr. The *Roan* is well characterized by *Prof. Mitchell*, as the easiest of access and the most beautiful of all the high mountains of that region. "With the exception of a body of [granitic] rocks, looking like the ruins of an old castle, near its southwestern extremity, the top of the *Roan* may be described as a vast meadow, [about nine miles in length, with some interruptions, and with a maximum elevation of six thousand and thirty eight feet,] without a tree to obstruct the prospect; where a person may gallop his horse for a mile or two, with Carolina at his feet on one side, and Tennessee on the other, and a green ocean of mountains raised into tremendous billows immediately about him. It is the pasture ground for the young horses of the whole country about it during the summer. We found the strawberry here in the greatest abundance and of the finest quality, in regard to both size and flavor, on the 30th of July."*

At sunrise we had fine weather and a most extensive view of the surrounding country; in one direction we could count from eight to twelve successive ranges of mountains, and nearly all the higher peaks of this whole region were distinctly visible. Soon, however, we were enveloped in a dense fog which continued for several hours, during which we traversed the southwestern summit, and made a list of the plants we saw. The herbaceous plants of this bald and rounded summit are chiefly *Aira flexuosa*, *Juncus tenuis*, *Carex intumescens*, *festucacea*, *æstivalis* of Mr. Curtis, and a narrow-leaved variety of *C. Pennsylvanica*, the latter constituting the greater part of the grassy herbage, *Luzula campestris*, *Lilium Philadelphicum* and *Canadense*, which here only attain the height of four to eight inches, *Sisyrinchium anceps*, *Smilacina bifolia*, *Habenaria* (*Platanthera*) *peramœna*, *Veratrum viride*, *Helonias* (*Chamælirium*) *dioica*, *Osmunda Claytoniana*, *Linn.* (O. interrupta, *Michx.*), *Athyrium asplenioides*, *Pedicularis Canadensis* mostly with purplish-brown flowers, now just in blossom, *Trautvetteria palmata*, *Ranunculus repens*, *Thalictrum dioicum* just in flower, *Geum radiatum* in the greatest profusion, (it was here that Michaux obtained this species,) *Potentilla tridentata* and *Canadensis*, *Fragaria Virginiana*, the fruit just ripe and of the finest flavor, *Rubus villosus* now in flower, *Castilleja coccinea*, *Geranium maculatum*, *Clematis Viorna* about eight inches high, *Sanicula Marilandica*, *Zizia aurea*, *Heracleum lanatum*, *Hypericum*

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* Prof. Mitchell of Chapel Hill University, in the *Raleigh Register* of Nov. 3d, 1835, and in the *American Journal of Science and Arts*, for January, 1839.

*corymbosum*, with larger flowers than usual, a more upright and larger-leaved variety of *Hedyotis serpyllifolia*, *Œnothera glauca* β., *Senecio Balsamitæ*, *Rudbeckia triloba*, and a dwarf variety of *R. laciniata*, *Liatris spicata*, *Cacalia atriplicifolia*, *Cynthia Virginica*, *Aster acuminatus*, *Solidago bicolor*, *S. spithamæa*, *Curtis in Torr. & Gr. fl. ined.*, a very distinct dwarf species, *S. Curtisii*, *Torr. & Gr. l. c.* not yet in flower, and *S. glomerata* in the same state as at *Grandfather Mountain;* also *Saxifraga leucanthemifolia*, *Sedum telephioides*, *Heuchera villosa*, *Polypodium vulgare*, the dwarf var. of *Hedyotis purpurea* previously noticed, *Scirpus cæspitosus*, and *Agrostis rupestris!* which are confined to the rocky precipice already mentioned. The only tree is *Abies Fraseri*, a few dwarf specimens of which extend into the open ground of the summit; and the following are all the shrubs which we observed, viz. *Diervilla trifida*, *Menziesia globularis*, *Vaccinium erythrocarpum*, *Rhododendron Catawbiense*, forming very dense clumps, *Leiophyllum serpyllifolium*, *Sorbus Americana*, two to four feet high, *Cratægus punctata* only a foot in height, *Pyrus arbutifolia* var. *melanocarpa*, *Ribes rotundifolium;* and a low and much-branched species of Alder, which Mr. Curtis proposes to call *Alnus Mitchelliana*, in honor of Professor Mitchell; but we fear it may prove to be a variety of what we deem the *A. crispa*, *Ait.* from the mountains of New York, New Hampshire, &c., and Newfoundland, although it has more rounded leaves, with the lower surface nearly glabrous, except the primary veins; while in the former (to which the names of *A. crispa* and *A. undulata* are not very appropriate,) the leaves are often, but not always, somewhat velvety-pubescent beneath. To our list must be added an apparently undescribed species of *Vaccinium*, first noticed by Mr. Constable.* We made a hasty visit to the other principal sum-

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* Vaccinium Constablæi (*spec. nov*): pumilum, foliis deciduis ovalibus pallidis subtus glaucis reticulato-venosisque glanduloso-mucronatis integerrimis vel obsoletissime serrulatis ciliatis, racemis brevissimis sessilibus, bracteis squamaceis parvis caducis, corollis brevissime cylindricis, antheris inclusis muticis, ovariis 10-locularibus, loculis pluri-ovulatis.

In summo jugo '*Roan Mountain*' dicto, (Tennessee et Carolina Septentrionali,) ad alt. 6000 pedes. Julio floret.—Frutex 1–3-pedalis, erectus, ramis griseo-viridibus teretis. Folia sesqui-biuncialia, lato-ovalia vel elliptica, utrinque sæpius acuta, glabra, nisi costa supra puberula et margines ciliati, subsessilia, infra saturate glauca. Racemi 5–10-flori, sæpe corymbosi, ad apicem ramulorum anni præcomit, where we found nothing that we had not already collected, excepting *Arenaria glabra, Michx.*, and descended partly by way of the contiguous *Yellow Mountain.*

Retracing our steps, we returned the next day to the foot of *Grandfather*, and reached our quarters at Jefferson the second day after. We had frequently been told of an antidote to the bite of the *Rattle-snake* and *Copper-head*, (not unfrequent throughout this region,) which is thought to possess wonderful efficacy, called *Turman's Snake-root*, after an 'Indian Doctor,' who first employed it; the plant was brought to us by a man who was ready to attest its virtues from his personal knowledge, and proved to be the *Silene stellata!* Its use was suggested by the markings of the root beneath the bark, in which these people find a fancied resemblance to the skin of the Rattle-snake. Nearly all the reputed antidotes are equally inert; such herbs as *Impatiens pallida*, &c. being sometimes employed; so that we are led to conclude that the bite of these reptiles is seldom fatal, or even very dangerous, in these cooler portions of the country.

About the foot of the *Roan* and *Grandfather*, we obtained a few specimens of *Pycnanthemum montanum, Michx.* (Monardella, *Benth.*) just coming into blossom. Our plant accords with Michaux's description, except that there are frequently two, or even three axillary heads besides the terminal one. The flowers have altogether the structure of *Pycnanthemum*, and the upper lip of the corolla is entire; so that it cannot belong to *Monardella*, although placed as the leading species of that genus.

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dentis solitarii vel aggregati. Baccæ immaturæ cæruleæ, glaucæ, limbo calycis majusculo coronatæ, decem- (nunc abortu quinque?) loculares; loculis pleio- (3–6?) spermis.

Prof. Dunal (in *DC. prodr.* 7. *p.* 566,) notices as an extraordinary exception to the character of Vaccinium, a species with an 8 to 10-celled fruit and a single? seed in each cell. The first-named character is not unfrequent in the genus; several of the more common species which I have cursorily examined, exhibit a more or less completely 8–10-celled ovary, but with many ovules in each cell. There is a small group, however, (Decachæna, *Torr. & Gr. ined.*) presenting a different structure, which is best exemplified in *V. resinosum, Ait.* The 10 carpels of this species, enclosed in the baccate calyx, are very slightly coherent with each other, and become crustaceous or bony nuts, each containing a single ascending seed. The same is the case in what I take to be *V. dumosum* and *V. hirtellum;* and probably in some other species which have the leaves sprinkled with resinous dots. *V. frondosum, Willd.* (which is the *V. decamerocarpon* of Dunal,) is similar in structure, except that the carpels appear to be more coherent and less indurated.

As to the species from which Mr. Bentham derived the generic name, (*Pycnanthemum Monardella, Michx.*,) I am by no means certain that it belongs either to *Pycnanthemum* or *Monardella.* The specimen in the Michauxian herbarium is not out of flower, as has been thought, but the inflorescence is undeveloped, and perhaps in an abnormal state. In examining a small portion taken from the head, I found nothing but striate-nerved bracts, obtuse and villous at the apex, and abruptly awned; the exterior involucrate and often lobed; the innermost linear, and tipped with a single awn. The aspect of the plant, also, is so like *Monarda fistulosa*, that I am strongly inclined to think it a somewhat monstrous state of that, or some nearly allied species; in which case, the genus *Monardella* should be restricted to the Californian species. Pursh's *P. Monardella*, I may observe, was collected beneath the Natural Bridge in Virginia, where we also obtained the plant, and subsequently met with it throughout the mountains. It is certainly a form of *Monarda fistulosa*, according to Mr. Bentham's characters; but the taste is much less pungent, the throat of the calyx less strongly bearded than is usual in that species, and the corolla nearly white. We thought it probably a distinct species; but these differences may be owing to the deep shade in which it commonly occurs. The *P. Monardella* of Elliott, according to his herbarium, is identical with that of Pursh. We collected in Ashe County several other species of *Pycnanthemum*, and in the endeavor to discriminate them, we encountered so many difficulties that I am induced to give a revision of the whole genus.*

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* CONSPECTUS PYCNANTHEMORUM.

§ 1. *Calyx vix bilabiatus; dentibus bracteisque subulato-aristatis, rigidis, nudis, corollam æquantibus. Verticillastri densi plerumque terminales. Ovaria barbata. Folia subpetiolata, rigida.*

1. P. ARISTATUM (*Michx.*): foliis breviter petiolatis ovato-oblongis acutis subserratis basi rotundatis cauleque tenuissime canescenti-tomentosis vel glabris.—P. setosum, *Nutt. in jour. acad. Philad.* 7. *p.* 100, excl. syn. *Pursh.* Origanum incanum, *Walt. herb.*

Hab. a Nova Cæsarea ad Floridam.—Folia floralia nunc candicantia.

2. P. HYSSOPIFOLIUM (*Benth.*): foliis subsessilibus lineari-oblongis obtusis subintegerrimis cauleque glabris vel tenuissime subtomentoso-canescentibus.—P. aristatum, *Pursh*, (fide, spec. in *herb. Lamb.* et *herb. Bart.*,) *Nutt.* et *Ell.*

Hab. a Virginia usque ad Floridam et Louisianam.—Duæ species arcte affines optime dignoscuntur in *Benth. Lab. gen. et spec.* Stamina e fauce corollæ subexserta.

§ 2. *Calyx bilabiatus; nempe, dentibus (plerumque subulatis, sæpe pilis rigidiusculis barbatis,) 3 superioribus in labio superiore basi coalitis. Verticillastri cymosi, laxi. Ovaria sæpius barbati. Folia petiolata.*

Some additional plants were obtained around Jefferson, which were not previously in blossom, such as *Campanula divaricata; Cacalia reniformis; Silphium perfoliatum;* the larger form of *Coreopsis auriculata,* with nearly all the leaves undivided; the

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3. P. ALBESCENS (*Torr. & Gray, fl. N. Amer. ined.*): verticillastris cymosis, dentibus calycis æqualibus triangulari-lanceolatis brevibus obtusiusculis muticis, foliis oblongis ovato-lanceolatisve subserratis utrinque acutis supra glabris subtus canis.

Hab. in Louisiana, *Ingalls, Hale,* et Alabama, *Gates.*—Minus per totum quam *P. incanum;* foliis superioribus, ut in aliis utrinque candidis, cæteris cauleque pube brevissima incanis. Ovaria ad apicem brevissime barbata.

4. P. INCANUM (*Michx.*): verticillastris cymosis, dentibus calycis subæqualibus lanceolato-subulatis, apice plerumque 1–2-setosis, foliis ovato-oblongis remote serratis basi rotundatis pubescentibus subtus albo-tomentosis, floralibus utrinque candidis.

Folia ampla. Ovaria ut vidi villoso-barbata, non "apice attenuata, appendice paleaceo acuminata."—Mihi ignotum est P. Loomisii, *Nutt. in jour. acad. Philad.* 7. *p.* 100, quod in characteribus datis omnino P. incano convenit.

5. P. TULLIA (*Benth.*): verticillastris cymosis, (floribus omnino explicatis in ramos subsimplices arcte secundis,) dentibus calycis bilabiati subæqualibus e basi lanceolata longe subulato-aristatis bracteisque apicem versus pilis longis barbatis, 2 inferioribus tubum æquantibus, foliis oblongis acutis vel acuminatis subserratis petiolatis cauleque villoso-pubescentibus, floralibus dealbatis.—Tullia pycnanthemoides, *Leavenworth, in Sill. jour.* 20. *p.* 343, *t.* 5.

Variat 1, calyce imberbi, *fide Benth. Lab. suppl. p.* 728 (Carol. Austr. *Mitchell*); 2, foliis ovato-oblongis basi aut rotundatis aut acutis (sic legimus in comitatu Ashe, et invenit cl. *Curtis* in com. Burke, Carol. Sept.); 3, foliis lanceolatis utrinque acutis vel attenuatis (cum præcedente legimus). In stirps *Leavenworthii* (ad *Paint Mountain,* Tennessee Orient. exeunte Octobri decerpta), rami fructiferæ, cymæ subsimplices elongati sunt, densiflori, floribus sessilibus arcte secundis.—Exstat specimen in *herb. Bart.* cum schedula, "P. montanum? *Michx.* in Virginia juxta Staunton," manu Purshii inscripta. Dentes calycini attenuato-subulati, pilis setiformibus longissimis articulatis plerumque barbati; 2 inferiores labium superius subæquantes, nunc paulo superantes. Ovaria pilis paucioribus barbulata.

6. P. DUBIUM (*spec. nov.*): verticillastris cymosis, dentibus calycis bilabiati subulatis bracteisque pilis longis barbatis, 2 inferioribus tubo labioque superiore brevioribus, foliis lanceolatis utrinque acutis subintegerrimis glabriusculis petiolatis, caule villoso-pubescente.

Hab. in Carolina Septentrionali, comitatu Ashe, cum *P. Tullia* et *P. piloso* β. vigens, ubi legimus ad finem Julii.—*P. Tulliæ* nimis affinis, sed differt, (an satis ?) foliis angustioribus fere integerrimis, nunquam incanis vel dealbatis, dentibus calycis brevioribus et inæqualibus, ovariis calvis nec barbulatis, etc.—Folia 2–3-pollicaria, semipoll. lata, acutissima, ad venas pl. m. pubescentia. Bracteæ et corolla præcedentis.

7. P. CLINOPODIOIDES (*Torr. & Gray, fl. N. Amer. ined.*): verticillastris contractis, dentibus calycis subæqualibus brevibus subulatis bracteisque canescenti-pilosis, foliis oblongo-lanceolatis utrinque acutiusculis subserratis breviter petiolatis supra glabratis subtus cauleque molliter pubescenti-villosis.

Hab. in siccis circa urbem Novum Eboracum et in Nova Cæsarea. Augusto floret.—Caulis pedalis et ultra, pube molli laxa vestitus, subsimplex. Folia 2–3-pollicaria, nunquam dealbata; pagina superiore sæpe glabra; inferiore, præsertim ad costam et venas villoso-pubescente. Bracteæ breviores quam in præcedente, et minus barbatæ. Dentes calycis tubo fere dimidio breviores, 3 superiores basi satis coaliti. Stamina modice exserta. Ovaria barbata.—Stirpes angustifoliæ versus sequentem, latifoliæ ad *P. incanum* tendentes vel transeuntes?

glabrous and narrow-leaved variety of *C. senifolia* (C. stellata, *Nutt.*) which alone occurs in this region; *Melanthium Virginicum*, which is a very handsome plant, with the flowers cream-colored when they first expand; and *Stenanthium angustifo-*

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§ 3. *Calyx subæqualiter dentatus. Verticillastri laxe capituliformes, plerumque terminales, corymboso-paniculati. Bracteæ floribus breviores. Ovaria sæpius calva. Folia vix petiolata.*

8. P. Torrei (*Benth.*): calyce subæqualiter dentato, dentibus subulatis bracteisque pubescenti-canescentibus, foliis lineari-lanceolatis oblongo-linearibusve glabriusculis acutis vix serratis basi in petiolum brevissimum sensim angustatis, caule stricto pubescente. —P. Virginicum, *Nutt. gen.* 2. *p.* 33?

Hab. in Nova Cæsarea, et circa urbem Novum Eboracum, ubi frequens; etiam in Carolina Australi, ex *Benth. Lab. suppl.*—Facies aliquantum *P. lanceolati*, sed facile distinguitur; foliis longioribus (minus rigidis) basi longe attenuatis, verticillastris contractis nec capitatis, bracteis plerisque subulatis haud adpressis, dentibus calycis gracilioribus, corolla ampliore magis ringente, et staminibus exsertis.

9. P. pilosum (*Nutt.*): calyce subinæqualiter dentato, dentibus ovato-lanceolatis acutis bracteisque canescenti-villosis, foliis lanceolatis subintegerrimis basi acutis subsessilibus caule ramisque erectis molliter pubescentibus aut villosis, floralibus nunquam dealbatis.—P. muticum, *Benth. Lab. p.* 329, partim.—Variat, 1, calyce fere æqualiter 5-dentato; 2, dentibus calycinis 3 superioribus basi manifeste coalitis; et, ni fallor,

β. leptodon: calyce fere æqualiter dentato, dentibus longioribus e basi lato acuminatis vel subulatis bracteisque (acuminatis) villoso-canis.—An species?

Hab. in civitatibus occidentalibus, ab Ohio et Tennessee ad Missouriam et Arkansam. Var. β. in comitatu Ashe, Carol. Sept. legimus: etiam cl. *Boykin* e Georgia misit.—Species ab *P. mutico* certissime diversa, habitu, pubescentia, foliis minus rigidis basi angustatis, dentibus calycis dense villoso-barbatis, etc. etc. Ovaria apice obsolete barbulata.

10. P. muticum (*Pers.*): calyce æqualiter dentato, dentibus triangulari-ovatis brevibus bracteisque muticis pube brevissima canescentibus, foliis rigidis ovatis vel ovato-lanceolatis acutis sæpius serratis basi rotundatis (nunc subcordatis) sessilibus subpetiolatisve, inferioribus cauleque laxe paniculato glabris aut tenuiter subtomentosis, summis dealbatis.—Brachystemum muticum, *Michx. fl.* 2. *p.* 6. *t.* 32. Pycnanthemum muticum, *Benth. l. c.* partim?

Hab. Massachusetts usque ad Louisianam.—Folia 1–3-uncialia, nunc exacte ovata, nunc ovato-oblonga vel sublanceolata, interdum serrata ut in icone *Michx.*, haud rarius serraturis sparsioribus vel obsoletis, basi semper rotundata. Verticillastri capituliformes, pauci, parvi, bracteis acutis calycem æquantibus. Ovaria calva.

§ 4. *Calyx æqualiter dentatus. Verticillastri dense capituliformes, bracteis rigidis adpressis suffulti, numerosi, paniculato-corymbosi, fere omnes terminales, nunc subfasciculati. Corollæ labia brevia. Ovaria calva. Folia sessilia, angusta, crebra.*

11. P. lanceolatum (*Pursh*): dentibus calycis brevibus triangularibus (sæpe acutis) bracteisque ovato-lanceolatis villoso-tomentosis, foliis lanceolatis linearibusve integerrimis rigidis glabriusculis basi obtusis sessilibus, caule ad angulas pubescente.—Brachystemum Virginicum, *Michx.*

Variat foliis nunc lato-lanceolatis, nunc anguste linearibus, rarissime (spec. in *herb. J. Carey*, vidi) subserratis. Stamina sæpius inclusa, haud rarius vel duo vel omnia exserta, labia corollæ subæquantia!

12. P. linifolium (*Pursh*): dentibus calycis lanceolato-subulatis bracteisque (e basi ovata vel lineari subaristatis) rigidis glabrescentibus, foliis anguste linearibus rigidis integerrimis sessilibus cauleque glabris.

Stamina nunc inclusa, nunc subexserta.

*lium, Gray*, which is doubtless the *Helonias graminea* of the Botanical Magazine. We also made an excursion to the *White Top*, in Virginia, twenty miles northwest from Jefferson; a mountain of the same character as the *Roan*, but on a smaller scale, and with the pasturage of its summit more closely fed. We were not rewarded, however, with any new plants, and the cloudy weather obscured the prospect, which is said to be very extensive. On our return, we found *Cedronella cordata, Benth.*, nearly out of flower, with runners often two or three feet in length. Mr. Bentham has omitted to mention the agreeable balsamic odor of the genus, which in our plant is much less powerful than in *C. triphylla*. We saw plenty of *Cimicifuga Americana*, but the flowers were still unexpanded. Our endeavors to obtain the fruit of *Cimicifuga cordifolia* (common in this region,) were likewise unsuccessful; without which it is not always easy to distinguish this species from *C. racemosa*. The leaflets of the former are frequently very large, the terminal ones resem-

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§ 5. *Calyx æqualiter dentatus. Verticillastri dense corymbosi, terminales, paniculati, bracteis laxis, interioribus brevissimis. Ovaria calva. Folia brevia, remotiuscula, sessilia.*

13. P. NUDUM (*Nutt.*): glabrum pallide virens, dentibus calycis triangulari-lanceolatis brevibus pilosis, bracteis exterioribus lanceolato-linearibus interioribus brevissimis subulatis, foliis ovato-oblongis integerrimis sessilibus, caule simplici stricto.

§ 6. *Calyx æqualiter dentatus. Verticillastri (ampli) subglobosi, bracteis plurimis suffulti, solitarii terminales, aut sæpius in axillas foliorum parium 2–3 supremorum arcte sessiles. Ovaria barbata. Folia subpetiolata.*

14. P. MONTANUM (*Michx.*): capitulis globosis, bracteis acutissimis villoso-ciliatis exterioribus ovatis intimis linearibus, dentibus calycis brevibus acutis, foliis ovato-lanceolatis serratis acutis inferioribus basi rotundatis cauleque glabris.—P. montanum, *Nutt. gen.* 2. *p.* 33, et, sic opinor, *Michx. fl.* 2. *p.* 8: igitur Monardella montana, *Benth. Lab. p.* 331.

Hab. in altis montibus Carolinæ, *Michaux*. Ad jugum quod dicit "*Catawba Ridge*," Carol. Sept., *Nuttall*. Ad radices montium *Grandfather*, *Roan*, etc., legimus, et olim invenit *Curtis*. Julio–Augusto floret.—Caulis 1–3-pedalis, simplex vel ramosus. Folia submembranacea; inferiora 2–3-pollicaria, lanceolato-ovata, basi rotundata, petiolo brevi: superiora magis lanceolata, sensim acuminata, basi acuta subsessilia; pagina superior, rami, et sæpe bracteæ, dum soli expositæ, purpurascentes. Bracteæ acuminatissimæ; extimæ flores æquantes. Calyx tubulosus, pilis conspersus, denique subglabratus; dentibus brevibus triangularibus acutis. Corolla cerina, intus maculis purpureis notata, ringens; labio inferiore profunde trilobato, lobo medio longiore; superiore integro! Stamina longule exserta: antheræ loculis parallelis. Styli lobi (ut in cæteris Pycnanthemis) sæpe inæquales. Ovaria apice villoso-barbata.

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*Species inquirendæ.*

P. MONARDELLA, *Michx.* Verisimiliter est Monardæ species! (cf. adnot. supra.) Certissime Monarda est P. Monardella, *Pursh!* (fide *herb. Lamb.* et *herb. Bart.*) etiam Elliottii!

P. VERTICILLATUM, *Pers.* (Brachystemum verticillatum, *Michx. fl.* 2. *p.* 6. *t.* 31) est species mihi valde dubia. An recte cl. Benthamius ad P. lanceolatum attulit?

bling the leaves of the vine in size and shape, as remarked by DeCandolle; in one instance we found them ten inches in diameter; but they are generally much smaller and more divided, apparently passing into the former species. The number of the ovaries does not afford marked characters, since the lowest flowers of *C. racemosa* sometimes present two, while the upper ones of *C. cordifolia* are almost always monogynous.

We were too early in the season for several interesting plants, especially *Compositæ*, and did not extend our researches far enough south to obtain many others; such as *Hudsonia montana*, which appears to be confined to Table Mountain, *Rhododendron punctatum, Stuartia pentagyna, Philadelphus hirsutus, Silene ovata* (which Mr. Curtis found in Buncombe and Haywood Counties), *Berberis Canadensis* (which however Pursh collected on the mountains of Greenbrier in Virginia), *Parnassia asarifolia*, (which according to Mr. Curtis first appears in Yancey County, but Pursh procured it from "mountain runs on the *Salt Pond Mountain*, Virginia, and on the top of the Alleghanies near Christiansburg,") and, above all, the new *Thermopsis!* (T. Caroliniana, *M. A. Curtis, mss.*) recently discovered by our friend Mr. Curtis, in Haywood and Cherokee Counties. We were likewise unsuccessful in our search for a remarkable undescribed plant, with the habit of *Pyrola* and the foliage of *Galax*, which was obtained by Michaux in the high mountains of Carolina. The only specimen extant is among the 'Plantæ incognitæ' of the Michauxian herbarium, in fruit only; and we were anxious to obtain flowering specimens, that we might complete its history; as I have long wished to dedicate the plant to Prof. Short, of Kentucky, whose attainments and eminent services in North American botany are well known and appreciated both at home and abroad.*

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* SHORTIA. *Torrey & Gray.*

Calyx quinquesepalus; sepala imbricata, squamacea, striata, persistentia, exteriora ovata, interiora oblonga. Corolla . . . Stamina . . . Capsula calyce brevior, subglobosa, stylo filiformi (subpersistente) superata, trilocularis, loculicide trivalvis, valvis medio septiferis, placenta centrali magna persistente. Semina multa, parva; testa nucleo conformis. Embryo teres, rectiusculus, albumine brevior.—Herba cæspitosa? subacaulis, perenni, glabra; foliis longe petiolatis, rotundatis, subcordatis, apice nunc retusis, crenato-serratis, crenaturis mucronatis; scapis unifloris, nudis, apicem versus squamoso-bracteatis.

S. GALACIFOLIA, *Torr. & Gray.*—(*V. spec. sicc. in herb. Michx.*, cum schedula, 'Hautes montagnes de Carolinie. An Pyrola spec.? an genus novum?')

We left this interesting region near the end of July, returning to New York by way of Raleigh, Richmond, &c.; and found a marked change in the vegetation immediately on crossing the Blue Ridge. I cannot extend these remarks to the plants observed in our homeward journey, except to mention that the *Schrankia* of this part of the country, which extends to the eastern slope of the Blue Ridge, is the *S. angustata, Torr. & Gr.;* at least we observed no other species. This is doubtless the *S. uncinata* of DeCandolle; but not, I think, of Willdenow. I may here remark, that the reticulate-leaved species, (*S. uncinata, Torr. & Gr.*) is the *Leptoglottis* of DeCandolle, (*Mem. Legum.*) as I have ascertained from a fragment of the original specimen in the rich herbarium of Mr. Webb, which that gentleman obligingly sent me; but I find no neutral flowers or sterile filaments in the numerous specimens of this plant, from different localities, which I have from time to time examined.

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## Art. II.—*Account of three undescribed Plants of Central Ohio;* by Wm. S. Sullivant.

1. Arabis patens (*sp. nov.*): erecta, pilis rigidiusculis simplicibus furcatisve undique vestita, foliis radicalibus rosulatis petiolatis, mediis oblongo-ovatis grosse dentatis auriculato-amplexicaulibus, summis lineari-oblongis subintegris, pedicellis flore majusculo (albo) longioribus, siliquis patentibus sursum curvatis stylo conspicuo rostellatis.

Hab. Rocky banks of the Scioto River, near Columbus, Ohio.

Obs. The far less numerous siliques, widely spreading and with an upward curvature, and tipped with distinct somewhat clavate styles, as well as the larger flowers, will readily distinguish this species from *A. hirsuta*, with which it has perhaps been confounded. It has nothing of the strict habit of that species. The septum of *A. patens* presents descending, rather straight, and broken lines of tubuli, which anastomose and produce irregular oblong areolæ, parallel with the septum. In *A. hirsuta* the areolæ are amorphous, on account of the very tortuous, anastomosing lines of tubuli. The septum of *A. lævigata* has a straight central line, or raphe, extending throughout its whole length, with reticulations like those of the last species.

Dr. Torrey has given some interesting remarks on this subject, in the *Annals of the Lyceum of Natural History, New York*, 4, *p.* 88.

2. Fedia umbilicata (*sp. nov.*): fructu subgloboso-inflato glabro apice unidentato antice profunde umbilicato, loculis sterilibus fertili multoties majoribus, bracteis subspatulato-linearibus eciliatis.

Hab. Around Columbus, Ohio.

Obs. This species has the appearance of *F. radiata*, and *F. Fagopyrum, Torr. & Gray* (which also occurs in the central part of Ohio,) but is more nearly allied to *F. pumila*, of the south of Europe. The inflated sterile cells are in contact from top to bottom, and have a common dissepiment, (which, however, is often wanting or incomplete in the full-grown fruit,) but there is a deep circular depression in the middle of the anterior face. The flattened fertile cell is one-nerved on the back, under a lens; and is produced at the apex into a blunt, somewhat conspicuous tooth.

3. Eleocharis compressa (*sp. nov.*): culmis cæspitosis valde compressis (in siccis spiraliter tortis), spica oblongo-ovata acuta, squamis ovato-lanceolatis acutis ad apicem sæpissime bifidis, staminibus 3, stylo trifido, achenio obovato-pyriformi trigono punctatulo nitido apice in breve collum basi styli abbreviato-conica coronatum constricto, setis nullis.

Hab. Wet places in the Darby Plains, fifteen miles west of Columbus, Ohio.

Descr. Culm cæspitose, 12–18 inches high, slender, much compressed, strongly striate, closely invested at the base with a single, horizontally truncate sheath. Spike 3–5 lines in length, oblong-ovate, terete, acute, many-flowered. Scales ovate-lanceolate, acute, of a rather firm texture, dark purple on the back, with a broad white transparent margin, entire, except the apex, which (even in the young state) is deeply 2-cleft, the segments contorted. Bristles none. Achenium obovate, pyriform, obtusely triangular, of a light golden color, shining, minutely pitted longitudinally; the raised margins of the pits traversing it in undulating lines. Tubercle fuscous, small, not one-sixth the length of the achenium, which is contracted into a short neck beneath it.

Obs. This distinctly marked species approaches the *E. tricostata* of Torrey's *Monogr. N. Amer. Cyper. p.* 310. It was erroneously inserted in my Catalogue of Plants in the Vicinity of Columbus, under the name of *E. tortilis, Schultes.*

Two plants, which have been supposed to be nearly or altogether confined to Arkansas, are also natives of central Ohio; one, the showy *Erysimum Arkansanum* of Nuttall, has already been noticed; the other is the *Eulophus Americanus* of the same author, which I have collected in the Darby Plains, about fifteen miles from Columbus; and Dr. Short has also detected it in the southern parts of Kentucky.

Erigenia, *Nutt.* This genus, which exhibits an union of the campylospermous and cœlospermous structures, has been incorrectly described as destitute of vittæ. It has, however, three to four vittæ in each interval, and six to eight in the commissure.

Valeriana ciliata, *Torr. & Gray.* This interesting plant is polygamo-diœcious, at least in the Ohio localities, with the pistillate flowers not more than half the size of the staminate; just as in *V. dioica, tuberosa, tripteris,* and several other European species,—fide *Koch, Synop. Fl. Germ. et. Helv. p.* 337.

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## Art. III.—*Notes upon the Geology of the Western States; by* James Hall, State Geologist of New York.

Having made during the last spring a tour of exploration through the states of Ohio, Indiana, Illinois, a part of Michigan, Kentucky and Missouri, and the territories of Iowa and Wisconsin; a few observations upon the geology of this region may not be unacceptable to the readers of the American Journal of Science. The tour was commenced with a view of tracing the rocks of New York westward, and of ascertaining how far the grouping adopted in the reports already made, was applicable in the western extension of the series. Another object which was deemed of great importance, was that of clearly ascertaining and defining the true position of the rock in which the lead ore of Illinois, Wisconsin, and Iowa is found.

Much doubt and perplexity has arisen among geologists as well as others, in attempting to harmonize the geological reports of the different states; it being evident that the same rock was known under different names, and the descriptions in many cases being inapplicable to the same in other places from the great change in lithological character. Thus far, little attempt has been made to identify the particular rocks of the lower formations in distant localities by their fossils. In this condition of things we have the "cliff limestone" of Prof. Locke, a name applicable in Indiana and Ohio—and equally applicable, as will be seen, to another rock on the Mississippi river—and the "blue limestone" of the same report, given as the lowest member of the series in Ohio. Thus according to the report just quoted, and which in fact gives a very accurate account of the rocks of the state, we have in Ohio only two limestone formations, whereas in New York we have three very important ones, with some minor beds. These are, 1st. The limestone along the Mohawk valley, the principal member of which is termed by Mr. Vanuxem, the "Mohawk limestone," a name which with much propriety might be applied to the whole mass, forming the *Mohawk group.* This would include the Mohawk, Birdseye, and Trenton limestones, and the calciferous sandrock might also be included as the lower member of the group. 2d. The *Niagara group*, called in the reports Lockport limestone and Rochester shale. 3d. The "Helderberg limestone group" of Mr. Mather, including all those limestones of Schoharie and the Helderberg mountains, or all the rocks between the Onondaga salt group and the fossiliferous shales of Ludlowville, Moscow, &c. Between either of these groups in New York, there are thick deposits of other rocks, (shales and sandstones,) while in Ohio, the two limestones there named are separated only by a few feet, according to the report. Now it becomes very important to know, to which of the New York groups these two masses belong, and whether, in progressing westward, certain groups become more or less important. We have already seen from the New York reports, enough to anticipate that great changes might be expected when we should trace the same rocks over twice or thrice the extent of that state.

The extension of the great coal basin of Pennsylvania became another object of interest, from the fact that it borders the southern counties of New York, the lower member of the carboniferous system extending within that state, and for the most part resting upon what has been very appropriately termed the *Chemung group.* This latter object was the one first taken up, and the junction of the two formations traced with as much care through Ohio as it has been in Pennsylvania and New York. Again, after the reappearance of the carboniferous group in Indiana, the same line of observation was taken up and followed to the Mississippi river. Throughout the whole of this great extent, the fundamental rock of the system maintains its position and essential characters in a remarkable degree. The coarse gray or drab sandstone, and conglomerate of southern New York and Pennsylvania, is perfectly represented throughout the coal region of the west.

It may not be improper to state here, that the great coal basin of Pennsylvania and Ohio terminates to the east of the centre of the latter state, following a general S. W. and N. E. direction. Nearly along the boundary line between Ohio and Indiana, and in the same general direction, there is an anticlinal axis, throwing off the strata in opposite directions, and if ever the upper masses existed, elevating them so much that they have been swept off. Near the centre of Indiana the carboniferous rocks again appear, occupying the southwestern part of that state and a large portion of Illinois, extending in a narrow belt across the Mississippi river. The coal of Kentucky and Tennessee may be considered a part of the same basin, separated only by the Ohio river. The coal basin of Missouri is entirely distinct, being separated by the elevation of the lower rocks; the same may be said of the Michigan coal basin, which is separated from that of Indiana and Illinois, by an axis running more nearly in an east and west direction.

In tracing the rocks of this great western region, the carboniferous group forms a good starting point, and having no hypogene rocks, nor even the lower members of the transition or Silurean system, except at a few distant points, this becomes of the greatest importance. The conglomerate, sometimes a coarse grey sandstone with lines of cross stratification, is the most prominent member of the series, and the one which can best be traced over a great extent of country. On the Cuyahoga river in Ohio, it is seen to great advantage at the falls and other places, having a thickness of about one hundred feet: from this place it extends S. W. towards the Ohio river, and is visible in abrupt cliffs in many of the southern counties. In Indiana and Illinois it is seen along the Ohio, and at Hawesville and other places on the Kentucky side of the river.

In this notice, I shall present only some of the results of my observations; the details of each rock, with other matter, will form the subject of a more extended notice hereafter.

I have already stated that the conglomerate or fundamental member of the coal formation is every where to be recognized, whenever we come to that point in the series; it is identical with a rock of the same character in southern New York, and the bordering counties of Pennsylvania, and holds the same position, preserves the same essential characters, and contains the same fossils. The lower coal beds can be seen immediately succeeding this rock at the falls of Cuyahoga river, on the farm of Henry Newberry, Esq., and also in Jackson, Lawrence and other counties of Ohio. The same may be seen at Hawesville, Ky., and on the opposite side of the river in Indiana. With the exception of the space occupied by lower rocks in western Ohio and eastern Indiana, this rock forms a continuous mass of remarkably uniform character, from the eastern part of Pennsylvania to the Mississippi river.

The old red sandstone group in its red color, and bearing scales of Holoptychus and other fishes, I have already stated in my report, thins out on the Genessee river in Alleghany county in New York, and does not appear again between that place and the Mississippi river, in the direction of my observations. Neither in western New York nor in Ohio, so far as I have seen, is there any rock separating the Chemung group from the conglomerate.

The Chemung group belongs to the old red or Devonian system, and which in New York Mr. Lyell recognizes as bearing a most striking lithological similarity to the lower part of the old red sandstone in Forfarshire and other parts of Scotland, both in the grey thinly laminated sandstones and associated green shales. This group extends westward through Ohio, bearing its most essential characters, but there and in Indiana, more than in most parts of New York, it becomes more evidently distinct from the Silurian system. The rocks of this group may be seen in Ohio at the Cuyahoga falls, occupying a thickness of not much more than one hundred feet, while in New York it cannot be less than one thousand or fifteen hundred feet. At Akron, and numerous other places to the southwest of this, along the western margin of the coal-field, the same rocks can be seen. Near the Cuyahoga falls, and along the river below, at Newburgh, and at several other places, may be seen the equivalents of the Portage and Gardeau rocks of the New York reports, but of greatly diminished thickness. The Portage sandstone, however, is in considerable force in many places in Ohio, being known as the "Waverly sandstones" of the geological reports. This term has also been erroneously applied to a portion of the conglomerate of the coal group when free from pebbles. The Chemung, Portage, and Gardeau groups form the only rocks seen along Lake Erie shore, from Dunkirk in New York to Cleveland, Ohio, and they extend still farther west until the limestone from beneath rises to the surface. These three groups in Ohio present no essential differences, and may without impropriety be considered as one, the lower part being mostly of shale, the middle of sandstone, and the upper part of shales and flagstones. Fossils are not abundant in the upper member, and no other than fucoides appear, except very rarely in the two below. In the Ohio reports, all these rocks are usually spoken of as non-fossiliferous.

The casts of mud furrows which in New York form the distinguishing character of the Gardeau mass, are in Ohio equally continued through the Portage and Chemung groups, shewing there at least, that some of the same causes were in operation during the deposition of the three. These casts of mud furrows present some interesting features in the rocks of New York, which will be more fully explained at another time.

These groups reappear on the western side of the axis in Indiana, all together occupying less than three hundred feet in thickness. It is here that we first discover evidences of a very important change. The upper part of the mass, which I conceive to be the same as the Chemung, is quite sandy, with a few traces of fossils characteristic of that group in New York, with here and there thin seams or wedgeform layers of limestone, made up of crinoidal fragments and broken shells, portions of the mass being often oolitic. These thin layers contain a species of Productus, differing from any in the Chemung of New York. Finally, we discover a mass of limestone eleven feet thick, interstratified with the sandstone, the lower or smaller portion composed mostly of fragments of organic remains, while the upper portion is a perfect oolite. Other thinner masses are seen interstratified with the sandstone, and a few shells and corals are found in them; and whenever the thin layers of limestone disappear, the same fossils are found in the sandstone. These characters are distinctly seen near New Albany, in the hills known as the Knobs, to the northwest of the village.

Farther to the west and northwest, and above the sandstone extending along the Ohio, on both sides, and into the states of Illinois and Kentucky, there appears as a distinct and important mass, a limestone resembling that interstratified with the sandstone just noticed. The lower part of this limestone is compact, very fine grained, and some portions fit for lithographic stones; the upper part is coarser, often containing chert or hornstone, and finally the uppermost layers are oolite. It everywhere contains the Pentremite and a peculiar coralline fossil, the Archimedes of Le Seur, besides Cyathophyllum and several shells of the genera Terebratula and Delthyris. On the Mississippi it contains two or more species of Productus, a large Delthyris, and a peculiar crinoidal fossil. In the oolitic portion, I saw a single species of trilobite and a few small shells. This limestone can be traced along the Ohio, upon both sides, almost uninterruptedly as far as Leavenworth, fifty miles below New Albany; it there passes beneath the conglomerate, showing very clearly its position in regard to the latter and the Chemung group. Beyond this it does not uniformly appear; the conglomerate, and in some places, as at Hawesville, Ky., the coal formation coming to the level of the river. It reappears again about Shawneetown in Illinois, and is visible on one or both sides, almost continuously to the mouth of the river. In ascending the Mississippi above the mouth of the Ohio, it soon appears, forming cliffs which, below St. Louis, attain the height of from one hundred and fifty to two hundred and fifty feet above the level of the water. These cliffs are turned to very important economical purposes; small buildings are erected upon the top, where lead is melted for shot making; the cliff serves the purpose of a high tower, the shot being received below on the margin of the river. This limestone extends along the Mississippi to near the mouth of Rock river.

We have then throughout all this great extent of country, from central Indiana to beyond the Mississippi river, a limestone differing entirely in all its most essential characters, and emphatically in its position, from any in New York. Among its fossils are a few which appear to be identical with those of the carboniferous limestone of Europe, and one of these I am not able to distinguish from Producta hemispherica.*

I have here already pointed out the relative position of three successive formations; first, the old red sandstone group, corresponding both in its upper and lower part with the same series in Europe; secondly, a limestone, which is clearly the equivalent of the carboniferous limestone; and thirdly, a conglomerate which is the fundamental rock of the coal formation, and may therefore represent the millstone grit of Great Britain. It thus becomes quite unnecessary in this place to point out the striking similarity in position and other characters of the great coal formation, with that of Great Britain and other parts of Europe.

Continuing the groups of New York as the standard of reference, we next arrive, in the descending order, to the great group of fossiliferous shales so well developed along Cayuga and Seneca lakes, and known as Marcellus, Skaneateles, Ludlowville, and Moscow shales, which, for the sake of brevity, I shall speak of under the name of the *Ludlowville group*. This great group, which occupies in New York a thickness not less than one thousand feet, and contains a greater number of individual fossils than nearly all the other groups, thins out in its western prolongation, losing at the same time its distinctive paleontological character, so that when we arrive at the falls of the Ohio, (Louisville, Ky., and New Albany, Ia.,) it is represented by one hundred and four feet of black shale,† nearly or quite destitute of fossils. Farther west this shale descends beneath the higher groups, and I was not able to discover it on the Mississippi.

The "Helderberg limestone group" follows in the order of succession: next below is the "Onondaga salt group," and below this, the *Niagara limestone* and shale group. In New York, these form three very distinct and important masses, extending over great areas and with very considerable thickness. The first is in greatest force in the Helderberg mountains, in Albany county, and in Schoharie, where the whole thickness is four hundred or five hundred feet. This group gradually thins west-

* I have since been able to identify several other species of fossils from this rock with those of the carboniferous limestone of England.

† I am indebted to Dr. Clapp of New Albany, who has bored through this shale, for this accurate information of its thickness.

ward, only two or three of its members being distinguishable at the Niagara river.

The second or "Onondaga salt group," is in greatest force about the central part of New York, being about one thousand feet thick, consisting mostly of shales and marls containing the gypsum beds, and all the important salt springs of the state. In the eastern part of the state it is nearly lost from thinning out, but westerly it suffers but little diminution as far as the Niagara river.

The *Niagara limestone* and its accompanying shale, are scarcely recognized in the eastern part of New York, and even as far west as the centre, they form only masses of a few feet in thickness. The whole however gradually increases westward, and on the Niagara river, as well as at Lockport, the two masses are not less than two hundred feet thick.

These three groups are traced far into Canada with little variation, except that the Niagara limestone becomes thicker and the shale more calcareous. The line of outcrop or strike of this limestone is from Rochester westward, along a terrace known as the mountain ridge and which extends by Lewiston and Queenston into Canada, and is distinctly traced as far as the head of Lake Ontario.

Near the western end of Lake Erie the *Niagara limestone* appears above the surface of the water, having been elevated, and forms a continuation of the axis before alluded to, as extending from Lake Erie to the S. W., along the borders of Ohio and Indiana. In the central and western parts of Ohio it is the most important rock, and is designated the "cliff limestone" by Prof. Locke. Among its numerous localities may be named Springfield, Dayton, the vicinity of Columbus, and several places in Adams county. In Kentucky, at Louisville, and the falls of the Ohio, at Madison and other places in Indiana, it appears as the limestone of greatest thickness.

In examining the upper part of the "cliff limestone" I found it, so far as lithological characters are concerned, a continuation of the Helderberg group, the Onondaga salt formation having thinned out almost entirely, having in fact no representative except a thin layer of water-lime, which is seen at the falls of the Ohio and the canal below Louisville, but in other localities is of less importance and often scarcely to be recognized. We have here then this condition of things—the *Niagara limestone*, which commences in the eastern part of New York, a very insignificant mass, acquiring a great thickness, and becoming the most prominent limestone; the salt group, almost entirely thinned out, or so far as to be generally overlooked; and the great mass of the Helderberg limestone, so far thinned out as to appear an integral part of the Niagara mass, and if we did not know that in the state of New York it is separated by one thousand feet of rocks, indicating an enormous period of time as having elapsed between the termination of one and the commencement of the other, it might seem right to merge it in the Niagara limestone.

Farther westward, in the northern part of the state of Illinois, and in the territories of Wisconsin and Iowa, the Niagara limestone becomes still more important, increasing as far as the Mississippi river, where it is several hundred feet thick, and according to Prof. Owen's report, from barometrical observations made by Dr. Locke, five hundred and fifty feet. This statement I am able to verify to a great degree, but the uppermost one hundred feet should be credited to the Helderberg group, and to the cornitiferous mass of Eaton, which caps many of the high mounds of this region. Throughout this great extent of country and for many miles west of the Mississippi, the upper beds of the true Niagara limestone are characterized by containing the Catenipora escharoides, and often a Retepora, above which are the thin mass of water-lime and the fossiliferous portions of the Helderberg group. The Catenipora is the characteristic fossil of the upper part of the Niagara limestone in western New York, and so far as I know is confined to this rock. Its geographical range is therefore immense, when we consider the small thickness to which it is restricted.

The thickness of the Niagara limestone is not its most important character. It proves on examination to be the *lead-bearing rock* of the west, a fact which I had previously anticipated from the same rock every where containing the sulphurets of lead and zinc in western New York—sometimes in isolated particles or small masses, or here and there a few crystals in a cavity, or in thin veins in what appeared like fractures or fissures in the rock; in truth, presenting the aspect of a metalliferous rock, and inducing the belief that under the proper conditions it might become highly so. Leaving out of view the limits of districts or states, the Niagara is the most important limestone east of the Mississippi river, both as regards the extent of surface occupied by it, its thickness, and its mineral contents.

It would be quite out of place at present to go into detail regarding the lead mines, and the zinc and copper ores, which equally belong to this rock, as I shall have occasion to speak of these again in connexion with other facts relating to this subject.

The shale of Rochester, Lockport, and Niagara Falls, accompanies the Niagara limestone every where as it does in New York, but at the west it forms a very insignificant mass, generally not more than twenty five or thirty feet thick, and bearing the character of the upper portions of the same shale in New York, being a harsh, sandy-like rock, crumbling on exposure to weather, and almost destitute of fossils.

The "Protean group,"* or the green shales, Pentamerus limestone, and iron ores, are nearly or quite wanting, being only partially seen in a few places in Ohio, and forming nothing worthy of notice farther west, so far as my knowledge extends. The peculiar fossil of this group, Pentamerus oblongus, or a species so similar that I am unable to distinguish it, occurs in the Niagara limestone in Iowa, and also in Ohio, as I am informed, not having myself seen it in the latter place. Should such be the fact, it proves the existence of this shell for a long period after the destruction of the same in New York.

In the state of New York the Protean group is underlaid by the red shales and sandstones of Medina, the sandstone of Salmon river, and the shales and sandstones of Pulaski. These rocks occupy the basin of Lake Ontario, forming the southern, eastern, and western, and more than half the northern boundary of the lake, and may very appropriately all be merged in one group, the *Ontario.* In Ohio, Indiana, Kentucky, and Illinois, the red shale and sandstone, forming so thick a mass on the southern shore of Lake Ontario, has entirely disappeared. Some small portions of the Salmon river and Pulaski rocks are visible, but the great mass filling the place of these is limestone in thin beds, with alternating layers of green shale. In many places thin wedgeform masses of gray sandstone are attached to the layers of limestone, and here and there a distinct stratum may be seen, with the same species of fucoides as characterize this group in

* The iron formation of western New York.

New York. This mass is the "blue limestone," of Prof. Locke, in the Ohio reports, but not, as has been supposed, a member of the Mohawk group, but a limestone and shale series, representing what in New York is a shale and sandstone group. The fossils are essentially the same. Pterinea carinata, Cyrtolites ornatus, Bellerophon bilobatus, Leptæna ——? Trinucleus, and Graptolites, are the fossils which characterize equally rocks holding the same place in New York. Two or more species of Isotelus are frequently found in the same rocks. The Isotelus in New York is a characteristic fossil of the Trenton limestone. This group is well developed, forming high, abrupt cliffs on the Ohio below Portsmouth, and at Cincinnati; also at Maysville, Ky. and Madison, Ind. At either of these places many other fossils are found besides those enumerated. In the higher beds are Delthyris and Orthis, one species of the latter genus the same as occurs in the Niagara group in New York.

At Newport, Ky. opposite to Cincinnati, and at one or two other places in this vicinity, there is a green shale with the Triarthrus, Graptolites, and a few encrinal joints, shewing the same assemblage of fossils and in the same position as the "Utica slate" of New York. The rock below this, which is seen in place only during low water of the Ohio, is a shaly limestone, with shells and great numbers of the fragments, with sometimes perfect specimens of the Isotelus; Dr. Locke of Cincinnati has a very large individual of this genus. This rock is probably the equivalent of the Trenton limestone of New York.

The Ontario and Mohawk groups are both seen on the Mississippi above Dubuque, containing as elsewhere, a large number of fossils.* At the same place and below these rocks, there is a mass of sandstone, but I have not been able to identify it with any mass farther east.

My examinations were not extended far enough to the north to discover the lower members of the transition or Silurian system, which doubtless would be found there. I have sufficient data to feel entirely satisfied of the results of these examinations as here given. These may be of some use, particularly as regards the readers of the geological reports, where it is not only desirable to give extended views, but also to explain, as far as possible, the rocks now known by different names.

* At this place the mass appears much thinner than farther eastward.

The result shews very clearly that there are two great limestone formations occupying the valley of the Mississippi, and that the lead-bearing limestone is not the same as that immediately underlying the coal formation.* In some places, both these limestones are very similar, and in the absence of the neighboring rocks or fossils, might be mistaken without careful observation. Both are often light colored, a fact which is common to nearly all the western rocks as compared with those of New York. From the light color and magnesian character of the Niagara limestone, it has been erroneously considered as holding the place of the magnesian limestone of Europe, the true position of which is known to be above the coal formation.

The facts here stated show a great diminution, first of sandy matter, and next of shale, as we go westward, and in the whole, a great increase of calcareous matter in the same direction. A large portion of that mass known as Medina sandstone is shale, and in New York is of great thickness, while it has entirely disappeared westward. The Onondaga salt group, essentially a clayey or shaly one, is in its greatest force in central New York, while it is entirely wanting westward. The fossiliferous shales of the Ludlowville group, as already stated, are at the falls of the Ohio, represented by a little more than one hundred feet, and farther west by still less. Again, all those of the Gardeau, Portage, and Chemung groups, seem almost obliterated and to give place to an enormous mass of limestone, which goes on increasing westward as far as known.

The name "cliff limestone," of Prof. Locke, is very appropriate for what I have here termed the Niagara limestone, so far as the western part of Ohio and part of Indiana are concerned, and I own that after examining these districts I was much gratified with the name. But after seeing a limestone much higher in the series already described, forming cliffs for several hundred miles along the Mississippi, the name seems of doubtful propriety. The name "scar" or cliff limestone of English authors, is applied to one much higher in the series than that alluded to, so that the name having once been used for another rock, renders its adoption for this improper.

Albany, September 16, 1841.

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* The lead-bearing rock of Missouri is a different one from that of Iowa, Wisconsin, and Illinois.

## Art. IV.—*On the Perchlorate of the Oxide of Ethule, or Perchloric Ether;* by Clark Hare and Martin H. Boye.

Read before the American Philosophical Society, Dec. 4, 1840.

The energetic properties of perchloric acid, and its stability, compared with the other compounds of chlorine with oxygen, led us to the belief that this acid might be combined with the substance which performs the part of a base in that class of organic salts which are generally designated by the name of *ethers*, and for which Berzelius, in consequence of his theoretical views, has adopted the name of oxide of ethule. For this purpose a concentrated solution of perchlorate and sulphovinate of barytes, in equivalent proportions, was subjected to distillation. The sulphovinate of barytes may be considered as a double sulphate of barytes and the oxide of ethule; and we anticipated that, when heat was applied, a double decomposition would take place between the latter and the perchlorate of barytes. So long as the salts remained in solution, no reaction occurred, but as soon as they became solid in consequence of the distillation of the water, a reciprocal decomposition ensued, and a sweet ethereal liquid distilled into the receiver. This *liquid* is the *perchlorate of the oxide of ethule.*

As this substance is extremely explosive, it is necessary in order to prepare it with safety, to operate on small quantities. We have employed from seventy to ninety grains of crystallized sulphovinate of barytes, with an equivalent proportion of perchlorate of barytes;* but we would recommend, especially on the first performance of the experiment, the employment of considerably smaller quantities. The salts should be intimately mixed in a mortar, and placed in a small retort attached to a refrigerator containing ice, and a receiver similarly cooled. The retort is to be heated in an oil-bath, in which a thermometer is suspended, so as to indicate the temperature. A wooden screen, furnished with openings covered with thick plate-glass at such intervals as

* The amount of barytes in the perchlorate should be ascertained by an experiment, as it retains water with great tenacity. It may be worth while to mention, that the perchlorate of potassa cannot be substituted for the perchlorate of barytes, since the sulphovinate is decomposed without acting on it. We were equally unsuccessful in an attempt to procure the ether by the distillation of perchlorate of barytes and concentrated sulphovinic acid.

to afford a full view of the different parts of the apparatus, should be erected in front of it, and strings passed around the screen and attached to a bar traversing on a pivot, and supporting an argand spirit lamp, by which heat is communicated to the oil-bath, so as to enable the flame of the lamp to be removed from or applied to the apparatus, according to the indications of the thermometer, without exposing the person of the operator. After the heat has reached 212° F., below which the salts employed do not react on each other, it should be raised very gradually, and the distillation finished below 340° F. Under these circumstances but little danger is to be apprehended from the retort, but the ether in the receiver must be treated with the greatest caution, since it has exploded in our hands in attempting to remove it with a pipette from the stratum of water which covers it. This water, therefore, should be removed by the cautious use of strips of blotting paper, moistened at the end, and introduced into the tube employed as a receiver.

To avoid the danger attendant on the management of the ether in its pure state, it may be received in strong alcohol, since it is not explosive when dissolved in alcohol. If the experiment be performed with seventy grains of sulphate of barytes, from one to two drachms of absolute alcohol will be found sufficient for this purpose. By the addition of an equal volume of water, the ether may subsequently be separated from this solution, in small quantities, for the purpose of examination. But, in this case, a loss of ether is sustained by the decomposing influence of the water employed.

The perchlorate of ethule obtained in this way is a transparent, colorless liquid, possessing a peculiar, though agreeable smell, and a very sweet taste, which, on subsiding, leaves a biting impression on the tongue, resembling that of the oil of cinnamon. It is heavier than water, through which it rapidly sinks. It explodes by ignition, friction, or percussion, and sometimes without any assignable cause. Its explosive properties may be shown, with but little danger, by pouring a small portion of the alcoholic solution into a porcelain capsule, and adding an equal volume of water. The ether will collect in a drop at the bottom, and may be subsequently separated by pouring off the greater part of the water, and throwing the rest on a moistened filter, supported by a wire. After the water has drained off, the drop of ether remaining at the bottom of the filter may be exploded, either by approaching it to an ignited body, or by the blow of a hammer. We are induced to believe that, in explosive violence, it is not surpassed by any substance known in chemistry. By the explosion of the smallest drop, an open porcelain plate will be broken into fragments, and by that of a larger quantity, be reduced to powder. In consequence of the force with which it projects the minute fragments of any containing vessel in which it explodes, it is necessary that the operator should wear gloves, and a close mask, furnished with thick glass-plates at the apertures for the eyes, and perform his manipulations with the intervention of a movable wooden screen.*

In common with other ethers, the perchlorate of ethule is insoluble in water, but soluble in alcohol; and its solution in the latter, when sufficiently dilute, burns entirely away without explosion. It may be kept for a length of time unchanged, even when in contact with water; but the addition of this fluid, when employed to precipitate it from its alcoholic solution, causes it to be partially decomposed. Potassa, dissolved in alcohol, and added to the alcoholic solution, produces, immediately, an abundant precipitate of the perchlorate of that base, and, when added in sufficient quantity, decomposes the ether entirely. It would appear, therefore, impracticable, to form either perchlorovinates or perchlorovinic acid.

We have subjected the perchlorate of ethule to the heat of boiling water without explosion or ebullition.

It may be observed that this is the first ether formed by the combination of an inorganic acid containing more than three atoms of oxygen with the oxide of ethule, and that the chlorine and oxygen in the whole compound are just sufficient to form chlorohydric acid, water and carbonic oxide with the hydrogen and carbon.

The existence of a compound of the oxide of ethule with an acid containing *seven* atoms of oxygen, led us to attempt to combine, by the same method, this base with nitric acid. For this purpose we subjected a mixture of sulphovinate and nitrate of barytes to the same treatment as described above, but the reac-

* Having suffered severely on several occasions from the unexpected explosion of this substance, we would earnestly recommend the operator not to neglect the precautions mentioned above.

tion, even when conducted with the greatest possible care, is destructive, hyponitrous ether and gaseous matters being the principal products obtained. Nor were we more successful in our attempts to procure a sulphurous or hyposulphuric ether by the same process.

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## Art. V.—*A new Demonstration of the Principle of Virtual Velocities;* by Prof. Theodore Strong.

Let any body or system of bodies, (or material points,) be affected by the forces P, Q, R, and so on; imagine points considered as fixed to be taken in the lines in which the forces act, and let $p$ denote the distance of the point of application of P, from the point taken in the line of its action, $q$ the distance of the point of application of Q from the point taken in the line of its direction, and so on; and suppose the points to be so assumed that P, Q, &c. shall tend at the same time to increase each of the distances $p$, $q$, &c. or to decrease them, (the positions of the fixed points in other respects being supposed arbitrary): we shall regard each force and distance as positive, and it is manifest that the equilibrium consists in the relation of the forces to each other being such that their actions shall not alter any one of the distances $p$, $q$, &c.

We shall denote the sum of the products $Pp$, $Qq$, &c. by M, and we shall have $Pp+Qq+\&c.=M$, (1,) then if the forces balance each other, $p$, $q$, &c. will each be constant.

We shall suppose that $p$, $q$, &c. are each constant, and that P, Q, &c. become $P+P'$, $Q+Q'$, &c. but that $p$, $q$, &c. are yet each constant; also that M becomes $M+M'$; then (1) will become $(P+P')p+(Q+Q')q+\&c.=M+M'$, which by (1) reduces to $P'p+Q'q+\&c.=M'$, (2); if we multiply (1) by $\frac{M'}{M}$, we get $p\frac{PM'}{M}+q\frac{QM'}{M}+\&c.=M'$, which must evidently be identical with (2), so as to leave $p$, $q$, &c. each arbitrary, hence the coefficients of $p$ must be equal, also those of $q$ must be equal, and so on: $\therefore \frac{P'}{P}=\frac{M'}{M}$, $\frac{Q'}{Q}=\frac{M'}{M}$, and so on. Hence it is evident that P′, Q′, &c. have all the same sign, and that they have the same proportions among themselves that P, Q, &c. have; also if any one of them as $P'$ is $=0$, then each of the others and $M'$ will $=0$, as evidently ought to be the case, for when a system of forces as P, Q, R, &c. is in equilibrium, the equilibrium will not be disturbed by applying another system of forces, as $P'$, $Q'$, &c. which are proportional to P, Q, R, &c., to the same points severally, and in the same directions or in directions which are exactly opposite, &c.

We shall use $\delta$, (the characteristic of variations,) when prefixed to any quantity to denote any indefinitely small variation of the quantity, the variation being supposed to be positive when the quantity is increased, and negative when it is decreased. Suppose then that the forces balance each other, and that the body or system of bodies, receives a very small change of position, (consistent with its conditions, or with the mutual connections of its parts in the case of a system,) and that in consequence of the change of position $p$, $q$, &c. become $p+\delta p$, $q+\delta q$, and so on, and that P, Q, &c. become $P+\delta P$, $Q+\delta Q$, &c., also that M becomes $M+\delta M$; then (1) will be changed to $(P+\delta P).(p+\delta p)+(Q+\delta Q).(q+\delta q)+\&c.=M+\delta M$; now since $\delta P$, $\delta p$, &c. are each supposed to be indefinitely small, the products $\delta P.\delta p$, $\delta Q.\delta q$, &c. will be indefinitely smaller than $p\delta P$, $P\delta p$, and so on, and are hence to be rejected; $\therefore$ rejecting these products and reducing by (1), the above equation will become $p\delta P+q\delta Q+\&c.+P\delta p+Q\delta q+\&c.=\delta M$, and if we assume $p\delta P+q\delta Q+\&c.=\delta M$, (3), we get $P\delta p+Q\delta q+\&c.=0$, (4). Now it is evident (as in (2),) since $p$, $q$, &c. are the same in (3) as in (1), that we may suppose the forces $\delta P$, $\delta Q$, &c. to be applied at the same points and to act in the same lines as P, Q, &c. severally, by neglecting quantities of the order of the products $\delta P.\delta p$, $\delta Q.\delta q$, &c.; hence $\delta P$, $\delta Q$, &c. will have the same sign, and the same proportions among themselves that P, Q, &c. have; $\therefore$ when the forces balance each other, changing the position of the body or system (as above, in consequence of which, the small forces, $\delta P$, $\delta Q$, &c. are introduced), does not affect the equilibrium; and (4) which is called the principle of virtual velocities, will have place when the forces P, Q, &c. balance each other, as we proposed to prove; and it may be observed that $\delta p$, $\delta q$, &c. are called the virtual velocities of the points of application of P, Q, &c.

Conversely if (4) has place, the forces will balance each other. For if they do not balance, let the body or point to which P is applied move with the force P′, and that to which the force Q is applied move with the force Q′, and so on, and suppose the bodies or points describe the very small spaces $p'$, $q'$, &c. in the same time; then if the forces P′, Q′, &c. are applied in directions which are directly opposite to their several directions they will balance the forces P, Q, &c.; hence if $\delta p$, $\delta q$, &c. are the virtual velocities of the points of application of P, Q, &c. if we assume $mp'$ for the virtual velocity of P′ when it is applied in a direction exactly opposite to its direction, $mq'$ will be the virtual velocity of Q′ when it is changed to the opposite direction, and so on.

Hence by (4), since the system is in equilibrium, we shall have $P\delta p + Q\delta q + \&c. + P'mp' + Q'mq' + \&c. = 0$, but by supposition $P\delta p + Q\delta q + \&c. = 0$, $\therefore P'mp' + Q'mq' + \&c. = 0$, or $P'p' + Q'q' + \&c. = 0$; now it is evident that P′ has the same sign as $p'$, Q′ the same sign as $q'$, and so on; hence the equation cannot hold good, (since its terms have all the same sign which is +,) unless $P'p' = 0$, $Q'q' = 0$, and so on; $\therefore P' = 0$, or $p' = 0$, or both $= 0$, but on either supposition, the body to which the force P is applied is at rest, and in the same way the body to which Q is applied is at rest, and so on; ∴ when the equation of virtual velocities has place, the forces balance each other, as we proposed to prove.

*Application.*

Let P, Q, R, be three forces applied to a material point, and (for simplicity) suppose the directions of P and Q to be perpendicular to each other and parallel to two rectangular axes $x$ and $y$, drawn in their plane through any given point taken for their origin, and suppose that P and Q, act in the directions of $x$ and $y$, positive; then when there is an equilibrium between P, Q, R, it is evident that R must act in the same plane with P and Q, in a direction which is directly opposite to their resultant; also that R will be of the same magnitude as the resultant.

Let $x$ and $y$ be the co-ordinates of the point of application, (which is supposed to be within the angle formed by the positive co-ordinates,) of the forces when referred to the aforesaid axes; take the distances $a$ and $b$ reckoned from the origin in the axes of $x$ and $y$, such that $a$ is greater than $x$, $b$ greater than $y$, then we shall have $p = a - x$, $q = b - y$; also let $a'$, $b'$, be the co-ordinates of any fixed point in the line of direction of R, then evidently $a'$ is less than $x$, and $b'$ is less than $y$; $\therefore r = \sqrt{(x-a')^2 + (y-b')^2}$; the forces are supposed to tend to diminish the distances $p, q, r$, and by (4) we get $P\delta p+Q\delta q+R\delta r=0$, (5).

Now since $a, b, a', b'$, are each invariable (because they belong to fixed points), we have $\delta p=-\delta x$, $\delta q=-\delta y$, $\delta r=\frac{(x-a')\delta x+(y-b')\delta y}{r}$, and by substituting these values (5) becomes $-P\delta x-Q\delta y+\frac{x-a'}{r}R\delta x+\frac{y-b'}{r}R\delta y=0$, or $\left(\frac{x-a'}{r}R-P\right)\delta x+\left(\frac{y-b'}{r}R-Q\right)\delta y=0$; hence, since $\delta x$, $\delta y$ are arbitrary and independent of each other, we must have $\frac{x-a'}{r}R-P=0$, $\frac{y-b'}{r}R-Q=0$, or $P=\frac{x-a'}{r}R$, $Q=\frac{y-b'}{r}R$, $\therefore P^2+Q^2=R^2$, (8), since $\frac{(x-a')^2+(y-b')^2}{r^2}=1$, also $\frac{Q}{P}=\frac{y-b'}{x-a'}$, (9); hence from (8) and (9) it is evident that if two forces are represented in quantity and directions by the two sides of a rectangle, their resultant is represented in quantity and direction by the diagonal which passes through the angle formed by the two sides that represent the forces.

For other applications of (4) we shall refer to the Mécanique Analytique of Lagrange, and the Mécanique Céleste of La Place, especially to the first volume of the former work.

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Art. VI.—*Solution of a Functional Equation, which has been employed by* Poisson *in demonstrating the parallelogram of forces; by* George R. Perkins, A. M.

Poisson, in his able *Traité de Mécanique*, (see second edition, Vol. I, p. 44 et seq.) has given a beautiful demonstration of the parallelogram of forces. He makes his demonstration rest upon the determination of $\varphi x$, so as to satisfy the condition,

$$\varphi x\varphi z=\varphi(x+z)+\varphi(x-z) \quad (1).$$

He says, $\varphi x=2\cos. ax$, will satisfy (1), and he further says, that no other value of $\varphi x$ will satisfy it; but he does not show how he determined this value of $\varphi x$; but seems to have obtained it by induction. Neither does he show why there may not be other values of $\varphi x$, which will satisfy (1).

We propose to determine the nature of $\varphi x$ by rigorous analysis.

From the nature of the function $\varphi(x+z)+\varphi(x-z)$, which constitutes the right hand member of (1), we know that its second differential, with reference to $x$, is the same as its second differential, with reference to $z$; therefore the second differential of $\varphi x\varphi z$, which constitutes the left hand member of (1), with reference to $x$, is the same as its second differential, with reference to $z$; hence we have the following condition :

$$\varphi z.\frac{d^2.\varphi x}{dx^2}=\varphi x.\frac{d^2.\varphi z}{dz^2} \quad (2);$$

or, which is the same thing, $\frac{d^2.\varphi x}{dx^2}\div\varphi x=\frac{d^2.\varphi z}{dz^2}\div\varphi z$ (3).

Now, since the left hand member of (3) is a function of $x$ alone, and the right hand member is a function of $z$ alone, it follows that each member is equal to a constant quantity, which we will denote by $a^2$; then we shall have $\frac{d^2.\varphi x}{dx^2}\div\varphi x=a^2$ (4).

Multiply (4) by $2\varphi x.\frac{d.\varphi x}{dx}$, and we get $2.\frac{d.\varphi x}{dx}\cdot\frac{d^2.\varphi x}{dx^2}=2a^2\varphi x.\frac{d.\varphi x}{dx}$ (5).

Integrating (5) and adding the constant $c$, we get $\left(\frac{d.\varphi x}{dx}\right)^2=a^2(\varphi x)^2+c$ (6), or, by a slight reduction, we obtain $dx=\frac{d.\varphi x}{\sqrt{a^2(\varphi x)^2+c}}$ (7).

Integrating (7) we get $x=\frac{1}{a}\log.c'\left(\sqrt{a^2(\varphi x)^2+c}+a.\varphi x\right)$ (8), where $c'$ is another constant.

Multiplying (8) by $a$, and passing from logarithms to exponentials, we get $e^{ax}=c'\left(\sqrt{a^2(\varphi x)^2+c}+a.\varphi x\right)$ (9), where $e$ is such, that hyp. log. $e=1$.

Dividing (9) by $c'$ and transposing, we get $\sqrt{a^2(\varphi x)^2+c}=\frac{1}{c'}.e^{ax}-a.\varphi x$ (10).

Squaring (10) and reducing, we get

$$\frac{2a}{c'}.\varphi x.e^{ax}=\frac{1}{c'^2}.e^{2ax}-c \quad (11).$$

Dividing (11) by $\frac{2a}{c'} . e^{ax}$ we obtain

$$\varphi x = \frac{1}{2ac'} \left( e^{ax} - cc'^2 . e^{-ax} \right) \quad (12).$$

This is the complete form of the function sought, since it contains the two arbitrary constants $c$ and $c'$; substituting this function in (1) it becomes

$$\frac{1}{4a^2c'^2} \left( e^{a(x+z)} - cc'^2 . e^{-a(x-z)} - cc'^2 . e^{a(x-z)} + c^2c'^4 . e^{-a(x+z)} \right) =$$
$$\frac{1}{2ac'} \left( e^{a(x+z)} - cc'^2 . e^{-a(x+z)} + e^{a(x-z)} - cc'^2 . e^{-a(x-z)} \right) \quad (13).$$

If we equate the co-efficients of the like terms of (13), we shall find that $c = -4a^2$, $c' = \frac{1}{2a}$; substituting these values of $c$ and $c'$ in (12) we find $\varphi x = e^{ax} + e^{-ax}$ (14).

It now remains to find the value of $a$.

When $x = \frac{\pi}{2} = 90°$, the two forces oppose each other, and then $\varphi x = 0$; substituting these values in (14) we get

$$0 = e^{\frac{\pi}{2} . a} + e^{-\frac{\pi}{2} . a} \quad (15).$$

Equation (15) gives $a = \sqrt{-1}$; therefore (14) finally becomes $\varphi x = e^{x\sqrt{-1}} + e^{-x\sqrt{-1}} = 2 \cos. x$ (16); this value of $\varphi x = 2 \cos. x$ agrees with Poisson's value $\varphi x = 2 \cos. ax$, since he shows that it is necessary to take $a = 1$. Moreover it is evident that no other value of $\varphi x$ can be found which will satisfy the conditions of the question, since equation (12) is in its most general form.

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## Art. VII.—*Experiments on Bichlorure of Sulphur and certain carbures of hydrogen, made in the laboratory of Jefferson College (Louisiana)*; by Prof. F. Chevet.

A current of bicarbure of hydrogen being brought to bear on some bichlorure of sulphur, under the influence of the solar rays, the gas was absorbed in considerable quantities with a great throwing off of heat. The liquid, at first of a very deep pomegranate red, gradually became orange colored, then of a yellow orange color. The light refracted by the ball containing the bichlorure, assumed the finest violet hue, like that produced by vapor of iodine. This color lasted a very long time.

Among the vapors thrown off at first, the writer thought he remarked chlorohydric ether and sulphohydric ether. These vapors made the water through which they passed milky, but this effect soon ceased. Towards the end of the operation, the gases evolved burned with a very fuliginous flame, like bicarbure of hydrogen, pure; however they by no means had the same smell. There appearing to be no absorption, the liquid was gradually heated to bring about absorption, by producing an atmosphere of vapors; suddenly the yellow liquid assumed a raspberry red color, but no marked absorption was effected. Its bulk was very viscous like a thick syrup; its smell was penetrating and very enduring, similar to that of blackberries or raspberries; its flavor was at first sweet, then very pungent.

The next day, a deposit was found of a number of small needle-shaped crystals of a deep brown.

Neither water, alcohol, nor ether, appears to dissolve these crystals to any decided amount; however, alcohol discolors them, whilst it colors itself and leaves a drop of red liquid by evaporation. Water casts off from the alcoholic solution a white powdery deposit, and leaves a red drop at the bottom of the vessel. Nitric acid, cold, appears not to act, but warm, it dissolves the crystals and gives a yellow sediment of sulphur.

The crystals, having been several times washed with alcohol, assumed a light chocolate color; after being strained through pieces of blotting paper, they were discolored, leaving on the paper a very volatile oil which rapidly disappeared, but there remained a red stain on the paper, which shows that the volatile oil is distinct from that species of coloring matter. The crystals strained through paper, were placed in the pneumatic vacuum in the presence of sulphuric acid and moist fragments of potash; the surface of the acid became of a decidedly roseate hue and besprinkled with small oily drops; the potash had absorbed some of the chlorine. These crystals were then pretty white, and burned in a very lively manner, bubbling up and emitting a flame which betokened the presence both of sulphur and of a resinous matter. Sulphuric acid appears powerless on these crystals, unless it be that it discolors them. Another part of the crystals, having undergone a potash solution, gave a solid and very gluey deposit of a dirty yellow; the solution became yellowish; the sides of the vessel, in which the operation was performed, became very greasy, the deposits, as well as the potash solution, had a very strong and decided smell of cucumber.

The red liquor, in the midst of which was the mass of crystals, slightly smoked in the open air, though its point of ebullition was pretty high; its density is greater than that of sulphuric acid, but a part floats even above the water, which betokens a complex liquid; it is insoluble in water and in ether, but rather soluble in alcohol; however, the alcoholic solution having evaporated, appears to leave the liquor untouched; water brings about a powdery deposit of a currant red.

This liquid, on distillation, gives a yellowish oil of a flavor acrid, pungent, and very enduring; it reddens the blue paper, doubtless by free chlorohydric acid.

The writer further made bichlorure of sulphur prepared cold, react on two other carbures of hydrogen, oil of naphtha, and essence of turpentine, both as highly rectified as possible. With the oil of naphtha, the action is lively, and accompanied by a marked ebullition; the temperature rises rapidly, and a considerable quantity of chlorohydric acid is thrown off. A black deposit of a very glutinous nature was obtained; the liquid assumed a very brown red color. The whole, being distilled, gave a yellowish liquid, which, being washed with water, furnished a yellowish and glutinous mass, floating on the liquid; it was sulphur impregnated with a very volatile oil, rapidly disappearing from the paper used for straining, and without any sediment. This mass undergoing a warm preparation with alcohol, considerably diminished in bulk, and, after cooling, oily drops gathered on the surface. Ether dissolves this species of oil better than alcohol; what remained undissolved by the ether, still betokened, on being burned, the presence of a resinous matter; it was then subjected to the influence of boiling nitric acid, which left a globule of sulphur. The washings of the distilled liquid contained much chlorohydric acid and also some sulphuric acid.

The deposit left in the cucurbite became blacker and more plentiful; it burned like resin, and did not appear to contain sulphur; it is soluble in nitric acid, warm, and by evolving after a suitable evaporation, it deposits very long needle-shaped crystals of perfect whiteness; these crystals are of a slightly bitter flavor, and have no feature of acidity.

With the essence of turpentine, the reaction is extremely tumultuous, the vessel in which the operation was made, was sunk in cold water, and yet the matter boiled up considerably; the mass became very viscous, but it remained homogeneous. Distillation was performed; a great quantity of chlorohydric vapors were thrown off by the draught tube; a pomegranate-red liquid condensed in the recipient; this liquid exhaled a stinking smell, pretty similar to that from the products of the distillation of animal matter. A very black sediment remained at the bottom of the cucurbite. On applying nitric acid to this mass, no needle-formed crystals were obtained as with the naphtha; the washings of the distilled liquid gave a very viscous reddish mass, which sank to the bottom, instead of the floating yellowish mass obtained with the naphtha.

Not having at my disposal the means and appliances for proceeding to organic analyses, I have been unable to ascertain the composition of the different products to which the reactions above described gave rise, a composition, the knowledge of which is indispensable to a correct appreciation of these products. In publishing this memorandum, I have therefore had no other object in view but to point out a few facts relating to the action of bichlorure of sulphur on carbures of hydrogen, facts which have appeared to me worthy to engage the attention of chemists, and susceptible of being connected with one another, and brought under the laws of a common theory.

Deprived of the apparatus and reactives necessary for this study, I have deemed it my duty to give publicity to an entirely novel subject of study, which, in my opinion, holds out a certainty of important discoveries, and I hope and trust that some American chemist, placed in circumstances more favorable, and especially one more skillful, will, by following up this subject of inquiry, ere long enrich the science with several new and interesting combinations.

Art. VIII.—*Continuation of the Remarks made upon Arsenic,* considered in a medico-legal point of view;* by J. Lawrence Smith, M. D. of Charleston, S. C.

*Messrs. Editors*—Since my last letter on this subject, there has been a great deal of important matter brought to light by those of this place (Paris) who were interested with this subject, and I had prepared a detailed account of what had been done, and was on the point of sending it, when the report of the committee appointed by the Academy of Sciences to examine into this question made its appearance. I therefore have been induced to send this instead of the other, as it will encroach much less upon your Journal, and as also containing statements that are more to be relied on.

In the examination of poisoning by arsenic, all the excrements, such as matter vomited, urine, &c., as well as all parts of the body itself, present matter for investigation. The method by which they all are examined, is essentially the same, each one exacting the same careful but not difficult manipulations; no great chemical knowledge being necessary to carry them out, and the reagents used are such as are to be found at every druggist's shop.

*Manner of destroying the animal matter.*—Our first and most important step, in fact one without which it is impossible to proceed, is to rid ourselves of the organic matter that forms a large part of the liquids and solids that are to be examined, (the liquids should always be evaporated to dryness and treated as the solids are.) In my last letter was stated, what was then considered the best method of carbonizing the animal matter; but since MM. Danger and Flandin have described another, which from the report of the committee of the Academy, is almost as simple a one as can be desired, it being greatly superior to that by nitric acid and nitrate of potash in many points of view, which will be evident to all those who may wish to compare them.

"The matter being placed in a capsule of porcelain, (evaporating dish,) we add to it about one sixth of its weight of sulphuric acid, and heat slowly until sulphuric acid vapors begin to ap-

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* See this Journal, Vol. xl, p. 278.

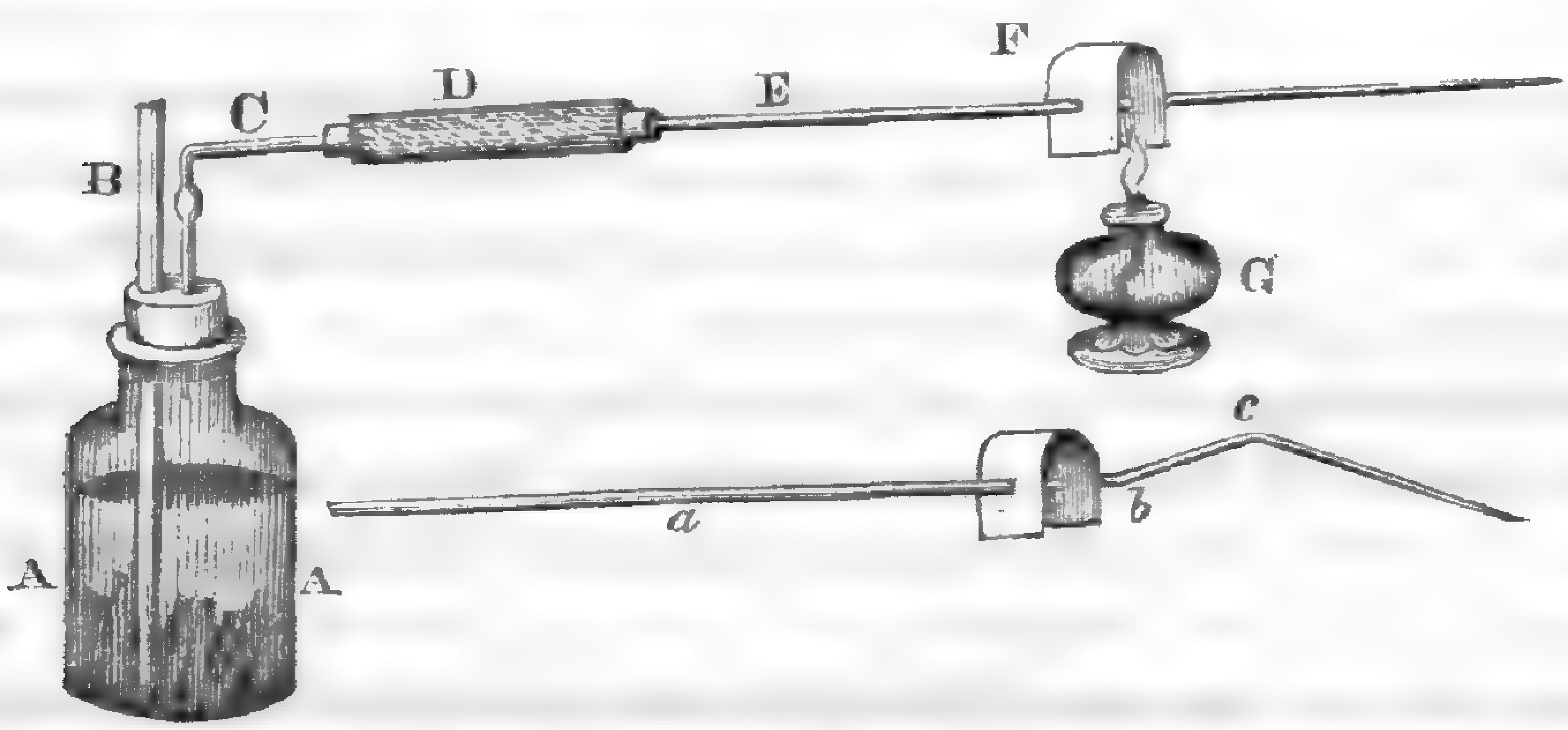
pear. The matter enters first into solution, and then becomes carbonized during the concentration of the liquid, which we continue to evaporate, stirring at the same time with a glass rod. The carbonization takes place without any swelling up of the materials, (as is the case when nitric acid is used.) The action of the heat is prolonged until the carbon appears friable and almost dry. The capsule is now left to cool, and then there is added to the carbon about the same quantity of nitric acid as we did of sulphuric acid in the first part of the operation. This serves to convert the arsenious into arsenic acid, which latter is much more soluble than the former: we again evaporate to dryness, and treat the residue with boiling water, which dissolves the arsenic acid only, and is always perfectly limpid, and sometimes colorless; and this liquid also, when introduced into Marsh's apparatus, produces no froth."

"This process is much preferable to the carbonization by nitric acid, for we can more easily manage the operation, and a much less quantity of reactives is required, (an important consideration,) and there never is any deflagration."

MM. Danger and Flandin recommend the use of a much smaller quantity of nitric acid than has been stated, but from the production very often of phosphite and sulphite of ammonia during the action of the sulphuric acid upon the animal matter, it is very necessary that there should be sufficient nitric acid to convert these compounds into phosphate and sulphate of ammonia, for otherwise our experiments would be singularly confused, as will be shown a little farther on. It would appear that the arsenious acid in the operation just stated, would be evaporated along with the sulphuric acid, but some experiments performed by the committee before mentioned, with reference to that point, show that no danger need be apprehended on that score.

I have now stated the best method to pursue, in obtaining a liquid that may contain all the arsenic in combination with any organic matter, and also one that is proper to be introduced into Marsh's apparatus. The next question that most naturally arises is, what form of this apparatus is the one that is most calculated to give us accurate results? The committee of the Academy of Sciences have also occupied themselves with this question, and the following is a detailed account of the instrument that has received their approval.

A A, an ordinary phial with a large mouth having a capacity of from ten to sixteen ounces, in which the gas is generated; B, a tube little less than half inch in diameter traverses the cork and reaches nearly to the bottom of the phial; it is for the purpose of introducing the liquid to be examined and the sulphuric acid. C, another tube of a much small diameter, and bent at an obtuse angle; this serves to conduct the gas into a tube D, about ten inches long and an inch in diameter, filled with cotton or asbestus. E is a glass tube, (it is to be preferred if it be of refracting glass;) its internal diameter should not be more than from one twelfth to one tenth of an inch, and its extremity should be drawn out to a capillary opening. F is a bent sheet of tin perforated with two holes, and which serves to support that part of the tube heated by the alcoholic lamp G.




In operating with this apparatus, one fifth the capacity of the phial should be left empty. The zinc and liquor to be tested are first introduced. The tube E is then heated by the lamp, after which we introduce slowly the sulphuric acid through the tube B. The gas being generated, it first traverses the tube D, where it deposits most of its moisture, as well as that portion of the liquor which passes out of the phial along with the gas. The gas arriving at the point of the tube E that is heated, is decomposed, and the arsenic deposits itself a little further up the tube, in the form of a metallic ring. The gas that passes out of the extremity is inflamed, and any arsenic that may still remain combined with it, is received on a porcelain surface.

This is the method of operating, that seemed to the committee most likely to give delicate and accurate results. They seem to think that fused chloride of calcium is not to be preferred to the cotton or the asbestus; but from many experiments that I have made, it would appear that it was; for the gas passing over the chloride of calcium is deprived entirely of its moisture, which does not happen in the other case; and the dryness of the gas must evidently augment the delicacy of the instrument, for if the gas contain moisture when it arrives at the point where it is decomposed, the arsenic, as it is liberated, will combine with the oxygen of the moisture, forming arsenious acid, which possesses no metallic lustre, and if the quantity of arsenic be infinitely small, I see no reason why it all should not undergo this change; at any rate, the tube D, let it contain any matter that may serve to dry the gas, is of essential importance.

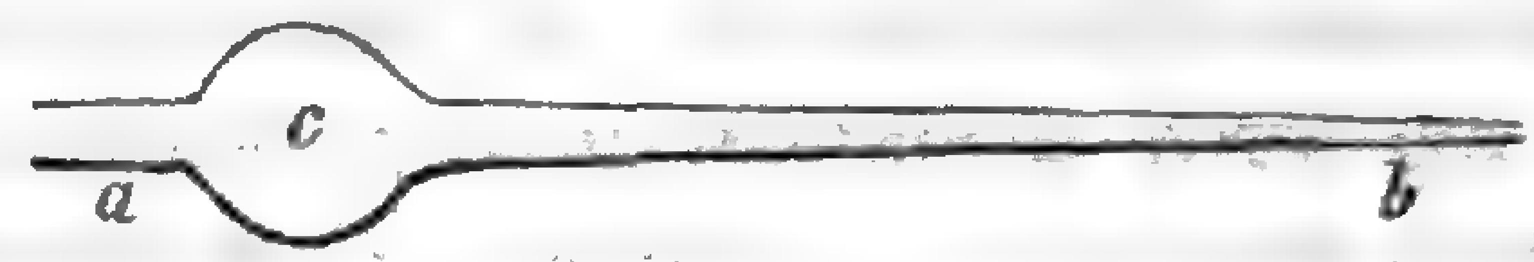
Another remark to be made about this apparatus is, that sometimes all the arsenuretted hydrogen is not decomposed, and it not unfrequently happens that a portion of that decomposed, is thrown out at the extremity of the tube along with the gas. To obviate these little inconveniences, I have used the following means, which appear to be of some service. In the interior of the tube E, at the point where it is heated, are placed very small fragments of charcoal, that have been heated to redness in a close vessel before being introduced, and bending the same tube, as is seen in *abc*, under the figure before described. The arsenic being collected in the tube E, as just mentioned, is described as follows:

1st. By its volatility.

2d. By its becoming changed into a white volatile powder when the tube, open at both ends, is heated in an inclined position.

3d. If we introduce a little nitric acid into the tube it dissolves the arsenic, converting it into arsenic acid, and if this nitric acid solution be evaporated to dryness in a capsule, taking care to add a few drops of hydrochloric acid to the nitric acid before commencing the evaporation—(the reason of this precaution is, that most nitric acid of commerce contains an organic substance, which gives to the residue a more or less black appearance, and by the addition of a few drops of hydrochloric acid chlorine is generated, which serves more or less to destroy this substance, and therefore afford us a whiter residue)—the residue will give a red precipitate if we add to it a drop or two of a concentrated solution of silver, and it is often well to place a small crystal of nitrate of silver in the capsule before the solution is added, for it tends to render the test more delicate.

4th. We may collect the arsenate of silver thus formed, mix it with a little black flux, introduce it in the bulb by the extremity *a* of the tube *ab*, (which extremity is to be subsequently closed by being heated,) and then heat the bulb, the arsenate will be decomposed, and the arsenic will make its appearance in the form of a metallic ring in the capillary portion of the tube *b*.




In experimenting with Marsh's apparatus, we should of course be sure of the purity of the materials used in generating the hydrogen gas, as well as of those used for carbonizing the animal matter. We should submit them all to the same examination alone, as we did in company with the substance which was the object of our experiment, that is to say, we should evaporate to dryness the same quantity, or even more sulphuric and nitric acids and water than was used, and test it with the same quantity of zinc. It must be understood at the same time, that all the reagents should be tested before as well as after the experiment.

In my last letter, I mentioned that it was generally supposed after the experiments of M. Orfila and others, that the bones contained arsenic, and it was also believed that the muscles did; there having been obtained taches resembling in some degree those of arsenic, which, I gave then as my opinion, were no doubt caused by the sulphur and phosphorus contained in the muscles.

MM. Danger and Flandin have been occupying themselves particularly with the investigation of the question of the existence of arsenic normally, in the animal economy. In their experiments they found that by taking a small portion of a muscle, and carbonizing it imperfectly, they were able to obtain taches resembling in all respects those of arsenic, but which in reality were not, for they ascertained that they were produced by the sulphite and phosphite of ammonia and an animal volatile oil, formed during the imperfect carbonization; and also by the aid of about one grain and a half of each of these salts and eighteen drops of spirits of turpentine, they formed these taches in considerable quantity; they have stated that they resemble in all respects those of arsenic, but no one accords with them on that point. The committee of the Academy of Sciences stated what follows, (which I have convinced myself is correct.) "That the taches obtained from phosphite and sulphite of ammonia and turpentine, differ from those of arsenic—1st. By being but partially soluble in cold nitric acid, and 2d. By the nitric acid solution when evaporated to dryness, giving with nitrate of silver, a yellow and not a red precipitate."

MM. Danger and Flandin, and still later the committee so often referred to, have examined also the bones, but were no more successful in tracing the presence of arsenic in them than they were in the case of the muscles. M. Orfila, one of the first who stated that they did contain arsenic, is no longer of his original opinion; so that at present the question of the existence of normal arsenic in the animal economy, is resolved in the negative; and happy it is for the medico-legalist that he is not embarrassed on that point. I may also add that humanity should rejoice at it, for did arsenic exist in the body normally, and was it generally known, its use as a destructive agent would be considerably extended, and those using it in a criminal way, might very justly suppose, that if they were suspected and tried, nothing would be easier for an ingenious attorney, than to snatch him from the hands of justice, by forcing certain doubts from the most skillful medico-legalist; but whereas, as the question now stands, facts are too easily brought to light and too well substantiated, that a doubt should be left upon the mind of any one.

There have been many other taches mentioned, but as they all except one, depend upon the liquid of the apparatus being thrown out by the gas upon the cooling surface, where any metallic salt that it may contain is subsequently decomposed by the hydrogen, no notice shall be taken of them, as the tube D (in the apparatus figured) prevents altogether, any thing of the kind happening. The tache excepted is that produced, when we use a surface whose glaze contains lead or tin in considerable quantity; the flame of the hydrogen reduces these metals at that point of the surface upon which it is directed, and gives rise to a tache more or less brilliant, although very easily distinguished from that of arsenic by being non-volatile, and insoluble in nitric acid.

As regards the tache produced by antimony, there is nothing to be said; for when we treat the matter for examination by sulphuric and nitric acids, antimony, if it be present, is converted into antimonious acid, which is insoluble in water; so there is no danger of introducing it in the apparatus, and moreover, the tests already mentioned, are sufficient to enable us to distinguish between antimony and arsenic.

I shall conclude what I have to say on this subject, with the *résumé* of the report of the Academy of Sciences.

"The committee, resuming the instruction contained in this report, think that Marsh's process, applied with all the precautions which have been indicated, satisfy the demand of medico-legal researches, in which the quantity of arsenic, which it is attempted to exhibit, is always much superior to that which the delicacy of the apparatus exhibits; ($\frac{1}{1000000}$ of arsenic acid existing in a liquid, is about the extent of the delicacy of the apparatus.) At the same time it must be well understood, that it is always to be employed as a means of concentrating the metal, in order to study its chemical characters, and that we should consider as nothing, or as extremely doubtful, the indications which it furnishes, if the deposit which is formed in the anterior part of the tube, does not permit the experimenter, on account of its very small quanity, to verify in a precise manner, the chemical characters of arsenic."

"We will add that in the greater number of cases of poisoning, the examination of the matter vomited, and of that which remains in the intestinal canal, will convince the experimenter of the presence of the poison, and that he will have only to proceed to the carbonization of the organs, in cases where the first efforts have been fruitless, or in those very rare cases, where presumed circumstances of poisoning shall indicate to him the necessity."

Paris, June 28th, 1841.

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## Art. IX.—*Remarks upon an examination of the Peroxide of Manganese;* by Henry C. Lea.

It is of great importance, both to the practical and theoretical chemist, to have the combinations which the different metals form with the acids, investigated, in order that the proper degree of confidence may be reposed in the various theories which have been formed from time to time by so many celebrated chemists. It is with this view alone that I consider these examinations as worthy of being published, as I unfortunately had not time to pursue them far enough to afford any very definite result. They may however serve to point the way to some one who has sufficient zeal for the science, to carry them out to some more useful end than I could hope to attain. I must here make my acknowledgments to Prof. Booth, in whose laboratory, and with whose assistance, these examinations were made.

The peroxide of manganese has never been investigated, as its existence has until lately been questioned by some of the first chemists in Europe, and the tendency of its salts to convert themselves into proto-salts, contributed to render it problematical whether it was not merely the protoxide disguised. It can be obtained in various ways, but the most convenient is to calcine the proto-nitrate gently until the nitrous acid ceases to be given off. A less troublesome method is to heat the common black or deutoxide, until part of its oxygen is given off, but this method is uncertain, as too great a heat converts it into the manganoso-manganic oxide, and it is almost impossible to obtain the black oxide free from admixture with iron. When obtained by calcining, its color is of a deep black, and sometimes shining; but when precipitated from a liquid, as the permanganate of potassa, it is of a dark brown. It has sometimes been found native, and is then known to mineralogists under the name of Braunite. It unites with water and forms the hydrate, which may be readily produced by precipitating the hydrated protoxide from a proto-salt, and exposing it to the action of the atmosphere. Obtained in this manner it appears under the form of a brown powder, but when found native, it is black and crystallizes sometimes in acicular crystals, and sometimes in octahedra, resembling in this state the deutoxide. The peroxide is composed, according to the calculations of Berzelius, of 43.37 of oxygen to 100 of manganese.

With the different acids it has very various actions; with some it is converted into protoxide, forming proto-salts; while with others it immediately forms per-salts, which seem to have no regular color, some being red, while others are nearly white, brown, or yellowish; a dirty white is however the most usual appearance. I have found it to be the case, that most vegetable acids which convert the peroxide into protoxide by giving off oxygen, when acting upon the deutoxide, will form per-salts by the loss of oxygen. They all contain a very great excess of acid, without the presence of which the peroxide seems incapable of forming any salt. The best test I have met with for distinguishing them from the soluble proto-salts, to which they in appearance bear a great similarity, is the yellow prussiate of potash. With the per-salts it gives a greyish green precipitate, while with the protoxide solutions the precipitate formed is white or whitish pink. The hydrochlorate of platina is also a good test for them, as with them it forms a yellowish precipitate, but with those of the protoxide, it forms none.

*Sulphuretted hydrogen.*—When this gas is passed over the peroxide placed in a tube, which at the same time is heated, the gas is decomposed, sulphur and water are given off, and the oxide is converted into a sulphuret of a light green color. The gas must be passed over until the tube becomes cool, for if the sulphuret be exposed to the air while hot, it inflames, acting the part of a pyrophorus. When digested in fuming nitric acid, a violent action takes place, the sulphuret is decomposed and converted into a proto-salt, and all the sulphur is precipitated. Analyzed in this manner, it gave 9.6 per cent. of sulphur, and when heated in the open air until the sulphur was burnt out and the oxide converted into manganoso-manganic oxide, it yielded 100 per cent. of manganoso-manganic oxide, which contains 72.178 per cent. of metallic manganese. Now 9.6 of sulphur will combine with 16.51 of manganese, which makes 26.11 per cent. of sulphuret. There then remains 55.67 per cent. of manganese, which, if considered as manganoso-manganic oxide, would form an oxy-sulphuret, containing

| | |
|---|---|
| Sulphuret of manganese, - - - | 26.110 |
| Manganoso-manganic oxide, - - | 71.893 |
| | 98.003 |

Thus in the operation, both the oxide and sulphuretted hydrogen are decomposed. The oxide is partly reduced to manganoso-manganic oxide, and partly to metallic manganese. The sulphur from the sulphuretted hydrogen is mostly driven off, but some of it combines with that part of the oxide which has been converted into the metal, while the oxygen from the oxide, and the hydrogen from the gas, unite and pass off under the form of steam. This oxy-sulphuret very much resembles the substance formed by gently calcining the red sulphuret in a close vessel, (during which operation sulphuretted hydrogen is given off,) but it upon analysis gave but 92.857 per cent. of manganoso-manganic oxide, while the first forms 100.

*Cyanogen.*—When cyanuret of potassium is added to a solution of a per-salt of manganese, the cyanuret is precipitated under the form of an extremely fine greyish green powder, which remains suspended in the liquid for some time.

*Sulphuric acid.*—The persulphate may be formed by digesting the black oxide in sulphuric acid for several days in the cold, or when peroxide is placed in dilute acid, it is formed in a few hours, but when the peroxide is used, there is a greater excess of acid. This solution is of a beautiful carmine red, but if the oxide be that precipitated from the permanganate of potassa, the solution has somewhat of a violet tinge. It has so great a tendency to convert itself into protosulphate, that it can neither be evaporated nor crystallized, and it cannot be kept for any time, as it is decomposed in the course of two or three weeks. This change may be accelerated by the addition of alcohol.

*Sulphate of manganese and potassa.*—This salt, which is the manganese-alum, may be formed, according to Mitscherlich, by adding a concentrated solution of sulphate of potassa to one of persulphate of manganese. It crystallizes of a violet brown color, and is decomposed by the addition of water.

If bisulphate of potassa be digested upon deutoxide of manganese, there is a strong action, which results in the formation of a double salt, which, upon evaporating, remains under the form of a somewhat crystalline mass of a dirty white color, and a pleasant acid taste; it reddens litmus paper, and shows the reaction of the peroxide with yellow prussiate of potassa, and does not seem to be decomposed by water; but it is most likely the manganese-alum of Mitscherlich.

*Nitric acid.*—When nitric acid is digested upon peroxide of manganese, it does not form a per-salt, but the nitrate may be made by adding nitrate of lead to the persulphate of manganese, until they are both neutralized.

*Hydrochloric acid.*—If this acid be digested upon per or deutoxide of manganese, there is a perchloride formed of a dark brown color, and which decomposes immediately by the application of heat, or in a week or two, in the cold. There then remains protochloride, while chlorine is evolved. When evaporated to dryness, we obtain crystals of protochloride of a fine pink.

Dr. John passed chlorine through a solution of three hundred grains of protochloride, dissolved in 12 oz. water, cooled to 41°. The liquid gradually congealed as the operation proceeded, and produced a yellowish crystalline mass, which melted at a temperature a little above 41°. It was decomposed by evaporation.* This may only have been the perchloride, surrounded by liquid chlorine, for when I repeated this experiment, at a temperature above 41°, I obtained a yellowish crystalline mass, which, however, on being placed between blotting paper to dry it, proved that a yellow liquid imparted that color to the salt, which itself was pink. I did not however observe that it was decomposed by evaporation.

*Sulphúrous acid.*—This acid has no action upon the peroxide, even when passed over it in a heated tube; and with the deutoxide it forms proto-hypo-sulphate. I do not think that the persulphite can be formed unless by double decomposition with some other salt.

*Carbonic acid.*—It has no action upon the peroxide, and as far as I have observed, it cannot be made to combine with it. The brown substance mentioned by Thomson, (Chem. Inor. Bodies, Vol. II,) and formed by decomposing the persulphate of manganese by carbonate of potassa, is most probably an hydrate of one of the oxides.

*Phosphoric acid.*—When digested upon peroxide, this acid forms a pink solution, giving the per reaction with tests, and which upon evaporation leaves an uncrystallizable pasty mass, of a pink or violet color, which becomes colorless in a short time, most probably by decomposition.

*Boracic acid.*—The borate can be readily formed by dissolving the peroxide in boracic acid. The solution thus formed by evaporation leaves a whitish crystalline mass, soluble both in nitric and muriatic acid.

*Arsenious acid.*—When peroxide is digested in arsenious acid, they unite and form a soluble pinkish white salt.

If bi-arsenite of potassa be digested upon peroxide of manganese, it forms a double salt, being arsenite of manganese and potassa.

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* Berzelius, Traité de Chimie, Tom. IV, p. 170.

*Chromic acid.*—Chromic acid seems to have no action upon the peroxide, but a chromate may be formed by digesting the peroxalate in chromic acid. The solution is of a dark chestnut brown, but it cannot be evaporated or crystallized, as it is decomposed by the application of heat.

Bichromate of potassa has no action upon the deutoxide of manganese.

*Oxalic acid.*—This acid has a violent effect upon the peroxide. Oxygen is given off, the insoluble protoxalate is precipitated, while a soluble peroxalate remains in solution. By careful evaporation it may be crystallized, but it is very apt to be decomposed, forming an insoluble salt, most probably the protoxalate. It dissolves in muriatic and nitric acid. It was analyzed by dissolving and precipitating the oxalic acid by chloride of calcium; while another portion was calcined and converted into manganoso-manganic oxide. Treated in this manner it showed 27.4348 per cent. of oxalic acid, and 8.5 of manganoso-manganic oxide =11.73 of peroxide. This leaves a very large per centage for water of crystallization. Thus

| | |
|---|---|
| Oxalic acid, - - - - - | 27.4348 |
| Peroxide of manganese, - - - | 11.7300 |
| Water and loss, - - - - - | 60.8352 |
| | 100.0000 |

The 11.73 of oxide, requires very nearly 16. of oxalic acid; which leaves 11.4348 of free acid, so that this salt, in common with the others, possesses a great excess of acid.

If binoxalate of potassa be digested upon the deutoxide of manganese, in the cold, a pink colored solution is formed, which by standing becomes yellow, letting fall a pink powder. If the solution of the binoxalate be hot, the action is very violent, and the resulting solution is yellow. By evaporation it leaves a crystalline, almost tasteless mass, partly white and partly green, and which is readily dissolved in water.

*Acetic acid.*—Glacial acetic acid does not form a per-salt when digested on peroxide of manganese.

*Tartaric acid.*—If this acid be digested upon peroxide, oxygen is given off and the prototartrate is formed. But if we dissolve deutoxide instead of peroxide, a pertartrate results, which on being evaporated leaves the salt of a light yellow or straw color.

Bitartrate of potassa, particularly if warm, dissolves the deutoxide of manganese with considerable energy, at the same time evolving oxygen and forming a tartrate of manganese and potassa, which is a highly crystalline brownish mass, of hardly any flavor, and soluble both in nitric and hydrochloric acids.

*Benzoic acid.*—When benzoic acid is boiled with peroxide of manganese, there is a benzoate formed, slightly soluble in water. Thus obtained, it is a dirty white substance, of a crystalline appearance.

*Succinic acid.*—This acid forms a protosuccinate when digested upon peroxide, but with the deutoxide, it, like tartaric acid, forms a per-salt, which is soluble in water, of a whitish color, crystalline and very acid.

*Racemic acid.*—This like the last forms a per-salt with the deutoxide, and a proto-salt with the peroxide. The resulting solution, by evaporation, leaves the salt somewhat crystalline, whitish brown, and quite acid.

*Citric acid.*—With citric acid, both the per and deutoxide act as towards the last. The percitrate obtained from the deutoxide is a brown, gummy, seemingly uncrystallizable mass, of a pleasant acid taste, slightly deliquescent, and is soluble, although not very readily, in both nitric and muriatic acids.

*Gallic acid.*—The pergallate of manganese may be obtained by dissolving the peroxide in gallic acid. The solution thus obtained is of a deep brown color, and the salt obtained by evaporation is nearly black. It does not appear to crystallize.

These are all the acids, of which I have been able to note the action with the per or deutoxide of manganese. I have followed Berzelius in calling peroxide, that one which might perhaps be more correctly termed sesquioxide, as its formula is $\ddot{\mathrm{M}}\mathrm{n}$, but as it is very similar to the analogous oxide of iron, also termed peroxide, and as it is the highest oxide of manganese which forms combinations with acids, it seems best to apply the term of peroxide to this, and super or binoxide to the black oxide of commerce.

If time should favor me, I propose to pursue the above subject, as it is probable that much remains to be determined, concerning the compounds of manganese, before we can say with propriety that we are acquainted with the metal.

Philadelphia, May 8th, 1841.

Art. X.—*A Sketch of the Infusoria, of the family Bacillaria, with some account of the most interesting species which have been found in a recent or fossil state in the United States;* by J. W. Bailey, Professor of Chemistry, Mineralogy, and Geology, in the United States Military Academy.

## Part II.*

Having given in the preceding part of this memoir, some account of those Bacillariae which belong to the section Desmidiacea, I continue the subject in the present part, by describing the Bacillariae of the section Naviculacea.

As all the species referred to this section have siliceous coverings, they often occur in a fossil state, and hence their study is of peculiar interest to the geologist. In beauty of form and elegance of structure, they will bear comparison with almost any class of organized beings.

## Sect. II. NAVICULACEA.

### Pyxidicula.

*Free, carapace simple, bivalve (siliceous) separate, globular, (may be compared to a Gaillonella with perfect spontaneous division or without division.)*

1. *Pyxidicula operculata.* (Pl. 2, fig. 1 and 1 a.) Body spherical, divisible into two hemispheres, carapace hyaline, internal organs greenish yellow, $\frac{1}{120}$ to $\frac{1}{48}$ line.

I have seen hemispheres, probably derived from this species, among fossil infusoria from Manchester, Mass., &c.

2. *Pyxidicula globata.* This name has been given to globular bodies found in flint. Beautiful figures of them by Bauer, will be found in Pritchard's Hist. Infusoria, pl. 12, figs. 506 to 509. It is now suspected that these bodies are the gemmules of sponges, as the ramified tubes of sponge are often found preserved in the same pieces of flint.

3. *Pyxidicula?* (Pl. 2, fig. 2, a, b.) The spheroidal bodies represented by these figures, occur in the tertiary infusorial stratum discovered

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* Since the second part of this memoir was ready for the press, I have received Pritchard's beautiful work entitled "History of Infusoria living and fossil." I have gladly availed myself of the opportunity to introduce here many of the novel facts which it contains. Many of these facts will be given in the form of notes, as time does not now allow me to incorporate them in this sketch in any other form.

by Prof. W. B. Rogers in Virginia.* Of the real nature of these bodies I am quite uncertain; they agree however with Pyxidicula, in separating into two hemispherical portions. The surface is beautifully marked with rows of circular or hexagonal spots or cells, resembling those on the beautiful species of Coscinodiscus which accompany these bodies in the same deposit.

### Gaillonella.

***Free, carapace simple, bivalve (siliceous), form cylindrical, globular or discoid, producing chains [long articulated cylinders] by imperfect spontaneous division.***

1. *Gaillonella moniliformis.* (Pl. 2, fig. 3.) Corpuscles smooth, cylindrical, short, conical at the sides and truncate, form octangular [?] circular when seen endwise, ovaries green, $\frac{1}{72}$ line. *Ehr. Meloseira moniliformis, Ktz.*, Linn., 1833, Pl. 17, fig. 71. *M. nummuloides, Grev.* in Brit. Flora, V, p. 401.

This very beautiful species grows only in salt or brackish water, and occurs in great abundance in various places in the United States. I first noticed it several years ago, among specimens of Algæ from Providence, R. I. I subsequently found it almost covering the bottom and shores of Providence Cove at low tide. I found it again in vast quantities, in salt ditches near the railroad at Stonington, Conn., where it formed large fleecy masses, sometimes of several feet in extent. Still more recently I have found it at Staten Island, and also, much to my surprise, sixty miles up the Hudson River near West Point.†

The form is not strictly octangular, but at first appears so, in consequence of the two minute projections of the delicate transverse ridges seen near the ends of each of the two globules belonging to a joint. They do not change their form when heated

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* For an account of this truly interesting discovery, see Report on Geology of Virginia for 1840. The infusorial strata of Virginia are of great interest from their vast extent, and from being the first infusorial deposits noticed in this country, of *a period anterior to the present epoch.* I am indebted to Prof. Rogers for specimens from various localities, and with his permission I include in this memoir, figures drawn by myself of several of the interesting forms found in these beds.

† The Flora and Fauna of the Hudson River at West Point would, in a fossil state, be rather puzzling to the geologist, on account of the singular mixture of *marine* and *fluviatile* species. While Vallisneria and Potamogeton grow in such vast quantities in many places as to prevent the passage of a boat, and the shore is covered with *fluviatile* shells, such as Planorbis, Physa, &c. in a living state; we yet find the above fresh-water plants entangled with bunches of marine Algæ, such as Enteromorpha, Ectocarpus, &c., and often covered with *marine* parasitic zoophytes and *marine* infusoria (Achnanthes, Gaillonella, Echinella, Naunema, &c.;

to redness, nor by action of hot hydrochloric acid. They fuse with effervescence with carbonate of potassa, and the fused mass when treated with hydrochloric acid gives silica in abundance. There can, then, be no doubt that the glass-like filaments of this species are siliceous. Our species agrees in all respects with authentic European specimens (in Herb. Tor.) collected by Hoffman Bang, at Hofmansgave.

2. *Gaillonella aurichalcea.* (Pl. 2, fig. 4, 4 a ?) Corpuscles elongated, cylindrical, truncate, flattened smooth, contiguous, a simple or double pierced furrow in the middle of the body, ovaries greenish, becoming golden yellow when dry, $\frac{1}{192}$ line. *Conferva orichalcea, Ag.*, Syst. Alg. p. 86. *Meloseira orichalcea, Ktz.*, Linn., 1833, p. 72, 588, Pl. 17, fig. 68.

Our species (Pl. 2, fig. 4, a, b,) agrees so closely with Kutzing's figure 68, even in the branching character and occasional production of large globular joints, (see (c) in fig. 4,) that I feel little hesitation in considering it as the *G. aurichalcea*, although I am unable to perceive the "sillon percé" alluded to by Ehrenberg in his specific character. This species might easily be mistaken for a Conferva. It often forms bluish green masses, of full a foot in extent, and while fresh it is quite as flexible as any Conferva; but on drying, it becomes of a light brassy yellow color, and is then excessively fragile. There is much variation in the diameter of the filaments, and in the relative length of the joints. The filaments which have the smallest diameter, have, generally, the longest joints. They retain their forms when heated to whiteness, and when treated with strong nitric acid. This species occurs in springs, rivulets, &c., and appears as common in this country as in Europe. In (Pl. 2, fig. 4, b,) is represented a species of Gaillonella apparently distinct from figs. 4 and 4 a. It shows the pierced furrows and agrees in most respects with the figure of *G. aurichalcea* given by Ehrenberg in his memoir entitled *Die Fossilen Infusorien und die lebendige Dammerde*, Pl. 1, fig. 23. It is possibly, only a state of our species above referred to. It occurs in ponds near West Point.

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while the rocks below low water mark are covered with Balani and minute corallines, and the marine flora is represented by vast quantities of a very elegant Polysiphonia, nov. sp.?) abundance of Enteromorpha intestinalis, Ectocarpus siliculosus, and an elegant Alga, apparently identical with Delesseria Leprieurii of Montagne, which was first detected on the shores of Cayenne. (See Annales des Sciences Naturelles, 2d series, Bot., tom. 13, p. 196, and pl. 5.)

3. *Gaillonella distans.* (Pl. 2, fig. 5.) Corpuscles cylindrical, short, truncate and flattened on the ends, smooth, with two pierced furrows, always separated in the middle, $\frac{1}{576}$ to $\frac{1}{72}$ line, usually $\frac{1}{288}$.

This species occurs in vast quantities in the fossil state in Europe. It constitutes a large portion of the slate of Bilin and Cassel, and of the "Berghmehl" or "fossil farina" of various localities. It occurs in most of the specimens of American fossil infusoria, which I have seen. It is particularly abundant in the specimens from Manchester, Mass., which are chiefly composed of exceedingly minute frustules of this species. It forms here, a true fossil farina, almost as light as flour, and containing in a cubic inch many hundred millions of these minute siliceous shells. It occurs in a living state at West Point.

4. *Gaillonella varians.* (Pl. 2, fig. 6, a, b.) Corpuscles flat on each end, cylindrical surface smooth, ends with fine radiating lines, ovaries yellow or green, $\frac{1}{192}$ to $\frac{1}{40}$ line.

Our fig. 6, represents a species which is not uncommon in ponds near West Point. The discoid surfaces of the individuals show minute radiating lines quite distinctly.

5. *Gaillonella sulcata.* (Pl. 2, fig. 7, a, b ?) I noticed fragments of this species two years ago in peat from a salt marsh near Stonington, and among marine Algæ in the same vicinity. I had prepared a sketch and description of it for this memoir, before I heard of the discovery of the infusorial stratum of Virginia. I was, therefore, agreeably surprised to find, on inspecting specimens of the fossil infusoria from Richmond, Rappahannock Cliff, &c., that this species was very abundant in them. A careful comparison of the recent specimens from Stonington, and the fossil specimens from the tertiary of Virginia, has left no doubt in my mind of their *specific identity*. The following is the account of the recent specimens, written several months before the reception of the Virginia fossils. They consist of frustules, each of which is divided by a transverse line ; the *cylindrical* surface of each frustule has a great number of parallel lines in the direction of the axis, and the ends or *flat* surfaces show a rim having lines corresponding to those on the cylindrical surface ; within this rim is a diaphragm having minute radiating lines. Chains of thirty or forty individuals are not unfrequent in the infusorial earth of Richmond, particularly in the upper part of the stratum. These are doubtless the "oblong cylinders" alluded to by Prof. W. B. Rogers in his Report on the Geological Survey of

Virginia, p. 39. Ehrenberg gives the following description of *Gaillonella sulcata*, a fossil species occurring in the schist of Oran; from this description I suspect it to be closely allied to our species, and therefore copy its specific characters for the purpose of comparison.

" *Gaillonella sulcata.* Corpuscles cylindrical, short, truncate at the two ends and flattened, furrowed across and in form of cells" (sillonnés en travers et sous forme de cellules,) $\frac{1}{96}$ to $\frac{1}{72}$ line.*

6. *Gaillonella ?* ——. (Pl. 2, fig. 8.) Corpuscles long, cylindrical, with two lines of constriction, adhering by alternate angles so as to form long zigzag chains, and occasionally auricled.

The curious bodies represented in Pl. 2, fig. 8, appear to partake of the characters of both Gaillonella and Bacillaria, showing the cylindrical corpuscles of the former, united by alternate angles, as in many species of the latter. It is, perhaps, related to *Diatoma auritum* of Lyngbye, which is described as having the "joints quadrangular, rounded, with an auricle at each angle," and of which Greville remarks that the auricular appendages of the angles give to the frustules the appearance of "microscopic woolpacks." Having seen no figure or specimen of *D. auritum*, I cannot decide as to its identity with our species; I believe, however, that ours must be different, both from its abundance and from the remark of Kutzing (Linnæa, 1833, p. 585) that *D. auritum* probably belongs to the Desmidiaceæ.

Our species consists of large cylindrical siliceous joints, usually adhering together by alternate angles in a zigzag manner. Most of the frustules show two lines of constriction, as shown in the figure. The connection of the frustules is by a very conspicuous, flexible hinge-like ligament, which often gives to the joints an auricled appearance, which makes the comparison of them to "microscopic woolpacks," or rather bales of cotton, not inappropriate.

The joints usually contain a yellow or ochraceous substance, arranged in a stellate manner, and not unfrequently this appears to be composed of minute globules, (ova?) as shown in the figure. This species occurs, in vast quantities, in the Hudson River, at West Point. It may be found in some places at low tide, giv-

* In Pritchard's History of Infusoria, Recent and Fossil, I find a figure of *Gaillonella sulcata*, which leaves no doubt that our fossil specimens from Richmond, as well as our recent ones from Stonington, belong to this species. The living animals have also been detected at Cuxhaven, by Ehrenberg. See appendix to Pritchard's work, p. 434.

ing to the shores a ferruginous color in spaces even as much as a hundred square yards in extent.

7. *Gaillonella ferruginea.* Corpuscles very minute, convex on the ends, ferruginous, oval, smooth, having the form of articulated threads, often united, almost branching, $\frac{1}{3000}$ to $\frac{1}{1000}$ line.

Ehrenberg states with a mark of doubt, that it occurs in all ferruginous waters; fossil in bog iron ore; and in the yellow opal of Bilin. A copy of Ehrenberg's figure may be seen in Lyell's Elements of Geology, p. 39, (Am. Edit.) and in Pritchard's Hist. Inf. fig. 129–130. I have often seen in bogs and small streams, large quantities of a ferruginous colored floculent matter which dispersed with great ease when touched, and in which I have sometimes been able to see, by means of the microscope, excessively minute filaments which were apparently moniliform. I believe these filaments to be the *G. ferruginea* of Ehrenberg, which is the same as the *Oscillatoria ochracea* of various algologists. The filaments are fragile and incombustible, and are said to be composed of silicate of iron. (See Pritchard's Hist. Inf. p. 199 and 200.)

### Actinocyclus.

*Free, carapace simple, bivalve, (siliceous) form cylindrical, (discoid) divided internally by several radiating partitions; spontaneous division imperfect in form of a chain.*

Ehrenberg mentions seven species, viz. A. ternarius, A. quaternarius, A. quinarius, A. senarius, A. septenarius, A. octonarius, and A. denarius, distinguished respectively by the number of cells formed by the radiating partitions. Several species occur in the "schiste of Oran" in Africa, in a formation which M. Rozet considered as tertiary, but which Ehrenberg suspects is more nearly connected with the chalk.

It appears to me to be an interesting fact, that the remarkable *marine* infusorial deposit discovered by Prof. W. B. Rogers in the tertiary formation of Virginia, appears to agree with the infusorial conglomerate of Oran, in containing several species of Actinocyclus, together with *Gaillonella sulcata,* and beautiful punctate discs, which I suspect belong to the genus Coscinodiscus. I have seen no account of this last genus, but its name appears peculiarly appropriate to the *sieve-like discs* which form so large a portion of the infusorial stratum of Richmond, Va. Ehrenberg mentions *Coscinodiscus patina* as predominating in the deposits of Oran, Zante, Caltasinetta, &c. (See Weaver's View of Ehrenberg's Observations in Lond. and Ed. Phil. Journ. for May, 1841, p. 393.) In figs. 9, 10, and 11, are represented several fossil species of Actinocyclus from Richmond, Va.; the same species also occur fossil in cliffs on the Rappahannock River. In figs. 12, 13, and 14, are represented the discs which I believe to belong to the genus Coscinodiscus. When perfect, the form seems to be that of a torus, having the circular bases covered with hexagonal or circular spots, which present considerable variety in their size and arrangement in different specimens. The most usual disposition of the spots is in rows corresponding with the radii, as shown in the large specimen fig. 14. In consequence of this arrangement, they also form beautiful spiral rows in other directions, so that the curves present no inconsiderable resemblance to those often seen on the back of watches; at other times the spots are found to form three sets of lines, making angles of 60° and 120° with each other, as shown in fig. 12, and on others the spots are disposed without much apparent regularity, frequently having a star-like figure in the centre. The spots are so small on some of the discs, as to be almost invisible even by the highest magnifying powers; on others, as in fig. 14, they are quite large and distinctly hexagonal. The largest discs have not always the largest spots. There are certainly several species of this genus in the infusorial stratum of Richmond, Va., but as I have not seen Ehrenberg's account of the European species, I cannot venture to name our own.

*Note, October 10th,* 1841.—Since the above was ready for the press, I have seen in the appendix to Pritchard's History of Infusoria, living and fossil, some interesting statements of recent discoveries by Ehrenberg, with reference to the genera of Actinocyclus and Coscinodiscus. It appears that these genera, which were first discovered in a fossil state in the schiste of Oran, Caltasinetta, Zante, &c., have also been recently found in sea water, and that many of the living species are identical with the fossil ones; indeed, Ehrenberg states that *Actinocyclus senarius, Coscinodiscus patina*, and *Gaillonella sulcata*, species now living, may be shown as the chief forms met with in the chalk marls of Sicily, and also that the species of the chalk formations are yet to be found as crowds of living creatures in the waters of our seas.

I select from the species of Coscinodiscus, described by Ehrenberg, the following, as apparently identical with American species from Richmond, Va. In connection with the description, I give a reference to figures drawn by me from fossil American species, long before Ehrenberg's characters for the species were received.

*Coscinodiscus lineatus.* (Pl. 2, fig. 12, a, b.) Carapace marked by small cells disposed in a series of parallel and transverse lines. Found fossil in the chalk marl of Caltasinetta, and in the live condition at the Cuxhaven. The cells in this species form parallel lines in whatever direction they may be viewed. In large and well preserved fossil specimens, as many as twenty five openings were seen near the circumference. Within the live forms, numerous yellow vesicles are sometimes seen, as in Gaillonella. Diameter of fossil, $\frac{1}{1150}$th to $\frac{1}{480}$th; living $\frac{1}{1150}$th to $\frac{1}{860}$th. Fossil at Richmond, Va.

*Coscinodiscus radiatus.* (Pl. 2, fig. 14.) Carapace large, marked with cells of moderate size, disposed in lines radiating from the centre. Towards the margin the cells become smaller in size. Very abundant in fossil state at Oran, alive near Wismar and Cuxhaven, $\frac{1}{860}$th to $\frac{1}{240}$th. Fossil at Richmond, Va.

*Coscinodiscus Argus,* (? var. of *C. radiatus.*) Carapace with large cells at the centre, and smaller ones at the circumference, the order of the rays being often interrupted.

Fossil at Oran and Caltasinetta in chalk marl, living in sea water at Cuxhaven. The cells of the discs from Oran vary very much in size. The ova are of a greenish color in the living forms, which are very rare. Diam. $\frac{1}{860}$th to $\frac{1}{290}$th. Fossil at Richmond, Va.

*Coscinodiscus oculus-iridis.* Carapace marked with rather large radiant cells, except near the centre and circumference, where they are smaller. Some of the larger cells in the centre form a sort of star. Fossil in the chalk marl of Greece; alive near Cuxhaven. Diameter, $\frac{1}{240}$. This large species is curiously marked, whilst under the microscope, with colored rings, which are apparently caused by the peculiar arrangement of the cells. There are generally from five to nine large cells at the centre. Specimens are found in the infusorial stratum of Richmond, Va., which have the star-like centre and probably belong to this species.

*Coscinodiscus patina.* (Pl. 2, fig. 13, a. b.) Carapace large, cells of moderate size disposed in concentric circles. Cells smaller towards the circumference. Fossil in chalk marl of Zante, alive at Cuxhaven. The young and vigorous specimens of live individuals are completely filled with yellow granules, whilst the older ones have an irregular granulated mass within them. Diameter, $\frac{1}{860}$th to $\frac{1}{240}$th. Fossil at Richmond, Va. Our figure shows a small specimen.

Of the genus Actinocyclus, Ehrenberg describes several new species, which have been found fossil in the chalk marls of Oran, Caltasinetta, &c., and living in sea water at Cuxhaven, Christiana and Tjörn. Several of these species have no partitions, but have surfaces marked with minutely punctate rays. The great variety which occurs among the forms of Actinocyclus, found fossil at Richmond, leave no doubt in my mind, that all of Ehrenberg's species will be found among them. I also believe that I have seen a living species of this genus, or of Coscinodiscus, in the ooze of the Hudson River, near West Point.

For Ehrenberg's characters for the new species, see Pritchard's Hist. Inf., p. 428–429.

NAVICULA.

*Free, separate or binary, carapace simple, bivalve or multivalve (siliceous) having six [?] openings; never united in form of a chain by perfect spontaneous division.*

On these characters as given by Ehrenberg for the genus Navicula, I would remark that there do not appear to be any true valves or parts capable of separation without fracture, although each species will usually break along certain lines or edges into a definite number of parts. I have not been able to satisfy myself of the existence of six openings in *N. viridis*, (see remarks concerning that species,) and with regard to the species ever forming chains, I can state that it is not rare to meet with four, sometimes even eight united laterally. I have even seen them thus united in the fossil state.

*a.* Having transverse striæ, (internal cells,) subgenus Surirella.

*Navicula viridis.* (Pl. 2, fig. 16, a, b.) Striate, carapace straight, lateral faces truncate at the ends, ventral faces rounded at the ends, fifteen striæ (cells) in $\frac{1}{100}$th of a line. Length, $\frac{1}{96}$ to $\frac{1}{6}$ line.

This beautiful species is one of the largest and most abundant, both in the recent and fossil state. It occurs all over Europe, and is equally diffused in this country. I have myself observed it in Maine, Massachusetts, New York, Ouisconsin and Virginia. It is easily recognized by means of its large size and beautifully marked ventral faces. The striæ seen on these faces may *correspond* to internal cells, but I believe them to be linear openings in the carapace itself, as may easily be seen on the fragments of fossil specimens. There are three rounded spaces on each ventral face, which I think have been mistaken for openings, but which appear to me to be thicker portions of the carapace. One of these spaces is in the middle, and the other two at the extremities of the striated surfaces, and they are connected by a very delicate double line (canal?) A similar structure is seen on several other species of Navicula, Cocconema and Gomphonema. The real orifices are shown at *c, c, c, c,* in our fig. 16, *b.* Moving particles somewhat like those of Closterium may sometimes be seen near the extremities. In fig. 17, a, b, Pl. 2, I have copied from Ehrenberg, (Die Fossilen Infusorien und die lebendige Dammerde, Berlin, 1837, Pl. 1, fig. 19,) a sketch in which he represents the organs of motion, the stomach &c. of this species. The reference letters having been omitted by the engraver of Ehrenberg's plate, I have been obliged to insert them according to what I believe was their intended position.

The following is a translation of Ehrenberg's explanation of this figure. (See fig. 17, Pl. —.)

"A living specimen of Navicula viridis, in which by the injection of indigo are distinctly to be seen; the stomach *v*, the two great spherical sexual glands *s s*, and the lamelliform extensions of the green ovarium, o′ mouth opening, o′ sexual opening? a, a, a, a, four movement openings, *p* the pediform organs of motion. The visible currents on the body, both when creeping and at rest, are denoted by arrows."

2. *Navicula viridula.* Carapace straight, lanceolate, linear, very slender, truncate at the ends, flattened on one side, lanceolate and obtuse on the other, 13 to 15 striæ in $\frac{1}{100}$ line, $\frac{1}{250}$ to $\frac{1}{24}$ line. *Frustulia viridula, Ktz.*, Linn. 1833, Pl. 13, fig. 12.

Ehrenberg mentions this as one of the species detected by him among fossil infusoria from West Point. Kutzing's figure does not allow me to determine with certainty, which of the various forms occurring at West Point, belongs to this species.

3. *Navicula* ——. (Pl. 2, fig. 18.) This figure represents a panduriform species, very much contracted in the middle. It occurs in peat from a salt marsh near Stonington, Conn.

4. *Navicula* ——. (Pl. 2, fig. 19.) This species occurs with the last, and is perhaps a state of it resulting from its complete spontaneous division into two individuals by the contraction at the middle.

5. *Navicula* ——. (Pl. 2, fig. 20.) This resembles the preceding very much, but is a fresh-water species, occurring in ponds near West Point, also in streams in Virginia.

6. *Navicula? striatula.* (Pl. 2, fig. 21, *a*, *b*.) I refer to this genus with much hesitation the very elegant and interesting species shown by fig. 21 *a*, *b*. It is easily known by a set of peculiar and beautiful undulating ridges, represented in the figure, and which give to the margin of the form a ruffled appearance, in whatever position they are observed. One of the faces (a) is lanceolate, the other (b) is somewhat wedgeform, with both ends obtusely truncate. The lanceolate face shows a set of fine lines apparently proceeding from the ridges above referred to, and reaching nearly to the middle line of the face. I have sometimes seen two individuals united laterally by their lanceolate faces, producing a very beautiful form. All the individuals which I have seen, have been free, without pedicel, and when living, their spontaneous motions were very distinct. I have found it in a living state in fresh-water ponds and streams near West Point, also in Mountain Run, near Culpepper Court House, in Virginia; and I detected it in a fossil state among other fossil infusoria from Bridgewater, Mass. (See figs. 6 and 7, Pl. 20, of Hitchcock's Final Report on Geology of Massachusetts.

In Pritchard's History of Infusoria, I find two figures representing *N. striatula*, which leave no doubt that ours is the same species. (See Hist. Inf. Pl. 3, fig. 137, 138.) The following interesting remarks with regard to the organs of locomotion in this genus, are also taken from this work.

"In the small pools left by ebb of the tide near Cuxhaven, Dr. Ehrenberg remarked numerous little bodies, apparently similar to *Navicula* (*Surirella*) *elegans* and *N. striatula*, but which from their comparatively very great size and structure of lorica, were easily distinguishable from the latter upon closer examination. One of these ribbed glass-like creatures was, besides its size, remarkable for its great mobility, and Dr. E. was enabled to investigate its system of locomotion much more satisfactorily than he had hitherto done in any of the genus. This organ he states was very different, both in form and size, to what he had before noticed in that genus. Instead of a snail-like expanding foot, *long delicate threads projected where the ribs or transverse marks of the shell join the lateral portion of the ribless lorica, and which the creature voluntarily drew in or extended.* An animalcule $\frac{1}{18}$th of a line long, had twenty four for every two plates, or ninety six in the total; and anteriorly, at its broad frontal portion, four were visible. It is probable that this creature may form the type of a special group of the Bacillariæ."

7. *Navicula* ———. (Pl. 2, fig. 22.) This small species of Navicula with striate faces, is not uncommon in the infusorial stratum of Richmond, Va.

*b.* Without transverse striæ.

8. *Navicula* ———. (Pl. 2, fig. 23, a, b.) This species is distinguished by having two grooves which cross each other at right angles on the ventral face, presenting a cruciform appearance, and dividing this face into four equal portions, which are without striæ. It is a conspicuous species in many American specimens of fossil fresh-water infusoria, and is very common in the living state. I have found it in New York, Ouisconsin and Virginia.

9. *Navicula sigma.* (Pl. 2, fig. 24, a, b.) Smooth, carapace lanceolate, sigmoid, not striate, linear, lanceolate on the straight side.

Our figure represents a sigmoid species, found among marine Algæ at Stonington, Conn. A somewhat larger sigmoid species occurs in the infusorial stratum of Richmond, Va.

10. *Navicula?* ———. (Pl. 2, fig. 25, a, b.) This very remarkable form I detected among fossil infusoria, from the infusorial stratum of Richmond, Va. It is lanceolate when seen on one side; on the other side it presents the curious outline shown in fig. 6.

*Note.*—This may *possibly* belong to Ehrenberg's new genus Zygoceros, which is described as having a compressed Navicula-shaped carapace; each end provided with two perforated horns. (See Pritchard, l. c. p. 427.)

In addition to the American species of Navicula above described, Ehrenberg mentions the following as occurring in a fossil state at West Point, viz.

N. alata, *nov. sp.*
N. amphyoxys.
N. Suecica.

I am, however, ignorant of their specific characters; I have met with many species besides those referred to in the present memoir, but omit them, as my present object is to present only the most interesting forms.

## EUNOTIA.

*Free, single or binary, carapace simple, bivalve or multivalve (siliceous) prismatic, four openings on the same side, two at each end, ventral side flattened, back convex and often dentate, never catenate by perfect spontaneous division.*

1. *Eunotia arcus.* (Pl. 2, fig. 26, a, b.) Striate, carapace semi-lanceolate, elongated, two terminal knobs arcuate, 11 striæ in $\frac{1}{100}$ line.

Ehrenberg mentions *E. arcus* as occurring among fossil infusoria from West Point. I presume that our figure, which represents a form very common both in the recent and fossil state in the United States, belongs to this species.

2. *Eunotia diodon.* (Pl. 2, fig. 29.) Striate, carapace elongated, ventral side flattened, slightly bidentate at the middle of the back, 19 striæ in $\frac{1}{100}$ line, $\frac{1}{40}$ to $\frac{1}{24}$ line.

Hab. West Point, fide Ehrenberg. Probably the same as fig. 29, which is common both recent and fossil at West Point, and elsewhere in the United States.

3. *Eunotia tetraodon.* (Pl. 2, fig. 31.) Striate, carapace semi-lunar, short, flattened or concave on the ventral side, four rounded teeth on the convex back, 23 striæ in $\frac{1}{100}$ line, $\frac{1}{96}$ to $\frac{1}{48}$ line.

Common among fossil infusoria from Manchester, Mass., and West Point, N. Y. The living species occurs at West Point.

4. *Eunotia pentodon.* (Pl. 2, fig. 32.) Striate, carapace semi-lunar, short, five teeth on the convex back, 23 striæ in $\frac{1}{100}$ line.

Fossil at Manchester, Mass. Living at West Point.

5. *Eunotia serra.* (Pl. 2, fig. 33.) Striate, carapace linear, slightly curved, twelve to thirteen rounded teeth on the convex back, 19 striæ in $\frac{1}{100}$ line, $\frac{1}{36}$ to $\frac{1}{24}$ of a line.

Our figure is from specimens found fossil in Massachusetts. I have also received it from various other localities.

I strongly suspect that the number of the teeth on the back of the four last described species of Eunotia, is liable to variation, and that the number of species has in consequence been made too great. See remarks in Final Report on Geology of Massachusetts, Vol. II, p. 310, et seq.

6. *Eunotia* ———. (Pl. 2, fig. 27, a, b.) This species was found in water from a brackish ditch in New Jersey, which was sent to me for examination by Dr. Torrey. It is concave on one side, convex on the other, with a slightly elevated and widened portion in the middle. It is also minutely striate.

### Cocconeis.

*Free, single, carapace simple, bivalve (siliceous) prismatic or hemispherical, a single opening in the middle of both sides of each carapace (?), never double or catenate by spontaneous division.*

1. *Cocconeis ?* (Pl. 2, fig. 34.) Represents what I believe to be a species of Cocconeis. I found it adhering to a small marine Alga from the eastern shore of Florida.

Beautiful figures of *Cocconeis* (*Campylodiscus*) *clypeus*, drawn by F. Bauer, will be found in Pritchard's Hist. Inf., Pl. 12, fig. 516—518. I have received fine specimens of these elegant fossils from E. J. Quekett, Esq., of London.

### Bacillaria.

*Free, (never fixed) carapace simple, bivalve or multivalve (siliceous) prismatic, forming chains or zigzag polypidoms by imperfect spontaneous division of the carapace and perfect division of the body.*

1. *Bacillaria paradoxa.* (Pl. 2, fig. 35.)—*The standard bearer.*—Striate, carapace linear, very slender, often fifteen times longer than broad, yellow, frustules very active, $\frac{1}{96}$ to $\frac{1}{20}$ line. Syn. *Vibrio paxillifer*, *Müller.* See Encyl. Meth. Pl. 3, fig. 16 to 20.

I first detected this species in October, 1840, among Algæ from the Hudson River, near West Point. I am informed by Dr. P. B. Goddard of Philadelphia, that it also occurs in abundance near that city. It is a very interesting species, presenting by its curious motions and paradoxical appearance, an object well calculated to astonish all who behold it. At one moment, the needle-shaped frustules lie side by side, forming a rectangular plate; suddenly, one of the frustules slides forward a little ways, the next slides a little also, and so on through the whole number, each however retaining a contact through part of its length with the adjoining ones. By this united motion the parallelogram is changed into a long line; then some of the frustules slide together again, so that the form is then much like a standard. Similar motions are constantly going on, and with such rapidity that the eye can scarcely follow them. There are few more interesting objects for the microscope.

Several of the positions of these singular productions are well represented by Müller. (See Enc. Meth. Vers. Pl. fig. 16—20.)

Müller found his specimens abundant on *Ulva latissima;* I found mine pretty common among Enteromorpha, Polysiphonia, and Potamogeton, which grow together in brackish water on the flats in the Hudson River, near West Point.

2. *Bacillaria? tabellaris.* (Pl. 2, fig. 36, *a*, *b*.) Smooth, carapace linear, narrow, swollen in the middle, dividing into quadrangular plates of variable length, ovary lobed and yellow, $\frac{1}{96}$ to $\frac{1}{90}$ line, (width of filament.) Syn. *Diatoma flocculosum*, *Kutz.*, Linn. 1833, Pl. 17, fig. 67. *Diatoma flocculosum*, *Greville*, in Brit. Flora, Vol. V, p. 406.

This species is very common in all parts of the United States which I have visited. It is easily recognized by its zigzag chains, composed of plates (individuals) of various width, which have the middle and two outer edges considerably thickened, as is shown in the side view, fig. 36, *b*.

In fig. 37, *a*, *b*, is represented what I believe to be the full grown state of the species. It at first view appears very distinct from fig. 36; but on examination, we find the same thickening of the middle and ends, and similar transverse lines. The two varieties or states occur together; both are also found fossil. They are very abundant in ditches and ponds near West Point.

3. *Bacillaria* ———. (Pl. 2, fig. 38.) This is a *marine* species, which I found at Stonington, Conn., and Staten Island, N. Y., adhering to filamentous Algæ. It is distinguished by having on each half of its frustules two lines which commence near the centre and run straight and parallel, until they arrive near the extremities, when they suddenly become falcate for a short distance, and then resume their original directions. The curved portions of the lines have some resemblance to the upper portion of a pair of tongs. The position of these lines is very similar to those on *Bacillaria Meneghinii*. (See Schlechtendal's Linnæa, 1840, Tab. IV, fig. 1.)

### TESSELLA.

*Free, carapace simple, bivalve or multivalve (siliceous) prismatic, compressed in form of plates, forming zigzag polypidoms by imperfect spontaneous division of the body, and perfect division of the carapace. The chains have spontaneous motion.*

*Tessella catena.* (Pl. 2, fig. 39?) Carapace lamelliform, often broader than long, 4–24 longitudinal series of transverse striæ, 10 striæ in $\frac{1}{100}$ line.

Fig 39 is copied from a species, of which I found a few individuals adhering to a dried Alga from Stonington, Conn. It appears to belong to *T. catena.*

### Fragillaria.

*Free, carapace simple, bivalve or multivalve, (siliceous) prismatic, forming chains resembling fragile ribbons, resulting from the imperfect division of the carapace and body.*

1. *Fragillaria pectinalis.* (Pl. 2, fig. 40.) Striate, corpuscles broad, 2 to 4 times longer than broad, swollen and lanceolate on the lateral side, ovary yellow, $\frac{1}{192}$ to $\frac{1}{36}$ line.

The flat ribbon-like filaments of this species are very common in ponds, and slow running streams near West Point, and they often form masses as much as a square foot in extent. The filaments are of a yellowish green color, and resemble flat ribbons crossed by transverse parallel lines. Great variety occurs in the size and form of the frustules, but they are generally much longer than wide. Very minute striæ may often be distinctly seen on the edges of the frustules, as represented in our figure, but sometimes it requires a high magnifying power and skillful management of the light to render these apparent.

The masses composed of these filaments dry to a glistening silvery mass, which is exceedingly fragile, and which is unchanged by fire or nitric acid.

This species is not unfrequent in the fossil state, but the chains are then usually broken up.

Pl. 2, fig. 41, represents a variety (?) of this species with very narrow frustules, each of which when living, was marked with two yellowish spots, (ovaries?) Perhaps this is *F. bipunctata.* It occurs abundantly at Detroit, Mackinaw, and West Point.

2. *Fragillaria trionodis.* Ehrenberg mentions this species as occurring in a fossil state at West Point. I am ignorant of its characters, and may have confounded it with *F. pectinalis*, to which species all the varieties occurring at West Point appear referable.

### Meridion.

*Free, carapace simple, bivalve or multivalve (siliceous) prismatic, wedgeform, forming fragile spiral chains which often appear like complete circles, and which result from imperfect spontaneous division.*

*Meridion vernale.* (Pl. 2, fig. 42, a, b.) Corpuscles wedgeform, striate, anterior and truncate and dentate, polypidom spiral, often appearing perfectly circular, $\frac{1}{95}$ to $\frac{1}{20}$ line. *M. circulare, Agardh. M. circulare, Kutzing*, Linn. 1833, Pl. 15, fig. 37.

This is one of the most beautiful of the fresh-water infusoria, and excites great admiration in all who behold its elegant form and markings, under a good microscope. It occurs in immense quantities in the mountain brooks around West Point, the bottoms of which are literally covered in the first warm days of spring, with a ferruginous colored mucous matter, about one quarter of an inch thick, which, on examination by the microscope, proves to be filled with millions and millions of these exquisitely beautiful siliceous bodies. Every submerged stone, twig, and spear of grass, is enveloped by them, and the waving plume-like appearance of a filamentous body covered in this way, is often very elegant.

The spiral or helicoidal form of the chains is not easily perceived, unless the chains are thrown on edge, (as in fig. 42, b.) This is easily effected with Chevalier's compressor.

Alcohol completely dissolves the endochrome of this species, and the solution when evaporated, leaves a greenish resinous mass. The frustules, after the action of alcohol, are as colorless as glass, and resist the action of fire and nitric acid.

*End of the Naviculaceæ.*

*Explanation of the figures of Plate* 2.—The figures which accompany this memoir, were all drawn by the aid of a camera lucida, and to the same scale as was used in the plates of the first part of this sketch. That scale is shown in fig. 15, which represents $\frac{10}{100}$ths of a millimetre, magnified equally with the drawings. In the sketches, *a* represents the side of the animal usually seen, *b*, the other side.

Fig. 1. Pyxidicula operculata, fossil from Manchester, Mass.—fluviatile.

Fig. 1. *a*. Pyxidicula operculata? fossil from Massachusetts.

Fig. 2. *a*, *b*. Pyxidicula? Fossil in infusorial stratum at Richmond, Virginia.

Fig. 3. Gaillonella moniliformis, recent, marine.

Fig. 4. 4 *a*. Gaillonella aurichalcea, recent, fluviatile, at c is seen a globular joint.

Fig. 4. *b*. Gaillonella aurichalcea? recent, fluviatile.

Fig. 5. Gaillonella distans, recent and fossil, fluviatile.

Fig. 6. *a*, *b*. Gaillonella varians, recent and fossil, fluviatile.

Fig. 7. *a*, *b*. Gaillonella sulcata. Fossil at Richmond, Va., recent, marine at Stonington, Conn. *a*, jointed cylinder composed of several individuals; *b*, base of one of the joints.

Fig. 8. Gaillonella? ——. Recent, brackish water of Hudson River at West Point.

Fig. 9, 10. Actinocyclus. Fossil at Richmond, Va.

Fig. 11. *a*, *b*. Actinocyclus. *a*, base; *b*, side view, showing the alternate elevations and depressions which cause the light and dark portions seen on *a*. Fossil at Richmond.

Fig. 12. Coscinodiscus lineatus. Fossil in tertiary infusorial strata of Virginia, at Richmond, and on Rappahannock River.

Fig. 13. Coscinodiscus patina. With the preceding.

Fig. 14. Coscinodiscus radiatus. With the preceding.

Fig. 15. Scale representing $\frac{10}{100}$ths of a millimetre, magnified equally with the sketches.

Fig. 16. *a*, *b*. Navicula viridis, recent and fossil, fluviatile, *c*, *c*, *c*, *c*, the orifices.

Fig. 17. *a*, *b*. Navicula viridis, copied from Ehrenberg. See page 97.

Fig. 18. Navicula ——, marine, at Stonington, Conn.

Fig. 19. Navicula ——, marine, with the preceding.

Fig. 20. Navicula ——, fluviatile, West Point, &c.

Fig. 21. *a*, *b*. Navicula striatula, fluviatile, recent and fossil.

Fig. 22. Navicula ——, fossil at Richmond, Va.

Fig. 23. *a*, *b*. Navicula ——, fluviatile, recent and fossil.

Fig. 24. *a*, *b*. Navicula sigma? marine, Stonington.

Fig. 25. *a*, *b*. Navicula ——, fossil at Richmond, Va.

Fig. 26. a, b, c. Eunotia arcus, fluviatile, recent and fossil. c, cross section.

Fig. 27. *a*, *b*, *c*. Eunotia ——, brackish ditches, N. Jersey. c, cross section.

Fig. 28. Eunotia monodon,
Fig. 29. Eunotia diodon,
Fig. 30. Eunotia triodon,
Fig. 31. Eunotia tetraodon,
Fig. 32. Eunotia pentodon,
Fig. 33. Eunotia serra,
} fluviatile, recent and fossil.

Fig. 34. Cocconeis ——, marine, Florida.

Fig. 35. Bacillaria paradoxa, marine, Hudson river.

Fig. 36. a, b. Bacillaria tabellaris,
Fig. 37. a, b. Bacillaria tabellaris, full grown?
} fluviatile, recent and fossil.

Fig. 38. Bacillaria ——, marine, at Stonington, Conn. Recent.

Fig. 39. Tessella catena? marine, at Stonington, Conn. Recent.

Fig. 40. Fragillaria pectinalis,
Fig. 41. Fragillaria bipunctata?
} fluviatile, recent and fossil.

Fig. 42. *a*, *b*. Meridion vernale, fluviatile, recent, and fossil in fragments.

ART. XI.—*Description of Eight new Species of Shells, native to the United States;* by HENRY C. LEA, Philadelphia.

THE study of the marine shells native to the coast of the United States, has till lately been somewhat neglected. While our rivers, particularly the western and southern ones, have presented to the conchologist a series of shells, remarkable for their size and beauty, the productions of our coast, more especially towards the north, are usually small and plain in appearance. A few of the larger and more showy species were described by Lamarck and other European writers, and in our own country, Mr. Say early began to investigate them with great zeal. He was followed by Messrs. Barnes, Conrad and others, and of late years many have been described by Col. Totten, Dr. Gould, Messrs. Adams, Couthouy, and others. There can be hardly any doubt however, that many still remain undescribed. Some of the species have a very wide range along the coast. In Delaware Bay I have found the *Actæon trifidus*, Totten, *Cerithium terebrale*, *C. nigrocinctum*, and *C. Greenii*, Adams. The *Buccinum ornatum*, Say, is found in the southern states, and in New England, and I have a specimen from the West Indies. The *Cerithium Sayii*, Menke, although so plentiful in New England, I have not observed here. Those among the following species, which are marked from Delaware Bay, were found in the sandy mud adhering to the *Ostrea Canadensis*, Lam.

GENUS CYRENA.—*Lamarck.*

C. *purpurea.* Pl. 1, fig. 1.*

C. testâ rotundato-triangulari, æquilaterali, sub-inflatâ, sub-crassâ, diaphanâ, et purpureâ et albâ, politâ, striis transversis; natibus prominentibus; margine non crenulato.

Shell rounded-triangular, equilateral, sub-inflated, somewhat thick, partly purple and partly white, with transverse striæ; beaks prominent; margin not crenulated.

Length ·07. Breadth ·07. Diam. ·04 of an inch.

Hab. Delaware Bay. Cabinet of I. Lea.

*Remarks.*—This beautiful little species of *Cyrena*, has much

* The smallest figures are of the natural size; the three large ones, in outline, in figs. 5, 7 and 8, are merely to show the shape of the mouth.

resemblance to the *Venus gemma* of Totten. Indeed I considered it as such for some time, until I was able to obtain a view of the teeth, which prove it to be a *Cyrena.* It may, however, be also distinguished from the *Venus gemma,* by its equilateral form, and want of crenulations on the margin. The beaks are rounded at the summit. It has usually a dark purple mark along the posterior margin, which gradually fades off, and the anterior portion of the shell is whitish. Occasionally, however, it is nearly all purple, but darker towards the posterior margin, and I have one specimen which is pinkish. The striæ are perfectly regular, and at even distances. It is, I believe, the smallest *Cyrena* yet noticed.

### Genus Modiola.—*Lamarck.*

#### M. *elliptica.* Pl. 1, fig. 2.

M. testâ transversâ, ellipticâ, sub-inflatâ, pellucidâ, purpureo-maculatâ, politâ, radiatim striatâ posticè et anticè; valvulis tenuibus; natibus sub-prominentibus; margine crenulato posticè ac anticè; margaritâ diaphanâ et nitente.

Shell transverse, elliptical, sub-inflated, pellucid, marked with purple, polished, radiately striate posteriorly and anteriorly; valves thin; beaks somewhat prominent; margin crenulated posteriorly and anteriorly; nacre diaphanous, shining.

Length ·075. Breadth ·1. Diam. ·025 of an inch.

Hab. Delaware Bay. Cabinet of I. Lea.

*Remarks.*—The area of the valves is divided into three fan-shaped compartments by the striæ, of which the anterior contains about seven, and the posterior about twenty-four. The purple marks in some specimens are so numerous, as to completely cover the shell, while others are nearly free from them. They are frequently zigzag. The dorsal margin appears to be slightly crenulate. It is strongly allied to the *Modiola discors, nexa* and *discrepans,* and might be confounded with the young of either of those shells. But its size appears constant, as I have taken them at various seasons of the year; in addition to which the difference in shape and marking, and the want of transverse striæ, will distinguish it.

#### M. *pulex.* Pl. 1, fig. 3.

M. testâ transversâ, obovatâ, lævi, politâ, viridescente, diaphanâ, lineis purpureis ornatâ; valvulis tenuibus; natibus sub-prominentibus, sub-acutis.

Shell transverse, obovate, smooth, polished, greenish, diaphanous, marked with purple lines; valves thin; beaks somewhat prominent, sub-acute.

Length ·08. Breadth ·15. Diam. ·05 of an inch.

Var. *α*. Minore, compressiore, castaneo-brunneâ, sine lineis purpureis.

Smaller, more compressed, chestnut-brown, without purple lines.

Hab. Delaware Bay. Cabinet of I. Lea.

*Remarks.*—This species varies very much, both in form and color. The var. *α* may perhaps prove a species. The markings, as in the preceding species, are frequently zigzag. There are transverse lines of growth, only visible with a powerful microscope. In form it somewhat resembles the *Modiola tulipa.* It might be confounded with the very young of *Mytilis edulis*, but the difference in color and shape, as well as in the position of the beaks, will distinguish it on a very slight examination.

GENUS CREPIDULA.—*Lamarck.*

C. *acuta.* Pl. 1, fig. 4.

C. testâ ovatâ, valde convexâ, sub-tenui, lævi, externè fuscâ, intus tenebroso-castaneâ; epidermide luteo-fuscâ; apice acuto, recto; cyatho sub-triangulari, albido, diaphano, sub-convexo, vix æquali trienti testæ longitudinis; aperturâ ellipticâ.

Shell ovate, very convex, somewhat thin, smooth, externally brown, internally dark chestnut; epidermis yellowish brown; apex acute, straight; cyathus sub-triangular, whitish, diaphanous, somewhat convex, scarcely equal to a third the length of the shell; mouth elliptical.

Length ·17. Breadth ·1. Height ·05. Length of cyathus ·05 of an inch.

Hab. Delaware Bay. Cabinet of I. Lea.

*Remarks.*—This little species of *Crepidula* belongs to the *Crepipatella*, Lesson, a sub-genus of *Calyptræa.* The color internally varies from a chestnut brown to a horn color with brown marks. The cyathus or diaphragm, in common with our other species, is convex, the convexity usually ending at a regular line, about one fifth from one side, beyond which it is flat; it also generally comes a little further down on one side than on the other. It is usually very regular in its form. It bears a slight resemblance to the *Crepidula glauca*, but that shell is flatter when young than when old; besides which, the acute apex, less width, and want of transverse lines, will immediately distinguish it. It however approaches most nearly to the *Crepidula convexa*, and indeed it is with some doubt that I separate it. But the two sides are alike in their curvature, the outside smooth, the cyathus diaphanous and not so deeply situated, the color usually much darker, and the apex straight. Besides this, its habitat seems different, our species being found clinging to the *Ostrea Canadensis*, while the *C. convexa*, according to Dr. Gould, is found upon sea-weed and stones at the roots of sea-weed.

GENUS CARYCHIUM.—*Leach.*

C. *exile*. Pl. 1, fig. 5.

C. testâ ovato-conicâ, valde elevatâ, sub-perforatâ, diaphanâ, albidâ, longitudinaliter striatâ; spirâ obtusâ; anfractibus senis, convexis; suturis impressis; aperturâ ellipticâ, integrâ, dentibus tribus; labio valde reflexo.

Shell ovately conical, much elevated, sub-perforate, diaphanous, whitish, longitudinally striate; spire obtuse; whorls six, convex; sutures impressed; mouth elliptical, entire, with three teeth; lip much reflexed.

Length ·075. Breadth ·025 of an inch.

Hab. Under dead leaves and mould, on the Wissahiccon creek, near Philadelphia. Cabinet of I. Lea.

*Remarks.*—This beautiful little shell bears a strong resemblance to the *Pupa exigua* of Say, and it is with some doubt that I propose it. The chief points in which it differs from that shell are the following. The lip is continuous round the mouth, and not interrupted by the last whorl, as is the case with the *Pupa*, thus being a true *Carychium;* the lip is flattened, the number of whorls is greater, there is a tooth on the outer lip, the size is smaller, and the shape more elongated. It also nearly approaches the *Carychium minimum*, Leach, an European shell, but may be easily distinguished by its striæ, shape, number of whorls, perforation, and teeth. The tooth on the outer lip is very variable, being sometimes almost obsolete and sometimes larger than those on the inner one. Of the two teeth on the inner lip, one is placed at the middle, and the other very near the base of the mouth, and so far in as to be almost invisible on a front view. The mouth is ·02 of an inch in length. It appears to be the only true *Carychium* yet found in the United States, its small perforation, hardly amounting to an umbilicus, not being sufficient to separate it from that genus. In its shape and mouth it strongly resembles the genus *Clausilia*, but it wants the clausum, the distinctive mark of that curious and interesting genus. I have only met with it on the Wissahiccon, where it does not seem to be very common.

GENUS PASITHEA.—*Lea.*

P. *sordida.* Pl. 1, fig. 6.

P. testâ ovato-conoideâ, perforatâ, tenui, albidâ, diaphanâ, lævi, politâ; spirâ obtusâ; anfractibus quaternis, convexis; suturis sub-profundis; aperturâ ellipticâ, intus albâ; columella lævi.

Shell ovately conical, thin, perforated, whitish, diaphanous, smooth, polished; spire obtuse; whorls four, convex; sutures somewhat deep; mouth elliptical, white within; columella smooth.

Length ·075. Breadth ·025 of an inch.

Hab. Near Boston. Cabinet of I. Lea.

*Remarks.*—I found this shell among a number of specimens of *Cerithium Sayii*, sent to my father by Mr. Adams from Boston. It might be mistaken for a very young specimen of *Actæon trifidus*, Totten, but that species has the fold on the columella, the same shape and the transverse striæ, even in its youngest state. In the present species, the mouth is acute above and slightly rounded below, and is ·037 of an inch in length. It may perhaps be considered as the smallest of our marine shells yet described.

There has been great confusion among conchologists respecting the group of shells to which this species belongs. Lamarck placed some marine shells in the genus *Melania*, but the difference which must exist between species breathing fresh and salt water, would in itself warrant their separation. The genus *Eulima*, Risso, may perhaps embrace the *Pasitheæ*, but in the former the mouth is often not effuse, the labrum slightly thickened, there are non-secund varices, and the spire is frequently curved. Lowe has lately made a genus *Parthenia*, which only differs from *Eulima* in being white, and having cancellations. This does not seem sufficient to warrant a generic distinction. The genus *Rissoa*, Fremenville, closely resembles the *Eulima*, and will also take in part of the *Cingula*, Fleming, which however may be distinguished from others, by having the lip continuous posteriorly. The *Hydrobia*, Hartmann, according to Dr. Gould, seems to be the same as the *Cingula*. The *Turritella*, Lamarck, having the mouth non-effuse, is easily separated from the rest. The *Pasithea* differs from these in its effuse mouth and acute outer lip. The *Niso*, Risso, only differs from it in the large umbilicus. The *Pyramis*, Brown, judging from the references made to it by Dr. Gould, seems to differ from it but slightly. The *Actæon*, De Montfort, (*Tornatella*, Lamarck,) is easily distinguished from these genera by the fold on the columella, and it unquestionably has priority over *Odostomia*, Fleming, and *Jaminia*, Brown. There are also the genera *Truncatella*, *Choristoma*, *Alvania* and *Acmæa*, which I have only met with* as synonymes to *Rissoa*.

GENUS ACTÆON.—*De Montfort.*

A. *parvus.* Pl. 1, fig. 7.

A. testâ acuto-conoideâ, sub-tenui, lævi, albâ, umbilicatâ; spirâ acutâ; anfractibus quinis, planulatis; suturis linearibus; ultimo anfractu sub-angulato; umbilico parvo; aperturâ ovatâ, effusâ; columellâ uniplicatâ; labro acuto.

Shell acutely conical, somewhat thin, smooth, umbilicated; spire acute; whorls five, flattened; sutures linear; last whorl sub-angular; mouth ovate, somewhat effuse; columella with one fold; outer lip acute.

Length ·075. Breadth ·037 of an inch.

Hab. Delaware Bay. Cabinet of I. Lea.

*Remarks.*—In this little species there is nothing very remarkable. The mouth is ·025 of an inch in length, and not very acutely angular above. It appears to have a thin, horny operculum, though from the extremely small size of the shell, I cannot be certain as to that point. The only one of our species with which it can be confounded, is the *Actæon trifidus*, Totten, but the umbilicus, want of transverse striæ, and the difference in the shape of the mouth, will immediately distinguish it from that shell. It bears considerable resemblance to one or two fossil species described by M. Grateloup,† from near Dax, in France.

GENUS CERITHIUM.—*Bruguiere.*

C. *cancellatum.* Pl. 1, fig. 8.

C. testâ turritâ, sub-tenui, tenebroso-fuscâ, sub-perforatâ, cancellatâ, sulcis longitudinalibus, striisque transversis; spirâ acutâ; anfractibus octonis, convexis; suturis sub-profundis; basi brunneâ; aperturâ ellipticâ, supra angulatâ, infra sub-canaliculatâ; columellâ brunneâ; labro acuto; operculo nigro.

Shell turrited, somewhat thin, dark brown, sub-perforate, can-

* The three first genera in Philippi's "Enumeratio Molluscorum Siciliæ," and the last in Cuvier's "Animal Kingdom."

† Transactions of the Linnæan Society of Bordeaux, for November, 1838.

cellated, with longitudinal sulcations, and transverse striæ; spire acute; whorls eight, convex; sutures somewhat deep; base brown; mouth elliptic, angular above, sub-canaliculate below; columella brown; outer lip acute; operculum black.

Length ·15. Breadth ·05 of an inch.

Hab. Delaware Bay. Cabinet of I. Lea.

*Remarks.*—The transverse striæ are usually almost obsolete on the upper whorls, while the longitudinal sulcations become entirely so on about the last whorl and a half. The striæ are continued to the very base, which together with the columella are brown. The color of the last whorl and a half is generally yellowish, while the rest of the shell is dark brown. The lower whorls are frequently much more convex than the upper. The mouth is ·05 of an inch in length, and ·025 wide. I at first mistook this shell for a *Turritella*, from the fact of the canal not being added until the shell has attained its full growth. This species might be regarded as consisting of dwarf specimens of the *Cerithium Sayii*, Menke, but it is not more than half the size of that shell, its whorls are more convex, its cancellations more obsolete, and the shape of the canal is totally different, being much longer and less oblique. It resembles it however in its mode of growth, the lower whorls being entirely different from the upper.

Philadelphia, May 17th, 1841.

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## Art. XII.—*Observations on the Storm of December* 15, 1839; by William C. Redfield, A. M.*

Read before the American Philosophical Society, Jan. 15, 1841.

In the table and map which are annexed to these remarks will be found the observations which have been obtained of the direction of wind in this storm, in the states of Connecticut, Rhode Island, Massachusetts, New Jersey, and parts of the states of Maine, New Hampshire, Vermont, and New York.

The arrows on the map denote, approximately, the direction of wind, at or near the hour of noon, at the several places of observation. The concentric lines, drawn at intervals of thirty miles, were added, not as precisely indicating the true course of the wind, but to afford better means of comparison for the several observations.

It will be seen, that of forty-eight distinct sets of observations, which are comprised in the annexed schedule, about thirty are

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* From the Transactions of the American Philosophical Society.

derived from the meteorological journals of scientific and intelligent observers, or from the log-books of vessels exposed to the storm; and I take this occasion to offer my thanks to the gentlemen who have so kindly furnished me with their observations.

The position assumed for the axis of the gale, at noon, should, perhaps, be nearly in line with the position of the ship Morrison and Cape Cod Bay; at which places the wind was then blowing from opposite points of the compass, but, as may be seen, not in actually opposing directions. The Morrison was from China, bound to New York; and I have reason to believe that her position at noon may be safely relied on. The violence of the gale was here so great that the ship, as I am informed, was lying to without canvass. This ship had encountered the western side of the gale, suddenly, at 7, A. M., and the sun shone chiefly unobscured during the greater part of the day.

The gale was severe over the entire surface comprised in the map, except, perhaps, on its extreme northern and northwestern portions, and excepting, also, the lighter winds which were observed near the apparent axis of the gale, in the region of Buzzards' and Cape Cod bays, &c., in the afternoon and evening. A very heavy fall of snow accompanied the gale in the states of Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine; also, in some parts of New York and southern Vermont. Some snow also fell in the western and northern parts of New York and Vermont, but attended with more moderate and variable winds, chiefly from the north and west.

The southwesterly and southerly winds, which connect the westerly with the southeasterly winds in the circuit of rotation, are found at Nantucket in the afternoon, by the farther advance of the storm, and also in the log-books of a number of vessels whose positions were eastward and southward of the ship Morrison, but beyond the limits of the map.

The barometric minimum, as in other storms, appears to have nearly coincided, in its progress, with the apparent axis of the gale.

My main object in collecting the observations contained in the subjoined schedule, has been to establish the course of the wind in the body or heart of the storm at a given time, and apart from all other considerations. I am in possession, however, of more extended observations of this gale. Many of these appear to agree with some of the following characters or modes of action which pertain, more or less, to many of the storms or gales that visit the United States and other regions. These characters have claimed attention from almost the earliest period of my inquiries.

1. The body of the gale usually comprises an area of rain or foul weather, together with another, and perhaps equal, or greater area of fair or bright weather.

2. The fall of rain or snow often extends, in some direction, greatly beyond the observed limits of the gale.

3. The gale itself not unfrequently exhibits an apparently unequal extent of action, or degree of violence, on different sides of its apparent axis of rotation.

This peculiarity, as well as the second, is most common in winter storms, and in those which sweep over an extensive continental surface; and, like other irregularities, is less noticeable in the storms which are traced solely on the ocean.

4. The barometric indications of a gale commonly extend much beyond the observed limits of its action.

5. The body of the gale constitutes a determinate sheet or stratum of moving air; and of this sheet or stratum a large portion sometimes overlies another and more quiescent stratum of air, the latter having, perhaps, a different motion; as may be often observed in the common winds of the temperate and higher latitudes: in which case the gale is either not felt at the surface of the earth, or the observed changes of wind are found, in part, unconformable to the whirlwind theory.

6. Owing to the convergent and somewhat variable courses of storms in the extra-tropical latitudes, as well as to their unequal rates of progress, two storms will sometimes cover, in part, the same field, one of which will overlie the other, and, perhaps, thin out at its margin, in the same manner as common winds. This, also, may occasion a different order of change in the observed winds and weather from that which is commonly noticed in a regular whirlwind storm.

Owing to such causes, the oscillations of the barometer are often irregular; and this is particularly noticeable in the higher latitudes.

7. In most gales of wind there is, probably, a subordinate motion, inclining gradually downward and inward in the circumjacent air, and in the lower portions of the gale; and a like degree of motion, spirally upward and outward, in the central and higher portions of the storm. This slight vorticular movement is be-

lieved to contribute largely to the clouds and rain which usually accompany a storm or gale; and is probably due, in part, to the excess of external atmospheric pressure on the outward portions of the revolving storm.

8. In storms which are greatly expanded there is sometimes found an extensive area of winds of little force and variable direction, lying within the circuit of the true gale, and attended throughout with a depressed state of the barometer. This more quiescent portion of air in the centre of a gale has been found to extend, in some cases, to a diameter of several hundred miles.

In the case now before us, the direction of the arrows representing the course of the wind at noon, as carefully drawn on a larger map, shows an average convergence, or inward inclination, of about six degrees. But it is not deemed safe to rely upon this result in a single case, which is liable to be affected by the errors of observation and the deflecting influences of the great valleys and lines of elevation, as well as by the errors of approximation which often arise from referring all winds to eight, or, at most, to sixteen points of the compass.

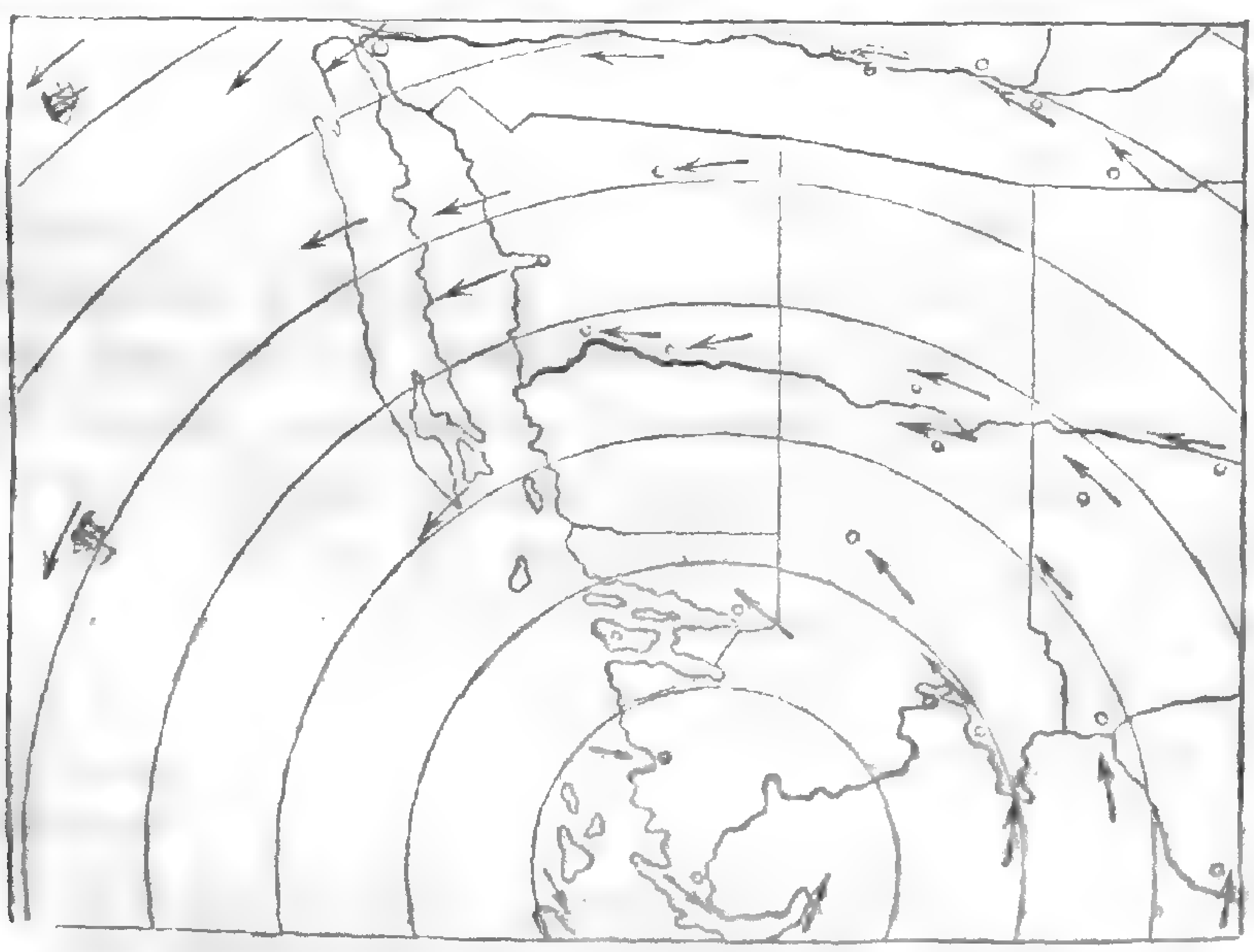
It is not intended, on this occasion, to support the foregoing characteristics by such extended details of evidence as their discussion would necessarily demand; and they are mentioned here only because the true character of the rotation in these gales, as well as the necessary or incidental connexion of this rotation with other phenomena which attend them, has seemed to be often misapprehended.

As relates to the whirling or rotary action in the case before us, it may be remarked, that had we obtained no observations from the northwestern side of the axis of this gale, it would have been easy, in the absence of more strictly consecutive observations than are usually attainable, to have viewed the initial southeasterly wind of the gale,* and the strong northwesterly wind which soon followed, as two distinct sheets or currents of wind, blowing in strictly opposing directions; and if we could so far lose sight of the conservation of spaces and areas, the laws of momentum and gravitation, together with a continually depressed barometer within the storm, we might then have supposed one of these great winds, if not both, to have been turned

* Observed between the coast of Massachusetts and latitude 25° N.

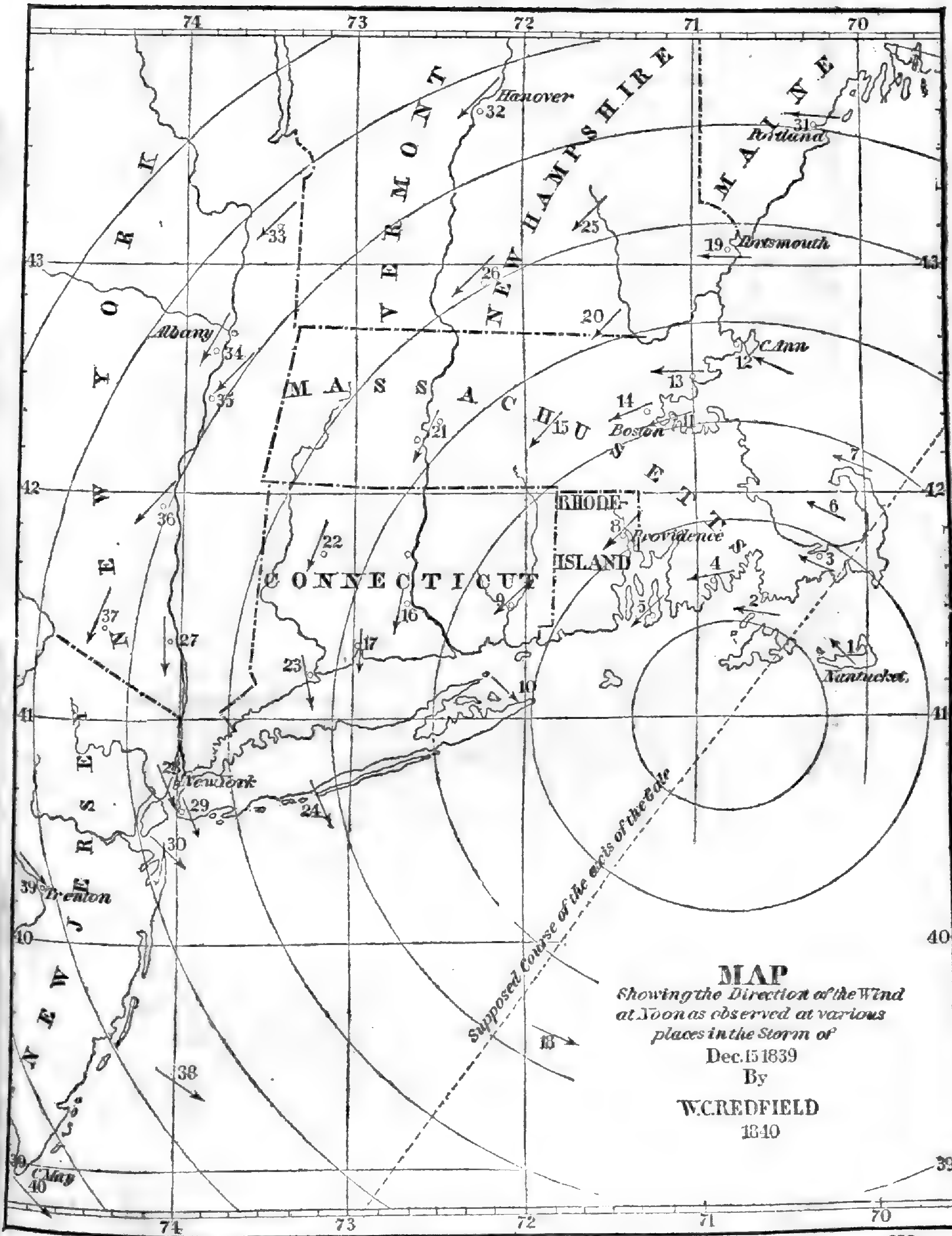
upward by an unseen deflection, and doubled back upon itself in the higher atmosphere. But the case neither calls for nor admits these speculations. If, however, the axis of this gale had chanced to pass westward and northward of our limits of correct observation, in pursuing its northeasterly course, as did, perhaps, that of the storm of December 21st, 1836, which has been ably examined and discussed by Professor Loomis,* it is, in such case, more than probable that its whirlwind character would not have been established.

[*Note.*—It having been claimed that this and other storms had been found to blow *inward*, towards some central point or line, I was induced to prepare and make public, shortly after the occurrence of this storm, a statement of observations on the direction of the wind *at or near sunset*, from such evidence as was then in my possession, and illustrated by a small geographical sketch or diagram. To this sketch, which is here subjoined, I have now added the latest observations on the 15th, at the following places, viz. Culloden Point, Worcester, position of ship Morrison, Stratford, Fire Island, Keene, West Point, Salem, N. Y., and the position of the barque Ann Louisa. It will be seen that the assumed axis of the storm on this sketch is more advanced in its northeasterly course than appears in the larger diagram of the observations made at noon, as seen on the following page.



I have seen no satisfactory evidence that the revolving character has been wanting in any active American storm.—W. C. R.]

* Trans. Am. Phil. Soc. Vol. VII, p. 125–163.


MAP
Showing the Direction of the Wind at Noon as observed at various places in the Storm of Dec. 15 1839
By
W.C. REDFIELD
1840
Supposed Course of the axis of the Gale
NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
NEW JERSEY
Hanover
Portland
Portsmouth
Albany
C.Ann
Boston
Providence
Nantucket
New York
Trenton
C.May
English miles
5 10 20 30 40 50 100 150 200 250

*Schedule of Observations on the Direction of Wind in the Storm of December 15th, 1839: With a Map indicating the Direction of the Wind at or near the hour of Noon.* By William C. Redfield.

| No. | Places of Observation. | A. M. | Noon. | P. M. | Observers and Authorities. |
|---|---|---|---|---|---|
| 1 | Nantucket, Ms. | E. | S.E. at 1 *p. m.* | S. W. | Report of James Mitchell, as published by Mr. Espy. |
| 2 | Woodville, Ms. | . . . . | "A little S. of E." | Clouds broke at W. before 2 P. M. | Observations on board Steamboat Telegraph, by William Mitchell of [Nantucket. |
| 3 | Barnstable, Ms. | N. E. at 7 *a. m.* | [E. S. E.] | E. at 2 *p. m.*: S. E. at Sunset. | Report to Editor of Boston Courier. } *I take the mean of E. and S. E for true direction at Noon.* W.C.R. |
| | Do. | Gale from S. E. | | S.W. *p. m.*: Clear at Sunset. | Letter of Wm. H. Brown to W. C. R. |
| 4 | New Bedford, Ms. | Sunrise, N.E. mod. | [E. by N.] | 2 *p. m.* E. N. E.: 3½ p. m. S. | Joseph Congdon's Meteorological Journal. } *I take E. by N. as the mean for Noon.* |
| | Do. | do. E. fresh, | | do. E: Sunset S S E | Sam'l Rodman's. do. as publ'd by Mr. Espy. |
| 5 | Newport, R. I. | N. E. | N. E. | N. E. | Meteorological Journal published at Newport. |
| 6 | Cape Cod Bay, | E. S. E. | E. S. E. | E. S. E. at 2 *p. m.* | Report of Capt. Slemmer, Brig Columbus. |
| 7 | Provincetown, Ms. | E. S. E. | E. S. E. | E. S. E. | Marine Reports in Boston Newspapers. |
| 8 | Providence, R. I. | N. E. | N. E. | N. E. | Professor Caswell's Meteorological Journal. |
| 9 | Norwich, Ct. | N. E. | N. E. | N. E. | Norwich Courier. |
| 10 | Culloden Point, N. Y. | *"changed to* | N. W. *at Noon."* | . . . . | Capt. Green's Account, as published by Mr. Espy. |
| 11 | Boston, Ms. | Sunrise, N. E. | E. N. E. } [E. 17° N.] | Sunset, E. S. E. | Wm. Cranch Bond's Meteorl. Journal. } *I take the mean of the observations at Noon.* |
| | Do. | E. by N. | E. by N. | E. by N. | Robert Treat Paine's Observations. |
| 12 | Gloucester, Ms. | E. S. E. | E. S. E. | E. S. E. | Letter from Gloucester, in the Boston Newspapers. |
| 13 | Salem, Ms. | Eastward. | Eastward. | Eastward. | Salem Gazette. |
| 14 | Waltham, Ms. | N. E. | [E. N. E.] | E. | Monthly Met. Jour., by C. F., in the Boston Daily Centinel. |
| 15 | Worcester, Ms. | N. E. | N. E. | N. E. | Met. Journal at State Lunatic Hospital—in National Ægis. |
| 16 | Middletown, Ct. | N. N. E. | [N. by E.] | N. | Reported by Professor Smith. } *I take N. by E. for the mean at Noon.* |
| | Do. | N. | | N. N. E. | Dr. Barratt's Met. Journal. |
| 17 | New Haven, Ct. | N. by W. | [N. 3° E.] | N. N. W. | Report of Capt. Woolsey, Steamboat Providence. } *I take the mean of N. 3° E.* |
| | Do. | N. N. E. | | N. N. E. till 1½ *p. m.* | Judge Darling's Meteorological Journal. |
| 18 | Ship Morrison, at sea: Lat. 30° 26 N. Lon. 71° 50 W. | S. E.: W. N. W. | W. N. W. | W. N. W. | Ship's Log Book—also, Statements of Capt. Benson and his Officers. |

| No. | Places of Observation. | A. M. | Noon. | P. M. | Observers and Authorities. |
|---|---|---|---|---|---|
| 19 | Portsmouth, N. H. | E. | E. | E. | Weekly Meteorological Journal, published at Portsmouth. |
| 20 | Nashua, N. H. | N. E. | N. E. | N. E. | Nashua Telegraph. |
| 21 | Northampton, Ms. | N. E. | [N. N. E.] | N. E. | Observations of W. Atwill and others. } *I assume the approximate mean* |
| | Amherst, Ms. | N. by W. | | N. by W. | Professor Snell's Met. Journal. } *of N. N. E. for Noon.* |
| 22 | Litchfield, Ct. | Night of 14, 15, N.E | [N. N. E.] | N. at Night of 15th. | Litchfield Enquirer. *Assumed mean for noon of 15th, N. N. E.* |
| 23 | Stratford, Ct. | N. by W. | N. by W. | N. by W. | Rev. J. R. Linsley's Meteorological Journal. |
| 24 | Fire Island Beach, N.Y. | Midnight, N. E.: veered by N. | N. N. W. | N. N. W. | Captains Cartwright and Skiddy, employed at the Beach. |
| 25 | Concord, N. H. | Northeasterly. | N. E. | N.E. and more N'ly | Letter from Concord to S. G. Arnold; from Mr. Arnold. |
| 26 | Keene, N. H. | N. E. | N. E. | N. E. | Rev. Z. S. Barstow's Meteorological Journal. |
| 27 | West Point, N.Y. | N. | N. | N. | Meteorological Journal of the Medical Department. |
| 28 | New-York City, | N. by W.: N. N.W. | N. N. W. | N.W. by N. | Meteorological Journal of W. C. Redfield. |
| | Fort Wood, N.Y. Harbor | N. | [N. N. W.] | N. W. | Met. Journal of Medical Officer. *Mean of N. N. W. taken for Noon.* |
| 29 | Flatbush, N.Y. | N. | [N. N. W.] | N. W. | Rev. T. M. Strong's Met. Jour. *Mean of N. N.W. assumed for Noon.* |
| 30 | Sandy Hook Bay, N.Y. | N. | N. W. | N. W. | Log Book of Bark Osceola. |
| 31 | Portland, Me. | N. E.: at 11 E. | [E. 6° S. mean.] | E. by S. | Met. Report of Keeper of Marine Observatory: Published at Portland. |
| 32 | Hanover, N.H. | N. E. | [ N. E. ] | N. | Professor Young's Meteorological Journal. |
| 33 | Salem, N.Y. | N. E. | N. E. | N. E. | William Brand and W. Larkin; Meteorological Journal. |
| 34 | Albany, N. Y. | N. E. | [N. 28° E.] | N. E. | T. Romeyn Beck, M. D. Met. Journal. } *Mean assumed for Noon,* |
| | Lansingburgh, N.Y. | N. N. E. | | N. | E. T. Foote, Meteorological Journal. } *N. 28° E.* |
| 35 | Kinderhook, N.Y. | N. E. | N. E. | N. E. | Silas Metcalf, Meteorological Journal. |
| 36 | Kingston, N.Y. | N. E. | N. E. | N. E. | Isaac Blauvelt; Meteorological Journal. *[noon, N. N. E.* |
| 37 | Goshen, N.Y. | N. E. | [N. N. E.] | N. | Nathaniel Webb and John S. Crane; Met Jour. *Mean assumed for* |
| 38 | Bark Ann Louisa, off Absecom, N. J. | W. N. W. | N. W. | N.W. | Ship's Log Book, and Statement of Capt. Wilson. |
| 39 | Trenton, N. J. | N. W. | N. W. | N.W. | Dr. F. A. Ewing's Meteorological Journal. |
| 40 | Cape May, N. J. | N. W. | N. W. | N.W. | Marine Reports, and Letter from Cape May, in Philad. Newspapers. |

*Abbreviations.*—N. H. State of New Hampshire; Me. Maine; Ms. Massachusetts; R. I. Rhode Island; Ct. Connecticut; N. Y. New-York; N. J. New Jersey.——*Note.* My own observations on the 15th P. M. have on a former occasion been erroneously printed N. W. by *W.*; for which read N. W. by *N.*

Art. XIII.—*Temperature of the cities of Rome (Italy) and New York;* by Jeremiah Van Rensselaer, M. D. (now residing in Rome.)

TO PROFESSOR SILLIMAN.

*Sir*—It was deemed advisable early last year that one of my children should pass some time in a milder climate than we enjoy in New York, and I determined to take my family to France, Switzerland, and Italy.

When the cold weather drove us from Florence in December, we found at Rome that delicious temperature, and mild, balmy air so grateful to the invalid, and there we spent the residue of the season. Indeed, the effects were so cheering, that I have come to this city to make the necessary arrangements for a residence of some years in that delightful climate.

Since my return, very many applications have been made for a comparison of the climates of New York and Rome. It so happens that I have with me a fragment of a register I kept in the latter place, and have prefixed to it an extract from a meteorological journal most accurately kept by a highly intelligent and observing lady of this city—thus showing the temperature of each place. I send them to you for insertion, should you deem them of sufficient importance or interest to occupy a page or two of your valuable Journal.

The range of the thermometer speaks for itself; but I may add, that vegetation continued green, the orange-trees under our windows were covered with fruit, and many of our rose-bushes were never without flowers during the winter. The inhabitants nevertheless called it a bad season.

For incipient diseases of the chest, the climate is admirable, and therefore I am induced to remain. These maladies are very rare among the natives, as may be learned from the fact that at the general hospital, Santo Spirito, where there are eighteen hundred beds, besides two hundred kept for accidents, and where all disorders are admitted, amounting to nearly twenty thousand in the year, the number of patients with diseases of the chest and lungs in 1840 was one hundred and seventeen.

Although little proficient in botany, the beauties of the vegetable kingdom delight and instruct me, and it was an amusement in my walks and drives on the lawns and at the villas, to watch the progress of vegetation in the budding and blossoming of plants, and I often put my observations on paper. Perhaps the few notes I made may be interesting to some of your readers who worship at the shrine of Flora, while not forgetful of Hygeria.

New York, July 22, 1841.

| 1841. | NEW YORK. | | ROME. | | OBSERVATIONS. |
|---|---|---|---|---|---|
| Jan. | Lowest. | Highest. | Lowest. | Highest. | |
| 5th | 6° | 23° | 45° | 58° | (deg. Fahr.) Thunder in evening. |
| 6th | 15 | 45 | 45 | 50 | Thunder. |
| 7th | 42 | 52 | 42 | 48 | |
| 8th | 42 | 49 | 40 | 44 | Thunder. |
| 9th | 33 | 41 | 41 | 43 | |
| 10th | 33 | 36 | 43 | 45 | |
| 11th | 33 | 38 | 47 | 54 | |
| 12th | 34 | 42 | 47 | 56 | |
| 13th | 33 | 34 | 39 | 49 | |
| 14th | 29 | 32 | 47 | 52 | |
| 15th | 28 | 33 | 47 | 57 | |
| 16th | 27 | 44 | 48 | 56 | |
| 17th | 33 | 47 | 43 | 55 | |
| 18th | 22 | 24 | 43 | 57 | |
| 19th | 11 | 24 | 45 | 58 | |
| 20th | 18 | 30 | 42 | 57 | |
| 21st | 25 | 36 | 37 | 57 | |
| 22d | 32 | 35 | 40 | 46 | |
| 23d | 27 | 32 | 39 | 48 | |
| 24th | 27 | 40 | 35 | 48 | |
| 25th | 31 | 39 | 39 | 45 | N. York. Rome. |
| 26th | 28 | 38 | 33 | 42 | Fine days, 12 13 |
| 27th | 33 | 39 | 28 | 42 | Rain or snow, 15 16 |
| 28th | 34 | 42 | 40 | 47 | Foggy, 4 overcast, 2 |
| 29th | 31 | 34 | 39 | 47 | — — |
| 30th | 32 | 39 | 33 | 38 | 31 31 |
| 31st | 28 | 40 | 34 | 44 | |

| 1841. | NEW YORK. | | ROME. | | OBSERVATIONS. |
|---|---|---|---|---|---|
| Feb. | Lowest. | Highest. | Lowest. | Highest. | |
| 1st | 31° | 35° | 37° | 41° | |
| 2d | 33 | 36 | 39 | 45 | |
| 3d | 30 | 40 | 39 | 50 | |
| 4th | 23 | 29 | 37 | 48 | |
| 5th | 22 | 31 | 48 | 56 | |
| 6th | 26 | 37 | 51 | 60 | |
| 7th | 32 | 36 | 48 | 62 | Daisies in profusion. |
| 8th | 25 | 36 | 53 | 59 | |
| 9th | 26 | 32 | 51 | 59 | |
| 10th | 26 | 31 | 47 | 60 | |
| 11th | 12 | 19 | 43 | 59 | |
| 12th | 6 | 16 | 40 | 51 | |
| 13th | 7 | 21 | 49 | 59 | |
| 14th | 14 | 27 | 52 | 57 | Blue violets in abundance. |
| 15th | 12 | 25 | 51 | 56 | Ranunculus do. |
| 16th | 15 | 30 | 49 | 54 | |
| 17th | 28 | 41 | 59 | 66 | Almond trees in full bloom. |
| 18th | 18 | 30 | 59 | 69 | Hyacinths. |
| 19th | 27 | 39 | 57 | 66 | Peach trees in full bloom. |
| 20th | 22 | 38 | 53 | 66 | |
| 21st | 31 | 45 | 51 | 64 | |
| 22d | 33 | 40 | 51 | 64 | Anemonies. |
| 23d | 33 | 50 | 51 | 66 | |
| 24th | 18 | 26 | 50 | 59 | |
| 25th | 19 | 34 | 44 | 58 | Hail in the evening. |
| 26th | 30 | 42 | 43 | 54 | Hail in the evening. |
| 27th | 34 | 40 | 39 | 58 | |
| 28th | 33 | 45 | 42 | 56 | |

| | N. York. | Rome. |
|---|---|---|
| Fine days, | 6 | 9 |
| Rainy days, | 12 | 11 |
| Cloudy days, | 10 | 8 |
| | 28 | 28 |

| 1841. | NEW YORK. | | ROME. | | OBSERVATIONS. |
|---|---|---|---|---|---|
| March. | Lowest. | Highest. | Lowest. | Highest. | |
| 1st | 37° | 52° | 35° | 48° | Lauristina, which had flowers all winter, was now covered with them. |
| 2d | 35 | 48 | 36 | 49 | |
| 3d | 34 | 46 | 32 | 47 | |
| 4th | 30 | 40 | 45 | 52 | Cherry trees in full bloom. |
| 5th | 19 | 31 | 43 | 56 | Pear trees do. |
| 6th | 25 | 34 | 45 | 59 | Hyacinths, jonquils, tulips. |
| 7th | 32 | 42 | 45 | 61 | Star-flower, cyclamene, stock-gillies. |
| 8th | 33 | 38 | 44 | 60 | Hawthorn in full bloom. |
| 9th | 31 | 38 | 44 | 62 | Plumb trees in full bloom. |
| 10th | 32 | 33 | 45 | 64 | |
| 11th | 29 | 40 | 40 | 48 | |
| 12th | 27 | 32 | 38 | 59 | Apple trees in full bloom. In the valley of the Rhone, near Marseilles, I saw them in bloom on the 8th of April. |
| 13th | 31 | 38 | 45 | 60 | Strawberries in full bloom. Carnations. |
| 14th | 27 | 40 | 47 | 58 | |
| 15th | 21 | 30 | 53 | 64 | |
| 16th | 23 | 25 | 52 | 64 | |
| 17th | 19 | 30 | 45 | 63 | Periwinkle. |
| 18th | 24 | 36 | 50 | 64 | |
| 19th | 33 | 56 | 52 | 65 | |
| 20th | 39 | 63 | 51 | 62 | |
| 21st | 42 | 56 | 53 | 69 | |
| 22d | 32 | 40 | 53 | 66 | |
| 23d | 35 | 56 | 53 | 66 | |
| 24th | 34 | 56 | 52 | 67 | |
| 25th | 41 | 60 | 52 | 70 | |
| 26th | 41 | 62 | 47 | 68 | |
| 27th | 50 | 63 | 47 | 66 | |
| 28th | 47 | 62 | 49 | 67 | |
| 29th | 37 | 39 | 51 | 66 | |
| 30th | 35 | 40 | 51 | 64 | |
| 31st | 29 | 39 | 51 | 69 | |

| | N. York. | Rome. |
|---|---|---|
| Fine days, | 12 | 27 |
| Rainy days, | 11 | 1 |
| Cloudy days, | 8 | 3 |
| | 31 | 31 |

ART. XIV.—*Observations and Experiments on Light;* by SAMUEL ADAMS, M. D., Professor of Chemistry and Natural History in Illinois College, Jacksonville, Ill.*

SOMETIME in July, 1838, while on a mineralogical excursion, I accidentally noticed the wing-feather of a bird lying upon the ground; and being struck with the delicacy of its tints, I took it up to examine it. Observing that the vane of the feather appeared very thin and nearly transparent, I held it between my eye and the sky, which was very clear with the exception of a few fleecy clouds, that contrasted finely with its rich blue. I was very much interested to observe, that the clouds and all light colored objects, which were highly illuminated, were seen through the vane of the feather beautifully fringed with the colors of the rainbow. I supposed that this phenomenon depended upon the peculiar structure of the vane of the feather, and intended to investigate it as soon as I could find leisure. I did not, however, resume the subject till accident again called my attention to it.

About the 20th of June, 1839, while walking in the College grove, I happened to observe lying upon the ground some wing-feathers of the Jay, which reminded me of my former experiment. I collected the feathers, and after observing the same phenomena that I had noticed on the former occasion, I held the vane of the feather between my eye and the sun, and was greatly surprised at the gorgeous display of colored spectra that were seen through it, arranged in the most exact mathematical order. The sun was seen in its natural position, slightly tinged with red, with its

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* *To the Editors of the American Journal of Science and Arts.*

*Messrs. Editors*—When "Observations and Experiments on Light" were forwarded to you for publication in the Journal of Science, I was not aware that Fraunhofer had anticipated the leading investigations of that communication. Pressing engagements, and frequent attacks of intermittent fever, prevented me from making so full an examination of the works of others on the subject as was desirable. I have since ascertained, that Fraunhofer has anticipated the leading results of my observations, in a series of experiments made by him by passing a beam of light through gratings, and examining the spectra produced through a telescope. (Herschel on Light, § 740, et seq.) I do not find, however, that the effect of the feather upon light has been before noticed, or that Fraunhofer ever exhibited the spectra upon a screen. You will oblige me by appending this as a note to my communication. Yours, &c. SAMUEL ADAMS.

*Illinois College, May* 21, 1841.

brightness considerably dimmed, and formed the intersecting point of two rows of colored spectra, that crossed each other nearly at right angles. One of the rows of spectra formed a very acute angle with the shaft of the feather at its outer extremity, and the other was nearly at right angles with the shaft. In each colored spectrum the side nearest to the sun was a mixture of violet and the contiguous rays of the prismatic spectrum, while the side farthest from the sun was uniformly red. The sun was slightly clouded when I made my first observations. Afterwards, when the sun shone perfectly clear, I observed that the angular spaces formed by the intersection of the two rows of colored spectra were occupied by less brilliant spectra, arranged in the same order as the two rows above described.

On Monday, the 1st of July, 1839, I varied the experiments above described, by making my observations upon the flame of a lamp, instead of the sun. I found an advantage in this, as it enabled me to change the distance of the luminous object at pleasure. In looking through the vane of the wing-feather of the wild pigeon at the flame of the lamp, I observed spectra, colored and arranged similarly to those which I saw when looking at the sun. I first looked at the lamp at the distance of eight or ten feet, and saw the two rows of colored spectra above described entirely distinct from each other, with some faint appearances of spectra in the angular spaces near the lamp. As I approached the lamp, (holding the feather to my eye and looking at the flame,) the colored spectra in the two rows gradually approximated to the flame of the lamp and to each other, their colors at the same time becoming less distinct and approaching to white light, while the spectra in the angular spaces became more perceptible. As I receded from the lamp, the spectra in the two rows receded from the central flame and from each other, their colors at the same time becoming more distinct, and the spectra in the angular spaces gradually fading away.

My next step was, in connection with my colleague, Prof. Sturtevant, to introduce a small beam of light into a dark room by passing it through the vane of the wing-feather of the Jay. We observed colored spectra arranged upon a screen in the manner described above. In the experiments which I first performed, the eye was the dark chamber and the retina the screen.

From reflecting upon these phenomena and conversing with Prof. Sturtevant upon the subject, I was convinced that they were to be referred to difraction, produced by the passage of light through the minute foramina formed by the crossing and interlocking of the barbules of the feather. This conviction was strengthened by a microscopic examination of the vane of the feather, which exhibited an extremely minute lattice-work between the barbs of the feather, formed by the crossing of the barbules, and by noticing that the lines, in which the colored spectra were arranged, were perpendicular to the bars of the lattice. The similarity between the arrangement of the colors in the spectra upon the screen, and those of the external fringes produced by difraction, could not fail to be observed, and to incline me to the opinion that the law of interference established by Dr. Young, had something to do with the production of the chromatic spectra. I was confirmed in this opinion by a series of experiments and measurements performed by Prof. Sturtevant and myself, by which we ascertained, that corresponding spectra received upon a screen at different distances from the feather, were not arranged in straight lines, but in curves. The curves seemed to belong to the hyperbola, and the latter to be formed by the section of a very acute cone. This is what might have been expected, as our experiments were performed upon parallel rays.

In order to understand the application of the law of interference* to the production of colored spectra by the feather, it will be necessary to recur to the fundamental facts of difraction. Let it be borne in mind, that when a beam of light falls upon the edge of an opaque body, the rays which pass by the edge are divided into two portions, one of which is bent into the shadow of the opaque body, and the other is bent outward from the body. This separation of a beam of light into two parts is called *difraction.* For the sake of brevity and clearness I shall, in my subsequent remarks, speak of those rays which are bent into the shadow of the opaque body as *inflected rays*, and of those which are bent outward as *deflected rays*, and I shall use the terms *inflection* and *deflection* in strict accordance with these definitions. The plane of difraction is a plane passing through an inflected

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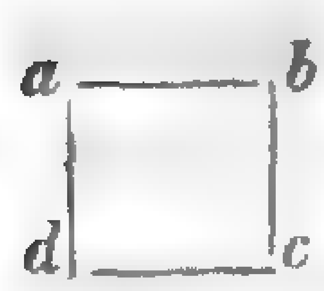
* See *Interference* in Brewster's Optics, and Herschel on Light.

and a deflected ray which have diverged from the same point, and is always parallel to and passes through the unmodified beam of light. When the difracting edge is a straight line, the plane of difraction is always perpendicular to a plane passing through the difracting edge and the corresponding outline of its shadow. In an irregular or curved difracting edge the same law will hold with regard to any indefinitely small portions of it, which may be assumed as straight lines.

I am aware that the terms inflection and difraction are used as synonymous by many who have written upon the subject of light. But without the definitions and limitations, which I have just indicated, I should be compelled to resort to circumlocutions, which might render ambiguous the explanations which I am about to give of the phenomena of the feather. Again, I am not aware that the law which regulates the position of the plane of difraction has been stated by any other writer, although it is fairly inferrible from the facts which they have brought forward, as well as from experiments performed by myself, and which I hope to notice more fully in a subsequent communication. It will be seen in the sequel, that the law which regulates the position of the plane of difraction determines the angle, which the two rows of colored spectra make with each other.

Let us now turn our attention to the lattice-work formed by the crossing of the barbules of the feather, and inquire how the light passing through a single opening would be affected. The openings of the lattice are of course one of the four varieties of the parallelogram. The angles of these openings differ in the feathers of different birds, and in different feathers of the same bird. Let *a b c d* represent one of these openings; and let us suppose a beam of light passing through it perpendicular to the plane of the paper. It is evident that each of the sides of the opening will be a difracting edge; and if we take any two opposite sides *ab*, *dc*, the inflected rays of one side will be bent in the same direction as the deflected rays of the other, and will be liable to interfere with each other, and produce colored fringes upon a screen placed to receive the difracted light, and these fringes would extend on each side of the opening in a line perpendicular to the two sides in question. The same will be true of the other two sides *ad*, *bc*, and thus we should have two rows of colored fringes, whose lines of direction would be perpendicular



respectively to the parallel sides of the opening, and consequently crossing each other at angles equal to those of the opening. But a part of the light would pass through the centre of the opening unbent, and would form upon the screen a white image at the intersecting point of the two rows of colored fringes. Thus it will be seen, that a beam of light passing through a single opening of the kind above described, would be divided into nine parts, four being produced by the inflection of the four sides, four more by the deflection of the same, and one being the remains of the beam that pass on unmodified. Now let us suppose that a beam of light, instead of passing through a single opening, passes through an extremely minute lattice, containing an indefinite number of such openings, as in the case of the feather. As all the bars of the lattice are parallel respectively to those which surround each individual opening, it is evident that the general effect upon the beam will be the same as that of a single opening, with this difference, that the range within which interference would take place, would be greatly enlarged, by enabling the inflected and deflected rays from different openings to interfere with each other; and thus the fringes, which are scarcely perceptible, when formed by a single opening or a single edge, become brilliant spectra, when a beam of light is passed through a lattice of the kind described. All this is realized in the experiments with the feather. It is proper to remark, however, that the central white image is probably not formed entirely of unmodified light, but is partly produced by light slightly inflected by the opposite edges of the bars of the lattice, and corresponding with the internal fringes, first explained by Dr. Young upon the principle of interference. It is not improbable, that some of the deflected rays fall within the central white image and add to its brightness. The faint spectra in the angular spaces may be explained by supposing that they are formed by light, which has undergone two inflections or two deflections, or one inflection and one deflection, by two contiguous bars of the lattice.

It should be noticed here, that all the colored spectra, as well as the central white one, are considerably elongated in a direction perpendicular to the barbs of the feather. With a very delicate feather and a small luminous object, the eye can easily distinguish a row of colored spectra arranged in the same direction. This is what might have been expected, and gives us some idea of the effect produced by passing a beam of light between extremely minute parallel bars arranged in the same plane very close to each other. The sun, moon, stars, the flame of a lamp, a small aperture in a dark room, &c., are convenient objects to be examined with the eye through the vane of a feather. When we wish to examine a luminous object through the vane of a feather, one of a dull or dark color should be chosen, as a white feather transmits so much light, as soon to exhaust the sensibility of the retina. For forming colored spectra on a screen a white feather is preferable. Those feathers taken from the wing and tail, whose vanes approach the nearest to a plane, give the most regular arrangement of the spectra. The feathers of small birds, from the greater minuteness and delicacy of their structure, produce the most brilliant and extensive colors. We see here the same principle, which Dr. Young applied to the construction of the Eriameter.* In looking through the vane of a feather at a bright object, the most brilliant spectra are seen on the side towards the outer edge of the feather. This may be owing to the thinning out of the feather towards the edge.

If the above explanation of the phenomena of the feather be correct, it follows, that if an opaque screen be perforated with circular holes sufficiently minute and near to each other, it would produce a succession of colored rings. When a beam of light passes through a lock of cotton, wool, or raw silk, inflection and deflection will take place in every possible direction, producing a blending of all the colors into white light in the centre, and a succession of colored rings in receding from the centre. As in the feather there is a regular arrangement of the difracting fibres, there is a corresponding arrangement of the colored spectra. The explanation of the colored rings produced by transmitting a beam of light through a lock of cotton, &c., applies to those produced by transmitting a beam through a plate of glass covered with fine particles.

Having satisfied myself with regard to the structure of the vane of the feather, and the mode in which it operates in producing colored spectra, I concluded, that, if that structure could be imitated by any artificial contrivance, the same effects might be produced as by the feather. I shall not detain the reader by de-

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* See Brewster's Optics.

tailing all the expedients which I resorted to in the subsequent course of my experiments, but will endeavor to indicate some modes of imitating the structure and effects of the vane of the feather more perfectly than can be done by any means which are at my command. Let it suffice to say, in the mean time, that silk cloth of a close and delicate texture, a dense gauze of fine wire, and similar contrivances, answer as clumsy substitutes for the vane of the feather.

The difficulty of obtaining the necessary materials, and of commanding the requisite mechanical skill, has prevented me from executing the most desirable plans, that have presented themselves to my mind. A convenient mode of arranging parallel fibres is, to bend a steel wire thus,  and wind a fine silk thread or delicate wire across its parallel sides. With a contrivance of this kind I was able to produce a row of spectra or fringes in a line perpendicular to the parallel fibres. I made use of a fine silk thread, but it is manifest, that fibres more minute, skilfully arranged, would greatly increase the brilliancy of the phenomena. In this case, it will be seen that the rays undergo two difractions in the same plane. The second set of fibres would increase or diminish the effect of the first set, according as its difracting influence coincides with, or counteracts that of the first; and it is probable, that both of these effects are produced upon different rays. A preferable construction would be to take a rectangular metallic frame and wind the finest platinum wire across two of its parallel sides, so close as just to admit the passage of light between the parallel turns of the wire. The wire may be fastened by metallic bars screwed down upon it, where it crosses the exterior sides of the frame, and then one set of the parallel turns of the wire may be cut away, so as to leave only one set to act upon a transmitted beam of light. Two of these contrivances might be placed together and turned upon each other, so that the parallel wires in one could be made to cross those of the other at any convenient angle, and thus the phenomena of the feather would be imitated. The crossing of the wires might be secured by winding the same frame in opposite directions, fastening the wires and cutting them away on one side in the manner above described. The first method, however, is preferable, as it admits the change at pleasure of the angles at which the two sets of parallel wires cross each other. This apparatus would probably be rendered more perfect by using fine hair, or wool, or better still a single thread of the silk worm, instead of a platinum wire. As difraction takes place at the edges of transparent as well as opaque bodies, probably an apparatus of the kind above described, made of very fine spun glass, would exceed all others in delicacy and power, as refraction in this would cooperate with difraction. Since writing the above, Prof. Sturtevant has suggested the mode of fastening parallel fibres into a wooden frame by gluing pieces of wood upon its exterior sides. I have acted upon this suggestion and constructed an instrument with fine silk thread, which, though immensely inferior to the vane of the feather, produces phenomena similar in kind.

As my frontier location deprives me of the means of attaining the desirable perfection in the constructions which I have described, it is hoped that others more favorably situated, will be able to realize what I have hinted at above. It remains to be determined, whether art, in the construction of a difracting instrument, will ever attain to that perfection which is presented to us by the hand of nature in the vane of the feather. Even with the latter we are able to render the chromatic effects of difraction and interference as conspicuous to a class of students as those of refraction. Prof. Sturtevant lectured a few days ago upon the phenomena of the feather for the first time, to the great satisfaction of his audience.

During the progress of the above investigations, several inquiries have arisen, which Prof. Sturtevant and myself are now pursuing, and one or both of us may be expected to be heard from again upon this subject.

Illinois College, April 16, 1841.

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Art. XV.—*The Birds of America, from drawings made in the United States and their Territories;* by John James Audubon, F. R. SS. Lond. and Ed., &c. &c. Vol. II. New York, published by J. J. Audubon: Philadelphia, J. B. Chevalier.

The extended notice we gave a year since of the general design of this work, and our full account of the author, his personal history, the surpassing merits of his former work, and the promise of equal excellence given to the public by the first volume of the present, render it unnecessary that we should devote much space or time to the volume before us. To praise it is no longer necessary; for since we essayed our feeble tribute in commendation of the undertaking of our enterprising and gifted countryman, the public have given indubitable assurance that his labors have been appreciated, in a manner alike satisfactory to the publishers, as it insures the liberal remuneration of the publication, and to the author, showing as it does, that it can hardly be said of him that he "is not without honor save in his own land." Since the completion of his first volume he has received no less than three hundred and ninety five new subscribers, of whom nearly one half are in the single city of Boston; a fact highly creditable to the liberality and intelligence of that city. Mr. Audubon has now nearly a thousand subscribers to his work; an instance of liberal support of a work on natural history certainly without a parallel in the New World, and hardly with one in the Old. This insures the success of the undertaking far beyond the most sanguine anticipation of the author, and enables him to continue to make marked and decided improvements in the publication as it advances. Although severe domestic afflictions have meanwhile bowed him to the earth, under the visitation of an overruling Providence; although the hand of sickness and disease, added to the combined death of two of his children by marriage, have contributed to render the task rather a means of relief from painful thoughts than the pleasant employment it once was, we witness no abatement in the interest or the value of the work. The text is, as ever, replete with a vast amount of new and important facts, while the plates, except in one or two instances, continue to improve as the work advances.

The second volume contains seventy plates, one hundred and thirty six figures of birds, besides a very large number of drawings of plants, insects, nests, &c. &c.; all this, with the text, furnished for the low sum of fourteen dollars—less than the cost would be for a single plate! The birds represented in the present volume are of seventy species, embraced in families of the wood-warblers, creepers, (including wrens,) titmice, warblers and thrushes. These families are those adopted by Mr. Audubon, and are like those of no other work, but are nearly similar to those of Mr. Swainson. We have already expressed our disapprobation of the system by which the present work is arranged.

We shall not, therefore, repeat those objections. We will only remark that we see nothing in the present volume to induce us to change our opinion; nothing to make good to us the loss of the usual division into *orders;* nothing to reconcile us to the countless subdivisions into *genera* on grounds that, to our eyes, seem mere *specific* differences. If any genus would justify this subdivision, it is the old and immensely large one of Sylvia. But it appears to us to be even far better to retain the old genus in this case, large as it is, in point of numbers, than to subdivide it into genera with so little perceptible variation one from another, as exist in the generic characters of Myiodioctes, Sylvicola, Trichas, Helinaia, Mniotilta, &c. &c.; and certainly, it is far better than to create such *specific* genera as the last. We have, however, only our regret to express. We intend to convey no censure for the adoption of this perplexing system, having already explained why it was, to some extent, hardly a matter of choice with the author. Of the seventy species described in the second volume, no less than twenty six are not to be found in the work of Wilson, and of these, seventeen are to be found in no other works on American ornithology than those of Mr. Audubon.

Besides these important discoveries of new species, the work embodies a large number of interesting, important and novel facts with regard to old species. In some instances where differences arising from age and sex have been the means of deceiving naturalists, and leading them to divide one species into two or more, these mistakes have been detected and pointed out in the present work. We will mention a few of the more important.

The bird described as a new species by Audubon, in the first volume of Ornithological Biography, as *Muscicapa Selbii*, is the young of the hooded warbler, *Sylvia cuculata* of Wilson, and *S. mitrata* of Bonaparte.

The *Sylvia Vigorsii* of the same has been ascertained to be not a new species, but the young of the pine-creeping warbler, *Sylvia pinus* of authors.

The *Sylvia autumnalis* of Wilson, Bonaparte, Nuttall, Audubon and all others, is pronounced to be the young of the hemlock warbler, *Sylvia parus.* We must confess we are somewhat staggered at this annunciation, and although we doubt not the writer believes he had good grounds for his decision in the case, we must confess that, familiar as we have been with the *S. autumnalis*, we never imagined that its claim to a distinct species ever would be questioned. We have seen it repeatedly in August and September on its way south, but never does the writer remember to have seen it in company with the *Sylvia parus*. It may be the case, but we are not yet satisfied that it is so.

The *Sylvia rara* is the young male of *S. azurea*. Both birds, under both names, are to be found in Bonaparte and in Audubon's Biography.

The *Sylvia Childrenii* of Audubon's Biography, is the immature bird of the common summer yellowbird of authors. This is an important correction, as writers have since been misled by the error. It has been adopted by Nuttall, as well as by Rev. Mr. Peabody, in his report on the birds of Massachusetts. As the bird breeds, to the certain knowledge of the writer, in this immature plumage, it is impossible for beginners not to be perplexed without the knowledge of this fact, namely, that the absence of the reddish spots on the breast shows it to be a young bird, and not a different species.

The *Sylvia palmarum* of Bonaparte, is the same bird with the *S. petechia* of the same as well as of other authors.

The *Sylvia pusilla* of Wilson, and the *S. sphagnosa* of Audubon, Nuttall, and Bonaparte, are not new species, but identical with *Sylvia Canadensis* of authors. They are young birds in different states of plumage.

The *Sylvia tigrina* of Bonaparte is not the same with the bird described under that name by Gmelin and Latham, but is identical with *Sylvia montana* of authors.

The bird described by Audubon as a new species, under the name of *Sylvia Roscoe*, is the young of the common Maryland yellow-throat. This too, is an important correction.

These are some of the more important corrections of errors of former works, to be found in the volume on our table. They are all important, and possibly further investigation may add to their number, and thus reduce yet more the number of species. It will be remembered that this reduction is one of the most difficult for naturalists to determine correctly. Writers are much more prone to create new species than to cancel previous ones and to study out their identity with others. The young student, therefore, owes Mr. Audubon a debt of gratitude for much labor and perplexity saved him by these investigations.

In his history of the chestnut-sided wood warbler, our author says: "Where this species goes to breed I am unable to say, for to my enquiries on this subject I never received any answers which might have led me to the districts resorted to by it. I can only suppose, that if it be at all plentiful in any part of the United States, it must be far to the northward, as I ransacked the borders of Lake Ontario, and those of Lake Erie and Michigan, without meeting with it. I do not know of any naturalist who has been more fortunate, otherwise I should here quote his observations." The writer is somewhat surprised at this, as the bird, although rare, is still occasionally to be found breeding in Massachusetts. He has known of several nests having been discovered in the vicinity of Boston, and is under the impression that he furnished Mr. Audubon, by letter, with a description of a nest and its eggs, which were five in number. Both were very similar to the nest and eggs of the summer yellowbird, *Sylvia æstiva*, and he regrets that as the egg of the bird is still in his possession, he was not aware of the desired information in time to furnish it for the text of the present work.

In his account of the *Sylvia æstiva*, so universally and so familiarly known in this portion of the country as the summer yellowbird, Mr. Audubon speaks at some length of the ingenuity so often displayed by individuals of this species, in evading the burthen of the cow bunting. Although not a summer passes that we do not hear of several instances of the remarkable fact, it does not seem to be so generally known as so interesting a display of instinct would seem to deserve. To escape the burthen, both of hatching the eggs and rearing the young of the cow blackbird, *Icterus pecoris*, the bird displays the surprising ingenuity narrated in the following extract: "Mr. Nuttall was the first naturalist who observed the very curious method in which it contrives to rid itself of the charge of rearing the young of the cowbird. 'It is amusing,' he says, 'to observe the sagacity of this little bird in disposing of the eggs of the vagrant and parasitic cow troopial. The egg deposited before the laying of the rightful tenant, too large for ejectment, is ingeniously incarcerated in the bottom of the nest, and a new lining placed above it, so that it is never hatched to prove the dragon of the brood. Two instances of this kind occurred to the observation of my friend, Mr. Charles Pickering; and last summer I obtained a nest with the adventitious egg about two thirds buried, the upper edge only being visible, so that, in many instances, it is probable that this species escapes from the unpleasant position of becoming a nurse to the sable orphan of the cowbird. She, however, acts faithfully the part of a foster-parent when the egg is laid after her own.'

"The following note from my friend Dr. T. M. Brewer, shows that this little bird is capable of still greater exploits. 'There is a very interesting item in the history of the yellow-poll warbler, which has been noticed only within a few years, and which is well deserving of attention, both for the reasoning power which it exhibits, and for its uniqueness, for it is not known, I believe, to be practiced by any other bird. I allude to the surprising ingenuity with which they often contrive to escape the burthen of rearing the offspring of the cow troopial, by burying the egg of the intruder. I have known of four instances in which single eggs have been buried by the yellowbird, and building a second story to her nest and enclosing the intruder between them. In one instance, three of the Sylvia's own eggs were thus covered along with that of the cow blackbird; and in another, after a blackbird's egg had been thus concealed, a second was laid, which was similarly treated, thus giving rise to a three storied nest. This last you have in your possession, and will, I hope, give to the world a drawing, as well as a complete description of it.' * * * * * *

"The fabric alluded to above may be thus described. A nest of the usual form had been first constructed, of which the external diameter was three inches. It is composed of cotton rudely interwoven with flaxen fibres of plants, and lined with cotton of a reddish color, with some hairs round the inner edges. The egg of the cowbird having been deposited in this nest, another of a larger size, three inches and three quarters in external diameter, has been built upon it, being formed of the same materials, but with less of the flaxen fibres. The egg is thus surmounted by a layer three quarters of an inch thick, and was discovered by opening the lower nest from beneath. It is agglutinated to the lining of the nest, having been addled and probably burst. In this second nest a cowbird had deposited an egg, which was, in like manner, covered over by a third nest, composed of the same materials, and of nearly the same size as the second."

It may not be amiss for the reviewer to add to the above account, that the above triple nest was found in Roxbury, Mass.; the cotton of which it was built had been easily obtained by the bird, the family near whose house it was found having freely distributed pieces of that article on adjacent trees and bushes, for the express purpose of being used for nests by the birds. In the third story of this nest a brood of four young yellowbirds had been reared before the nest was taken.

In speaking of the prairie warbler, *Sylvia discolor*, Mr. Audubon says: "I never saw it farther east than the ridges of the Broad Mountain, about twelve miles from Mauch Chunk." It is not an uncommon bird in New York, Connecticut, and Massachusetts; we have known of its breeding in each of these states.

There are many, very many interesting portions of this work, descriptive of the habits and peculiarities of the genera which it contains, we should delight in transferring to our pages did the nature of our Journal permit. Wherever they referred to important discoveries we have already briefly mentioned them, and our limits forbid us to do more; more especially after having, in a previous number, already spoken so much *in extenso* of the general subject.

A third volume of this work is already half completed. When it is concluded we intend to refer to the subject again, and to continue our analysis of the new and important facts on ornithology furnished by the author. Till then we must bid him once more adieu, with the full assurance that if his present work continues to improve as it has done, he will not fail to add even to his present fame—what we were once disposed to believe impossible.

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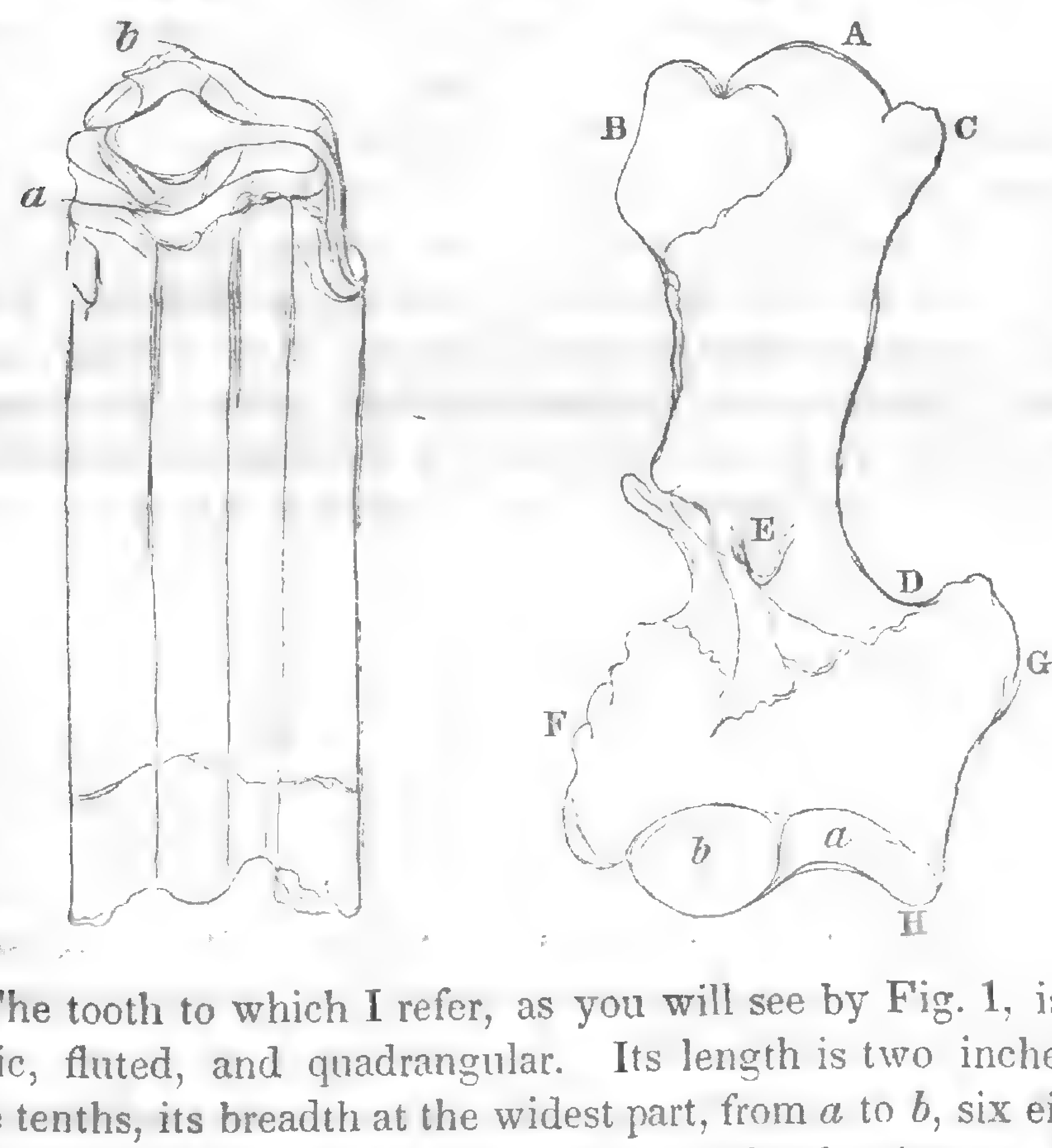
## Art. XVI.—*Notice of Fossil Bones from Oregon Territory, in a letter to Dr. C. T. Jackson;* by H. C. Perkins.

*My dear Sir*—Having recently received, by the generosity of Capt. John H. Couch, of this place, several fine specimens of fossil remains, some of which would seem to be somewhat rare, and perhaps unique, when viewed in relation to their locality at least, I herewith send you a short history and description of the specimens, together with drawings of the most interesting, in the hope and with the desire, if they are not what I have supposed them to be, that some one better acquainted with the subject may aid in determining the animals to which they once belonged.

The remains were found by Mr. Ewing Young, in December, 1839, on the Walhammet or Multnomah river, a tributary of the Columbia, in latitude 44° N. "They were," to use his own words, "about twelve feet under the earth." Among them I find a part of the tusk, an upper second, and a lower third molar of the fossil elephant, one of the tarsal bones of the fossil ox, which I should judge, comparing this bone with the corresponding one of an ox weighing over eight hundred pounds, could not have weighed less than fourteen or sixteen hundred pounds, besides several fragments of the shafts of bones, which I am unable at present to determine. But the greatest interest attaches to the tooth and large fragments which I am now about to describe.

Fig. 1. Fig. 2.




The tooth to which I refer, as you will see by Fig. 1, is prismatic, fluted, and quadrangular. Its length is two inches and nine tenths, its breadth at the widest part, from *a* to *b*, six eighths of an inch; the outside of the tooth resembles fine ivory. Within this is the bony or coarse ivory. Upon looking at the crown of this tooth you will perceive four facets looking towards each other, with an intervening, transverse, polished furrow; and it is to this part to which I would especially invite attention, and a careful comparison with the generic characters of Megatherium as given by Fischer,* which I quote: "Dent prim et lan $\frac{0}{0}$; molares $\frac{4-4}{4-4}$, obducti, tritoris, coronide nunc planâ transversim sulcatâ, nunc medio excavatâ marginalis prominalis." The lower part of the tooth is of the same shape and size as the crown, with a conical cavity at its base. It is a tooth of the Mylodon (Owen), Megalonyx (Harlan)?

The larger fragments above alluded to are two in number, which from their striking resemblance to the extremities of the humerus, I cannot but consider as portions of that bone. (See Fig. 2.) A, head of the bone; B, the greater, C the smaller tuberosity. The length of the largest fragment (from A to D) is fourteen inches; its breadth measured across the tuberosities, seven and a half inches; the diameter of the head of the humerus, four and a half inches; the circumference of the body of the bone just below the tuberosities, fourteen and a half inches; from the summit of the external tuberosity to the prominence E (see Fig. 4) on the front of the bone, twelve inches. There are the remains of a large protuberance on the outside of the humerus, a little more than half way down the body of the bone, which bears a strong resemblance (if my memory does not fail me) to a marked projection on the humerus of the Orycteropus. Some small portions of the front and back of the body of the bone are wanting; but the lowest parts on the sides correspond with the fractured surface of the lower extremity, which I will now describe.

On this portion are to be seen the external (F) and internal (G) condyles, and the articulating surface of the elbow joint (H); and on the back part, Fig. 3, a large deep hollow, I, for the reception of the olecranon process of the ulna; the internal larger half of the articulating surface (Fig. 2, *a*) presents the appearance of a hinge joint, and seems well adapted for progression, while the outer half presents a large smooth, round ball, (Fig. 2, *b*,) upon which the head of a radius might freely roll. The breadth of this fragment measures across the condyles, eleven

* Penny Cyclopedia, under Art. Megatherium.

and a quarter inches; across the articulating surface, six inches; its length (from D to H) is six inches.

Fig. 3.

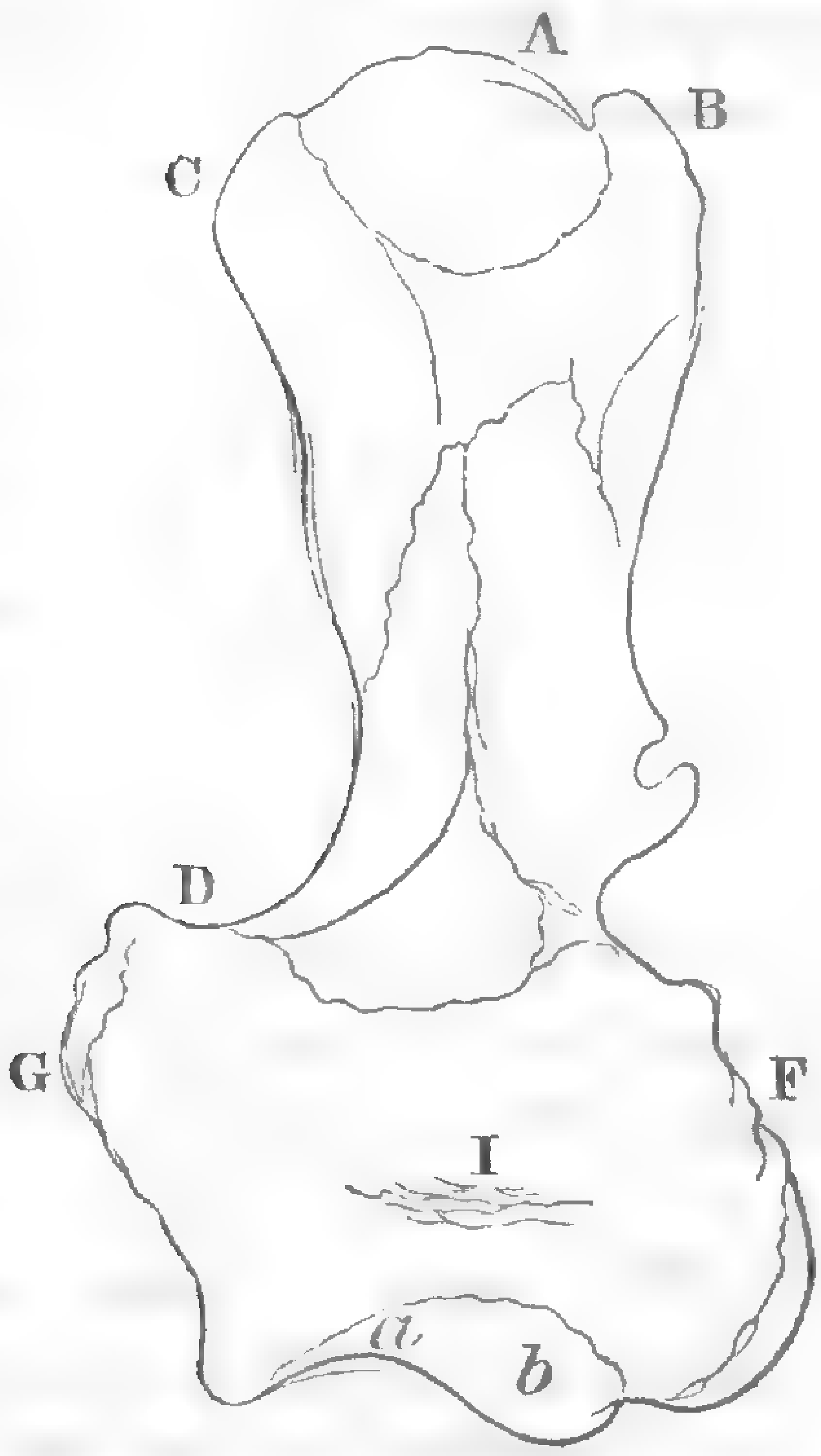
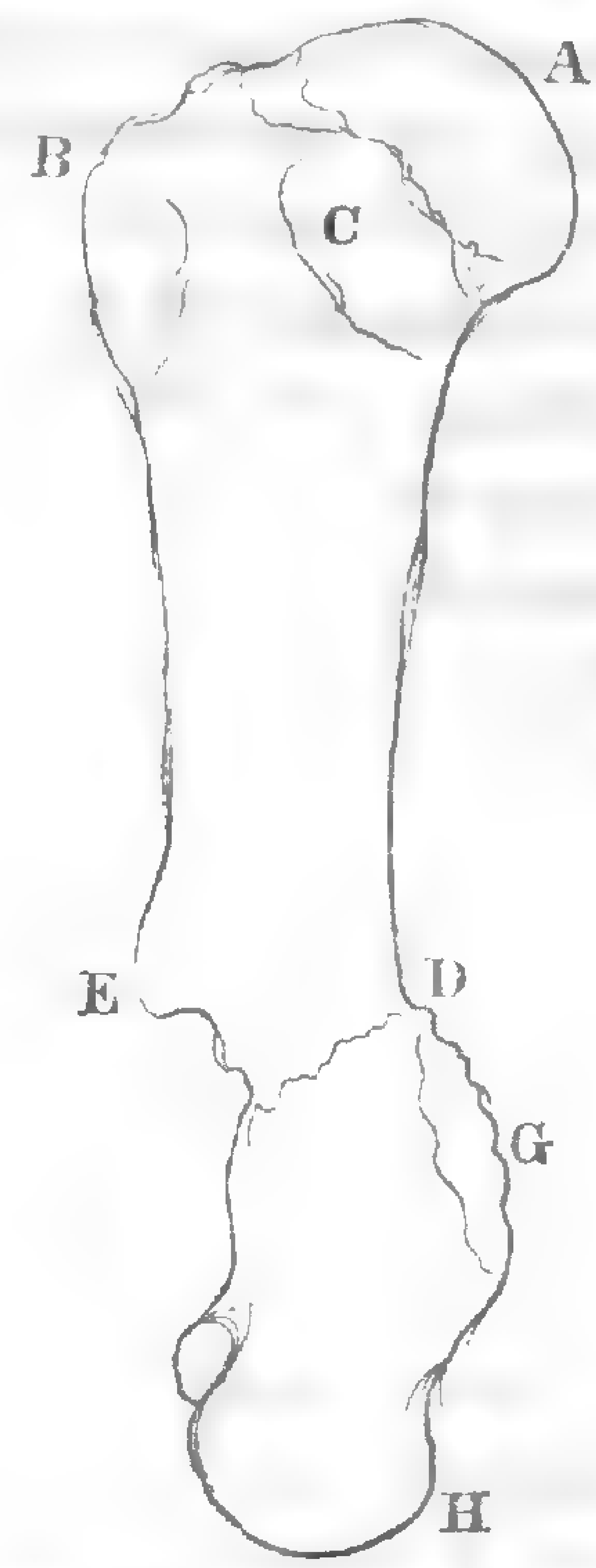



Fig. 4.




The structure of the upper and lower articulating surfaces, the great size and outward situation of the great tuberosity, the prominence on the outer part of the bone, together with the marked resemblance, so far at least as the adaptation of means to ends goes, between this bone and that of the ant-eater, led me to imagine that it was probably the humerus of a large animal which had the power of abducting the bone somewhat, of freely rotating the fore-arm, and who obtained his food by digging. Whether it belonged to the same animal with the tooth above described, which I suspect may have been the case, I have not the means of determining with certainty. There are apparent and essential differences between Cuvier's plate of the humerus of the Megatherium and the specimen under examination, although there appears to be some considerable resemblance. It still less resembles that of the fossil elephant, or any other I can find figured. My means of reference however are so scanty, that it would be folly for a tyro in palæontology to attempt to name it, and I must leave it for you and others better qualified to say to what genus it belongs, if not to some one of the megatherioid tribe.

Should these specimens be considered of sufficient interest by scientific gentlemen, it would afford me great pleasure, on being informed of the fact, to exchange casts of them as soon as practicable, for other fossil remains or casts, and to learn their opinions upon the subjects of this communication.

Newburyport, Mass., June 2, 1841.

*P. S. addressed to the Editors, Sept.* 8, 1841.—Since my communication was sent to Dr. Jackson, I have discovered among the fragments of bone in my possession, the body of a dentate vertebra, and what appears to be part of a clavicle, which, from their strong external resemblance in color and texture, would seem to have belonged to the same animal with the humerus.

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## Art. XVII.—*Objections to Mr. Redfield's Theory of Storms, with some strictures upon his reasoning;* by Robert Hare, M. D., Prof. of Chem. in the Univ. of Pennsylvania.

1. Mr. Redfield's idea, that tornadoes and hurricanes are all whirlwinds, involves some improbabilities. It requires that, during every hurricane, there should be blasts of a like degree of strength coinciding with every tangent which can be applied to a circle. Thirty two ships equidistant from the axis of gyration, and from each other, should each have the wind from a different point of the compass with nearly equal force. The only modification of which this view of the case admits, is that resulting from the progressive motion which tends to accelerate the wind on the side on which this motion concurs with that of the whirl, and to retard it upon the other side. Moreover, as respects any one station, the chances would be extremely unfavorable that the same hurricane should twice proceed from the same quarter! Yet in the course of time it would be felt, at any station, to proceed from many different directions, if not from every point of the compass.

2. The fact that during the same storm different vessels variously situated are found to have the wind in as many different directions, may be explained by the afflux of winds from all quarters to a common focal area, as well as by supposing them to be involved in a great whirlwind. Mr. Redfield has alleged that he observed proofs of gyration in the effects of the New Brunswick

tornado; but I think that the survey of Bache and Espy, shows that it would be inconsistent with the facts to suppose such a motion, unless as a *contingent* result, and that it could only be a casual effect of the currents rushing towards the axis of the tornado.

3. Being of opinion that calorific expansion is inadequate to explain the afflux of wind towards the equator, the same author alleges that "*the space previously occupied by the atmosphere, so left behind is by the centrifugal action of the earth's rotation, constantly supplied from higher latitudes.*"

4. I presume that the meaning of this allegation is, that the centrifugal force communicated to the air at the equator by the diurnal revolution of the earth, lessening the gravity of the air thus affected, causes it to rise and give place to those portions of the atmosphere, which existing where the diameter of the earth is less, have less rotary motion. Admitting an afflux to arise in this way, could it have any other effect than that of accumulating air over the equator, compensating by quantity and altitude for the loss of weight arising from a greater centrifugal force pertaining to that region? But on the other hand, if we attribute the ascent of the air at the equator to heat, the theory of calorific circulation will account for the continuance of the process.

5. In ascribing the prevalence of westerly winds in the upper regions of the atmosphere to the deflection of the trade winds by our mountains, Mr. Redfield's explanation harmonizes with the theory of Halley. In fact as the water accumulated by these winds, in the Gulf of Mexico, is productive of the Gulf Stream, is it not reasonable that there should be an aerial accumulation and current, corresponding with that of the aqueous current which is designated by the name above mentioned? But not perceiving that the trade winds cannot be explained without the agency of temperature, Mr. Redfield, in the following paragraph, rejects the influence of heat.

6. "*To me it appears that the causes of the great storms may be considered to indicate with entire certainty the great law of circulation in our atmosphere, and that the long cherished theory, which is founded on calorific rarefaction, must give place to a more natural system of winds and storms, founded mainly upon more simple conditions of the great laws of gravitation.*"

7. It would seem from this paragraph, as well as others, that Mr. Redfield considers gravitation, uninfluenced by heat or electricity,

mainly the cause of atmospheric currents. But in the absence of calorific and electrical reaction, what other effect could gravitation have unless that of producing a state of inert quiescence. The part which it performs in the mechanism of nature is well illustrated by that which it performs through the medium of a clock weight, which is of no use without being wound up.

8. It is remarkable that the author after ascribing the trade winds to momentum, as the antagonist of gravitation, loses sight of it in this summing up of the causes of atmospheric currents.

9. If, as Mr. Redfield alleges, the minuteness of the altitude of the atmosphere in comparison with its horizontal extent, be an objection to any available currents, being induced by calorific rarefaction, wherefore should not momentum, or any other cause diminishing or counteracting the influence of his favorite agent, gravity, be on the same account equally inefficient?

10. Assuming that the motion of the air in hurricanes, is *always gyratory*, Mr. Redfield considers *gyration* as a cause of these terrible meteors. How far his language on this subject is reasonable or consistent, may be seen from the following paragraph, which I quote from one of his essays. See this Journal for 1834, Vol. xxv, p. 125.

11. "*Notwithstanding these general and determinate horizontal movements, the equal distribution of the atmosphere over the surface of the globe, which results from gravitation, tends to prevent any very rapid or violent motion in any specific direction, and consequently to prevent violent and destructive winds. But owing to the tendency of all fluid matter to run into whirls or circuits, when subject to the influence of unequal or opposing forces, a rotative movement of unmeasured violence is sometimes produced. This peculiar movement, which in its most active state is sometimes distinguished by the name of tornado or hurricane, assumes every possible variety of position, appearance, velocity and extent, and is the only known cause of violent and destructive winds or tempests.*"

12. Agreeably to this paragraph, gravitation in lieu of being, as previously alleged, the *main basis of winds and storms*, tends to produce that equal distribution of the atmosphere over the surface of the globe on which I have insisted.

13. But if neither gravity, nor calorific expansion, nor electricity, be the cause of winds, by what are they produced?

14. He alleges that all fluid matter has a tendency to run into whirls or circuits, when subject to the influence of unequal or opposing forces; and that, in this way, a rotative movement of unmeasured violence is sometimes produced.

15. If this were true, evidently whirlpools or vortices of some kind, ought to be as frequent in the ocean, as agreeably to his observation, they are found to be in the atmosphere. The aqueous Gulf Stream, resulting from the impetus of the trade winds, ought to produce as many vortices in its course as the aerial currents derived from the same source; especially as in the ocean, the great laws of gravitation have full liberty to act, without any important interference from calorific changes, to which the advocates of the agency of such changes in producing wind, will not ascribe much efficacy where non-elastic fluids are in question.

16. There are few vortices or whirlpools in the ocean, because there are in very few cases descending currents, to supply which the confluence of the surrounding water is requisite. Of course vertical currents cannot arise from any imaginable cause.

17. The conflict of opposing or unequal forces does not produce curvilinear motion unless there be a successive deflection; as in the case where it results from centripetal force, or the influence of gravity upon a projectile. If one of two opposite forces be less than the other, retardation will ensue, and a lateral current or currents, carrying off the excess of momentum. If currents encounter each other obliquely, a diagonal current will result. I doubt if a whirlpool ever takes place without a centripetal force resulting from a vacuity.

18. But the author has not informed us how these unequal or opposing forces are generated in the atmosphere. Without any assigned cause, he appeals to "*certain unequal or opposing forces by which a rotative movement of unmeasured violence is produced;*" this rotative movement, although alleged to be an effect in the first instance, is stated subsequently to be "the only known cause of violent and destructive winds or tempests."

19. In a memoir on the causes of tornadoes, and in some subsequent communications published in the Transactions of the American Philosophical Society, and republished in this Journal, various facts and arguments were mentioned tending to prove that the proximate cause of the phenomena of a tornado is an ascending current of air, and the afflux of wind from all points of the compass to supply the deficiency thus created.

20. In this mode of viewing the phenomena, no difference of opinion exists between Espy and myself, however we may differ respecting the cause of the diminution of atmospheric pressure within the track of a tornado, which gives rise to the ascending current.

21. I adduced several facts, upon the authority of the accurate survey made by that gentleman and his associate, proving that the effects were, in some cases, inconsistent with the existence of a whirl; and I mentioned one which could not be explained without attributing it to a gyratory force. Hence I was led to consider gyration as a casual, not an *essential feature* in the meteors in question. It appeared reasonable to suppose that the conflict of confluent streams of air, rushing towards an axis moving progressively, might be productive of a whirling motion. The contortion of six feet of the upper part of a brick chimney upon the lower portion, so as to cause the corners of either portion to project beyond the sides of the others, was deemed inexplicable, without ascribing it to a gyratory force. Subsequently, however, it occurred to me that this fact was more likely to be the result of a *local* than of a general whirl; since, in the latter case, the chimney could not have been twisted as described without being precisely at the centre of the whirlwind. That such could have been its position, appeared to me to be extremely improbable, and had it been so situated, as the whirlwind was estimated to be moving progressively, at the rate of seventeen miles per hour, it is to me incomprehensible how the portion which was dislocated could have escaped an overthrow. Evidently, although twisted upon its base while concentric with the axis of gyration, it would in one second of time have been twenty feet upon the windward side of it, and consequently subject to the tangential force of the whirlwind. I adduce this, as well as other facts, to prove, that in tornadoes and hurricanes, there are local whirls, causing bodies, which are of a nature to favor an electrical discharge, to be particularly affected.

22. A fact, irreconcilable with a general whirling motion, has been recorded by Messrs. Espy and Bache. A frame building was so situated as to be protected by another edifice in one direction from the suction of the tornado, and yet was exposed to its influence as it advanced, and as it moved away. Hence two of the four posts, on which the frame rested, were so impelled by the

wind as to make furrows in the ground, of which one was nearly at right angles to the other. Evidently such furrows could not rise from the transient tangential impulse of a whirlwind.

23. Mr. Redfield admits that the confused directions of fallen bodies is distinctly recognized by all the parties to this inquiry. Conceding, that amid this confusion, he has been enabled, by a survey, to show that the directions in which certain trees fell are consistent with their having been subjected to a whirlwind, it does not demonstrate gyration to be an essential feature of tornadoes. It is sufficiently accounted for by considering it as a fortuitous consequence of the conflux of currents rushing into a space partially exhausted.

24. Mr. Redfield adopts the singular determination of not noticing "the insuperable difficulties" of the hypothesis which he has undertaken to set aside. As the advocates of the disputed hypothesis are not aware of any such difficulties, is it correct to allege their existence, without mentioning the facts and arguments which justify this allegation?

25. Without repeating here the evidence and the reasoning which I have already published on this subject, I will advert to one fact which is utterly irreconcilable with Mr. Redfield's "rotary theory;" I allude to the statement of a most respectable witness, that while the tornado at Providence was crossing the river, the water which had risen up as if boiling within a circle of about three hundred feet, subsided as often as a flash of lightning took place. Now supposing the water to have risen by a deficit of pressure resulting from the centrifugal force of a whirl, how could an electrical discharge cause it to subside?

26. I have already, I trust, sufficiently shown that the explanation which Mr. Redfield dignifies with the title of his "theory of rotary storms," amounts to no more than this, that certain imaginary nondescript unequal and opposing forces produce atmospheric gyration, that these gyrations by their consequent centrifugal force, create about the axis of motion a deficit of pressure, and hence the awful and destructive violence displayed by tornadoes and hurricanes.

27. I cannot give to this alleged theory the smallest importance, while the unequal and opposing forces, on which it is built, exist only in the imagination of an author who disclaims the agency either of heat or electricity. But admitting a whirlwind to be

produced, not by a deficit of pressure about the axis, but by unequal and opposing forces acting externally, in any competent way whatever, is it not evident that any deficit of pressure about the axis, consequent to the resulting centrifugal force, could only cause in the atmosphere a descending current, while it could not tend in the slightest degree to carry solids or liquids aloft? It must be obvious, that the stratum of air on the earth's surface, partaking of the circular motion, must also partake of the centrifugal momentum, and of course would have the inverse of any disposition to rush towards the axis so as to be productive of a vertical blast. Meanwhile the air being rendered rarer by the centrifugal momentum imparted as above alleged, ponderable bodies enveloped by it would have their gravity less counteracted than usual, and consequently far from acquiring any tendency to rise, would be unusually difficult to elevate.

28. I cannot help thinking that as respects the application of his "rotary theory" to account for the upward movement which appears to be essential to tornadoes, these arguments will amount to a "*reductio ad absurdum.*"

29. Mr. Redfield infers that the whirlwinds of which he assumes the existence, have a property which he alleges to be observable in "all narrow and violent vortices," viz. "a spiral involute motion quickened in its gyrations, as it approaches towards the centre of the axis or whirl."* But is it not evident, that if any fluid mass be made to revolve by unequal and opposing forces, or by any other than those resulting from the centripetal force, caused, as already described, by suction at the axis, the gyration will not quicken, in proportion as the gyrating matter may be nearer the centre; but on the contrary, will be slower as the distance from the axis may be less? It appears to me that the only case in which gyration is found to quicken in proportion as the matter involved approaches the vortex, is that which results from a confluence caused by an ascending or descending current at the axis of the whirl.

30. So far therefore as Mr. Redfield's observations confirm the idea that the whirling motion in tornadoes quickens towards the centre, it tends to confirm the opinions which he combats, and to refute those which he upholds.

31. Although the efforts which I have made to show that the phenomena of tornadoes and hurricanes arise from electrical reac-

* See this Journal, Vol. XXXI, p. 130.

tion should not be successful, I think it will be conceded that any theory of storms which overlooks the part performed by electricity must be extremely defective.

32. Both by Messrs. Espy and Redfield the influence of this agent in meteorological phenomena is entirely disregarded, although with the storms which have been especially the subject of their lucubrations, thunder and lightning and convective discharge are most strikingly associated.

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Art. XVIII.—*Abstract of the Proceedings of the Eleventh Meeting of the British Association for the Advancement of Science. Prepared from the Report in the London Athenæum.*

The eleventh meeting of this Association was held at Plymouth, during the week commencing July 29, 1841. The attendance was large, and the receipts at the meeting amounted to £1280. The value of the property of the Association is £6955 9*s* 11*d*. During the year, £1235 10*s* 11*d* have been expended for scientific purposes. The amount appropriated for similar uses during the coming year, is £3033 9*s* 8*d*.

At the general meeting on the evening of the 29th, the President, Prof. Whewell, on taking the chair, delivered an eloquent address on the objects and progress of the Association. A large portion of this interesting address was inserted in our last number.

Lord Francis Egerton was chosen President for the year ensuing. The next meeting will be at Manchester in June, 1842.

### Sect. A. *Mathematics and Physics.*

The committee on the reduction of the stars in *Lacaille's Cœlum Australe Stelliferum*, reported, that the observations are reduced, all the computations executed, and the arranged catalogue completed and delivered to Mr. Baily, to be employed in the construction of the extended edition of the Catalogue of the Astronomical Society.

The *Reduction of the Stars in Lalande's Histoire Céleste*, will be finished before the next meeting of the Association.

The *Extended Catalogue of Stars* of the Royal Astronomical Society, will be completed in a short time.

The following is the report of a committee consisting of Sir J. Herschel, Mr. Whewell, and Prof. Baily, for *revising the no-*

*menclature of the Stars.* "As regards the collection of synonyms, the detection of errors in mistakes of entry, copying, printing, or calculation, and their rectification, and the restriction within their just boundaries, of the existing constellations, the work of your committee has been progressive. * * As regards the revision and re-distribution of the southern constellations, a catalogue has in the first place been prepared of all the stars within the circle of 70° S. P. D., down to the fifth magnitude, with their present actual magnitudes, as determined by a series of observations, made expressly for that purpose, which catalogue is in course of printing and publication by the Royal Astronomical Society. With the magnitudes of this catalogue, a chart has been constructed, of which several copies have been made, and have been employed for the purpose of grouping the stars in various ways, (without regard to existing constellations,) and with reference only to forming among themselves the most compact and striking groups which their distribution in the heavens admits, and which the correctness obtained in the magnitudes has now, for the first time, rendered practicable. After trying many systems and arranging the groups in a great variety of ways, your committee have agreed on adopting, as the boundaries of the new regions into which they propose distributing the southern stars, only arcs of meridian and parallels of declination for a given epoch; thus including each region within a quadrilateral rectangular figure, whose angular points being tabulated in R. A. and Decl., may be treated as artificial stars, and thus brought up by the usual tables of precession to any other epoch, their situation among the stars being unchanged. Thus it will become a mere matter of inspection of a catalogue arranged for the original epoch, (which they propose to be that of the Royal Astronomical Society's forthcoming new Catalogue,) which region any given star shall belong to. Proceeding then to assign more particularly the limits of the several regions, they have succeeded in forming an arrangement, in which (subject to such revision and modification as may arise between this and their final Report,) they feel disposed to rest. * * As respects the nomenclature of the new regions, the committee are at present engaged in considering it; but some principles which will probably influence their recommendation when the subject is sufficiently advanced for that step, are stated in a paper, which will appear in the forthcoming volume of the Transactions of the Roy. Ast. Soc. But there is the same necessity, (grounded on the incorrectness of magnitudes, as laid down in all existing charts,) for a revision of the northern as well as southern stars in this respect. It therefore becomes worthy of consideration, whether a similar plan may not advantageously be carried into execution in both hemispheres. And as at all events, the actual state of the celestial charts in both is such as to admit of great improvement from an assemblage of more correct photometric data, a general review of all the stars, down to the fifth magnitude, with this especial object in view, has been undertaken by one of the members of the committee, conducted on the same plan, the principle of which is explained in the paper alluded to. This review is in a state of considerable advancement, and should circumstances and weather favor, will probably be completed before the next meeting."

On the *reduction of Meteorological Observations made at the Solstices and Equinoxes.* Sir J. Herschel reported, that the whole number of series in hand, amounts to more than three hundred, being the results of observations at about sixty stations. During the past year, Mr. Birt has been employed in tabulating, reducing, projecting and comparing the barometric curves, a process which has been completed for the whole of the American group, (which is by far the most numerous and consecutive,) for the years 1835, 1836, 1837, and for March, 1838, comprising eighty eight series made at twenty eight stations. * * The tabulated results of these reductions and their projected curves accompanied the Report.

The Astronomer Royal made report on the publication of the *Hourly Observations made at Plymouth, under the superintendence of Mr. W. S. Harris.* 1. The first series of observations for the thermometer extends from May, 1832, to Dec. 1836, and contains readings for every hour of the day and night. The means of the readings are taken for each day, and for each hour the means of groups of ten or eleven days are taken. 2. The second series extends from Jan. 1837 to Dec. 1839, and contains readings of the wet and dry thermometer for every hour of the day and night. The means of the readings are taken for each day. 3. The barometrical observations extend from Jan. 1837 to Dec. 1839, and contain readings of the barometer and attached thermometer for every hour of the day and night. The means are taken for each day. It was recommended that all these observations be printed in full.

Sir D. Brewster made a *Provisional Report on the Hourly Meteorological Observations at Inverness and Unst.* The hourly observations at Inverness were recommenced Nov. 1, 1840; but a difficulty presented itself to their renewal at Kingussie, which it was not easy to overcome. The observations have in consequence, been transferred to Balta Sound, in Unst, the most northern of the Shetland Islands, already distinguished in the history of science by astronomical observations made there in 1817 and 1818, by M. Biot and Capt. Kater. Dr. Edmonston, of Buness, undertook to superintend the observations, which were begun early the present year. The Isle of Unst being in N. lat. 60° 40′, Leith in 55° 58′, and Plymouth in 50° 22′, and all of them nearly in the same meridian, a series of peculiarly valuable hourly observations will now be obtained.

Prof. Whewell delivered Reports on the *tide-observations made at Bristol and at Leith.* At the former station particular attention has been given by Mr. Bunt to the effect produced by changes of atmospheric pressure on the heights of high water. After a discussion of numerous observations, he concludes that the water is depressed by atmospheric pressure almost exactly as much as it would be raised in the tube of a water-barometer. From observations made at the latter station, Mr. Ross had made an investigation of the corrections of the height and time of high water due to lunar parallax and declination.

A committee (of which Sir D. Brewster was chairman) reported on the question *how far the desiderata in our knowledge of the condition of the upper strata of the atmosphere may be supplied by means of ascent in balloons or otherwise,* and also reported brief directions for such observations, with the probable expense of the necessary instruments.—The principal objects required, are to determine the progression of temperature, and the law of the distribution of vapor, in ascending from the surface of the earth to the upper regions of the atmosphere. Observations of the thermometer and dew point should be unremitted during the whole time both of the ascent and descent, and of course, must be accompanied by simultaneous observations of the barometer; one person's time should therefore be wholly devoted to these objects. The prevailing forms and structure of the clouds, their internal motions if any, the number of strata which may be detected, and the number and direction of the currents which their motion may indicate, will also form interesting objects of observation in conjunction with the preceding. Cotemporaneous observations will of course be made on the earth, during the time of the aërostatic voyage, which will possess a greatly increased interest if circumstances shall permit it to take place on the day when hourly meteorological observations are made at all the principal observatories of Europe, according to the plan laid down by Sir J. Herschel. Portions of the air should be brought down, for examination, from the highest elevations; and this may probably be best effected by taking up several glass balloons or bottles carefully gauged, fitted with stop-cocks, and filled with water. The water should be allowed to run out at the proper station, and the stop-cocks closed. Experiments upon the radiation of heat would be interesting, although there are probably no known means of instituting them with all the accuracy which could be desired. To these observations might be added, others of great interest upon the electricity of the atmosphere, by dropping wires into clouds, or from stratum to stratum of cloudless air, and examining the nature of the electricity of their extremity by means of a very delicate electroscope, but the observer's attention must not be distracted by a great variety of objects. It would be desirable that two observers, stationed at the extremities of an accurately measured base, should take the altitudes of the balloon, at the instants the observations of pressure and temperature were made.

The committee, of which Sir J. Herschel is chairman, for superintending the scientific coöperation of the British Association in the *system of simultaneous observations in Terrestrial Magnetism and Meteorology*, made a report, of which the following is the principal part:

Your committee, referring to their last report for the history of the magnetic operations in progress up to that time, have to state, in continuation, that the magnetic observatory at St. Helena was finished, and the instruments established in August, 1840,—at Toronto in September, and at Van Diemen's Land in October of the same year. The observatory at the Cape of Good Hope was completed and in activity at the commencement of March in the current year, under the superintendence of Lieut. Eardley Wilmot. From each of these stations, returns have been regularly received since their respective dates of completion. Previous to this, there had been received returns of seven months of observations in a temporary observatory at Toronto, and of six at St. Helena. All the observations, as soon as received, have been regularly transmitted to Prof. Lloyd, and after examination by him, handed over to Col. Sabine, under whose superintendence, assisted by Lieut. Riddell,—(the state of whose health, has unfortunately compelled his return from Toronto,) they will be published, Government having, on the application of the Royal Society, taken upon themselves this additional expense. In consequence of this arrangement, the reduction and printing of the observations are now in progress. The portable observatories of the *Erebus* and *Terror* were put up at Kerguelen's Land, and also at Van Diemen's Land. At the former station, the May and June terms were observed,—at the latter, those of August and September, 1840. During the stay of the expedition at these stations, the magnetometers were observed *hourly;* and the regular work of the observatory at the latter station under the direction of Lieut. Kay has been begun, and will be continued on this doubly laborious plan of hourly intervals for the ordinary observations, while on the term-days, all the three magnetometers will be observed at the same instants of time, but at intervals of two and a half minutes,—the means of confronting this vast increase of labor being supplied by the colonial government, as administered by that ever active and zealous friend of science, Sir J. Franklin. In addition to this, and for the sake of multiplying occasions for observing the correspondence of magnetic perturbations with auroral discharges, one hour out of every twenty four, (viz. from 1h. 50m. P. M. to 2h. 50m. P. M. Göttingen mean time, commencing from Jan. 1, 1841,) will be occupied with observations of the magnetometers, at intervals of two and a half minutes, in this order, viz. Bifilar, declination; Vertical force, declination; B, D; V, D, &c. It is to be hoped that some of the European observatories will, at least occasionally, furnish observations in correspondence with these.

The first report of Lieut. Ludlow, the director of the Madras Observatory, and the first month's observations, have been received. It commenced regular observations on the 1st of January, 1841.

Of the foreign European observatories, Brussels, (M. Quetelet:) Prague, (Herr Kreil:) and Milan, (Sig. Carlini:) have regularly forwarded the term observations for each month to the Royal Society. The Cadiz observatory, (M. Montajo,) has been furnished with all necessary instruments.

Under the head of *Observatories entirely new*, your committee have to announce the establishment of a private one at Havañah, by Drs. Belot and Jörg.

The term-days of May and August, 1840, have been both remarkable for the magnitude of the disturbances. Mr. Riddell has undertaken to have all the observations of these two days projected in curves, which will probably be soon completed.

M. Kupffer reports that the observations in the magnetic observatory at St. Petersburgh commenced Jan. 1, and at Caterineburgh, March 10. In the course of the summer, they will be commenced at Helsingfors; and at Tiflis, in all probability, during the autumn. The total number of magnetical observatories which may be at present reckoned on as brought, or about to be brought, into effective coöperation, is fifty one.

On the 12th of November, 1840, the *Erebus* and *Terror* left Hobart Town for their first summer's research in the Antarctic Circle, leaving Lieut. Kay with Messrs. Dayman and Scott as his assistants, in charge of the observatory at Ross Bank. On board, and during temporary sojourns of the expedition on land or ice, the observations will be made on the same enlarged plan as at Hobart Town. The first term will, in all probability, have been observed in November at the Auckland Islands. The first point to be determined would be, the point of maximum intensity in the southern hemisphere, the meridian of which had been indicated by the daily observations in the passage from Kerguelen's Land to Van Diemen's Land, leaving only its latitude undecided. Having accomplished this, they will proceed, as rapidly as circumstances will permit, to seek and determine the position of the point of vertical dip. The observations at sea, it should be mentioned, succeed to the fullest extent of the most sanguine expectations; so much so, that the three magnetic elements are daily observed on board, with a precision perfectly adequate to the actual demands of magnetic science.

Intimately connected with a system of simultaneous observations at central stations, is the subject of magnetic surveys of the surrounding districts. It is only by reference to such central stations as zero points, that itinerant determinations can be divested of the influence of temporary and casual magnetic derangements, and brought into comparability with the general magnetic system of the globe. It is, therefore, of the utmost importance, that every advantage should be taken of the present fortunate conjuncture to secure the *whole* benefit of the simultaneous system, and to extend it from points over districts. Itinerant observations, made on a connected system, and precisely simultaneous with those at fixed observatories, will acquire, (if accurately made,) all the value of stationary ones, becoming *ipso facto*, and at each instant, reducible to a central station. Moreover, by this means alone can the amount of station error for each element, at the central stations themselves be ascertained; by which is meant, all that part of each resolved element of the magnetic force, which not being participated in by the surrounding district, must be attributed to attractions merely local and accidental. Without such surveys, executed at *some* epoch, this error cannot be even approximately fixed. If executed at this particular time, not only will it be settled with precision, but the surveys will become an independent part of the whole mass of observation, and be rendered infinitely more valuable as data for future reference, than they could possibly be if deferred till after the conclusion of the stationary observations.

Under this impression it is highly gratifying to your committee to be enabled to announce that one very important survey of this kind,—that of the British possessions in North America—has, on the application of the President and Council of the Royal Society, been undertaken by government, on a scale both liberal and satisfactory—a young, ardent and instructed officer, Lieut. Younghusband, R. A., qualified for the work by a residence and practice in magnetic observation in the observatory at Toronto,—having been added to the establishment of that observatory, with a view to this especial service, for three years, with a non-commissioned officer as his assistant, furnished with every instrumental requisite, a liberal provision for travelling expenses, and with the promise of gratuitous canoe conveyance, from the Hudson's Bay Company, in the territories belonging to them. In anticipation, moreover, of a similar magnetic survey of South Africa, though as yet no formal application for such a survey has been made, the

Master-General of Ordnance has ordered a second officer of Artillery, (Lieut. Clerk,) to be attached to the observatory at the Cape of Good Hope.

The magnetic survey of British Guyana has been undertaken by Mr. Schomburgk, one of the commissioners appointed by Government to determine the boundaries of that province. The African Expedition has also been supplied, by Government, with the necessary instruments for observation. From the scientific zeal which distinguishes many of the officers of that expedition, scarcely inferior to that zeal in the cause of humanity which has led them to enter on so perilous a service, results highly valuable to magnetic science may be expected.

Mr. Caldecott, astronomer to his Highness the Rajah of Travancore, has also declared his intention to undertake the magnetic survey of Southern India; while in the north of that empire we may expect, from the zeal and energy of Capt. Boileau, that no exertions on his part will be wanting to secure a similar advantage in that quarter.

In all such surveys, it is highly desirable that a regular and concerted system of observation should be followed, and above all things that the condition of exact conformity to the hours of simultaneous observation should be adhered to; as well as that, if practicable, all determinations of important points, intended to be made with particular care and exactness, should be performed on the term-days; which object, by the exercise of a certain degree of forethought in laying out the plan of travel, may doubtless be accomplished in the great majority of instances.

The President submitted a *series of curves*, prepared by Lieut. Riddell, *representing the simultaneous changes of the magnetical elements*, observed at Toronto, Dublin, Brussels, Prague, Milan, St. Helena, and Van Diemen's Land, on the 29th of May and 29th of August, 1840. He remarked that one of the chief objects kept in view in the arrangement of the great system of combined observation now in operation, was the extension of the plan of simultaneous observations at short intervals of time, first laid down by Gauss. The results of this system had been, that the observed changes of the magnetical elements were strictly simultaneous at the most remote stations at which observations had been hitherto made; and that these changes followed in all cases the same laws, the representative curves being similar to one another in all their inflexions, and differing only in the magnitude of the change. This similarity had been found to extend to the utmost limits of Europe, and to hold at stations as remote as Dublin, Petersburgh, and Milan. It became, therefore, a question of great interest in the extension of this system to still more distant stations, to determine whether there were any and what limits to this accordance. The question was determined by the very first results of the observations recently established by the British government, and the observations first mentioned, were selected as elucidating it in a very marked manner. The magnetical disturbances which occurred on these days were among the most considerable which had been as yet observed. On the former day, (May 29, 1840,) the declination at Toronto underwent a sudden change, amounting to 1° 52′ in about twenty minutes of time, while the disturbance of the horizontal force was so great as to carry the magnet beyond the limits of its scale. On the latter day, (Aug. 29, 1840,) the greatest change of the declination amounted to 1° 26′ at Toronto, and to 1° 18′ at Dublin. The greatest change of the horizontal intensity at the former station amounted to .028, or about one thirty sixth part of the whole intensity: while at Dublin the change was even greater, and extended beyond the scale of the instrument. It is probable that an attentive comparison of the curves may lead to many important results; but there are some which appear upon a cursory inspection, which Mr. Lloyd said he should now notice. The first was, that the greater magnetic disturbances appeared to be synchronous at the most distant stations. This important fact is exhibited much more evidently in the changes of horizontal intensity than in those of declination, and if verified by further comparisons, leads to the conclusion, that the principal forces which disturb the magnetic equilibrium of the earth, are not of local agency. The next circumstance which merited attention was, that the order of the changes was no longer regulated by the same law at very remote stations; the representative curves exhibiting none of that similarity already referred to, which was shown within the limits of Europe, and the epochs of the successive maxima and minima presenting no agreement whatever. This important fact was first brought to light in the course of a series of simultaneous observations, made by Prof. Bache at Philadelphia, and by himself at Dublin, in November, 1839, in the hope of determining differences of longitude by means of the corresponding movements of the magnet at the two stations. The changes observed in the observations at present under consideration, were however far greater in magnitude, and placed the phenomenon in a much stronger light. The last circumstance to which Mr. L. invited attention was, that the curves of horizontal intensity presented, at remote stations, a much nearer agreement than those of declination: from which it may be inferred that a true knowledge of the nature and laws of the disturbing causes will be better attained by the examination of intensity changes, (including, of course, those of the vertical intensity,) than those which are dependent solely on the direction of the acting forces.

The President also laid on the table the curves representing the changes of magnetic declination, observed at Cambridge, Massachusetts, by Mr. W. C. Bond and Prof. J. Lovering, on the term-days of May and October, 1840. The corresponding observations made at Toronto by Lieut. Riddell, were laid down in a curve in connection with the latter. The results exhibited the same close agreement in the forms of the curves, and in the epochs of the successive maxima and minima as had been already noticed in Europe, although, (as before remarked,) all resemblance between this and the European system of changes is nearly obliterated. Cambridge is distant about five hundred miles from Toronto: the mean declination at the former place is now 9° 20′ West.

Sir D. Brewster presented the following *report on the State of the Inquiry into the action of gaseous and other Media on the Solar Spectrum.* In prosecuting this inquiry, my attention has been principally directed to the action of the earth's atmosphere upon the solar spectrum, and I hope to be able to present to the next meeting of the Association a map of the bands produced by atmospheric absorption. I have also made considerable progress in constructing a map of the spectrum containing the numerous lines and bands produced by the action of nitrous gas. In submitting to examination several other gaseous media, my results have been principally of a negative character; but in my experiments with solid and fluid media, I have been led to many positive and interesting results. In order to obtain additional accuracy of observation, particularly near the extremities of the spectrum, Mr. Dollond has constructed for me some important pieces of apparatus for directing and condensing the solar rays; and I have recently obtained from Mr. Herz, of Munich, a very large prism, to be used with the telescope, and a series of smaller prisms for constructing a prismatic cylinder for the purpose of expanding or magnifying particular parts of the spectrum.

Prof. Whewell stated that the times of high water on the east coast of Britain, and the north coast of Belgium, Holland, and Germany, had led him to the conclusion that there must lie towards the *middle of the German Ocean, a central space, in which the rise and fall of the tide vanishes.* He presented a letter written by Capt. Hewett, who was lost in H. M. S. *Fairy*, in the German Ocean in 1840. Capt. H. had endeavored to decide the point by a series of observations, the details of which are given in the letter, and afford strong confirmation of the views of Prof. Whewell.

Mr. J. Scott Russell read a *Notice Supplementary to the former Report on Waves*, containing results of experiments made during the year.

Mr. W. S. Harris communicated a report on the *working of Whewell's Anemometer at Plymouth* during the year past. He exhibited the curves for the year on a diagram twelve feet high by seven wide, a red tape line showing the total effect. The instrument, after having undergone certain improvements, appears now to be entirely satisfactory. The mean result of the year's observations, shows at Plymouth an annual movement of the air from the S. S. E. toward the N. N. W. nearly. If we connect this fact with the results obtained from the hourly meteorological observations at the Dock-yard, we are entitled to say, so far as our experiments extend, that there is an annual movement of the atmosphere in this latitude towards the north, under a mean pressure of 29.9 inches nearly, taken at the level of the sea, and a mean temperature of 52° Fah. Having traced an annual movement in the air, it remains to determine its rate of motion. This, although at first sight a difficult matter, he hopes to accomplish by a mode of experiment now in progress.

*Further Researches on Rain*, by John Phillips, and at Harraby, near Carlisle, by Joseph Atkinson, Esq. At previous meetings of the Association, Mr. P. had offered a series of experiments on the quantities of rain received on equal horizontal areas, at different heights from the ground, from which it appeared that more was received near the surface of the earth than at higher points. Further experiments show that these results vary much with the nature of the gauge employed, and with the local situation of their exposure. The *globular rain-gauge* of Dr. Robinson was explained. A globe of copper stands on a stem with a funnel, so as to leave exposed to the rain its upper part; the rain, as it trickles down the globe, is caught by the funnel; when the wind is high, the drops, as they collect below, are in danger of being blown off, unless the funnel extends out so as to stand under about one quadrant of the globe, thus leaving about 270° exposed. In this way, the copper globe always presents a nearly equal cross section to the descending rain, whether the rain-drops fall in vertical lines, or in lines considerably inclined. This gauge had been fitted up on the flat roof of the observatory at Armagh, in the close vicinity of an ordinary horizontal gauge, the mouth of which exposed exactly one hundred square inches: the diameter of the globe had also been so regulated as to expose exactly an equal cross section. Except during the violent gale of January 6, 1839, he had never found the rain to be blown out of the receiving funnel of the globular gauge. It had been set up since Sept. 1838, and the mean result was, that the ratio of the quantity received by the globe gauge to that received by the ordinary gauge is almost exactly 2 : 1; this ratio, however, was very much departed from, on one occasion, during a very severe gale in November, 1839, in which the barometric column descended rapidly to a very low point, the globular gauge received 0.76, while not one drop had entered the horizontal gauge beside it: the curvets upon the roof, doubtless, having given rise to this remarkable circumstance, in the manner described by Prof. Bache, of Philadelphia.

Mr. T. Hopkins presented a paper on the *Influence of Mountains on Temperature in the Winter in certain parts of the northern hemisphere.* Mr. H. stated, that between the latitudes of 40° and 70° North, there is in the same parallels, a great difference of temperature, particularly in the winter, amounting in some cases to as much as 40° or 50° F. The western coasts of the two continents are much warmer than the eastern, and the winds generally blow from the sea to the western coasts; and it has been inferred that the prevailing winds passing over sea to the western coasts, and over land to the eastern, is the cause of the difference in the temperature. This inference, is not however in accordance with facts, as the low temperature is not proportional to the distance from the western coast. Throughout this part of the northern hemisphere, it is found that climate has certain relations to the elevation of land, not simply arising out of the elevation of that part of the earth's surface above the general level, but out of the influence which the elevation exercises on the atmosphere. After an extensive discussion of facts, Mr. H. considers himself warranted in concluding that the great difference in the winter climates of certain parts of the northern hemisphere, is attributable to elevations of land intercepting and condensing atmospheric steam, and thus rendering those parts wet and warm, while cutting off the supply from the more northern parts, leaves them dry and cold.

*On the theoretical computation of Refractive Indices,* by Prof. Powell.—In the Report on Refractive Indices, which the author had presented to the Association, his professed object extended only to exhibiting the results of *observation* without any reference to *theory.* Since that report was made, he has devoted his attention to the subject of their *theoretical* computation, and it is the object of the present communication to state very briefly the progress made in it. The results in the Report on Indices are classified under three heads: 1, those of Fraunhofer; 2, those of Rudberg; 3, those derived from the *latest* observations of the author, comprising many *new* results, *superseding* former ones; and others, the combined results of several sets of earlier observations compared with later. The first series was compared with theory, 1, by the author in the *Phil. Trans.* 1835, but only by an approximative and tentative method; 2, by Mr. Kelland, by a direct and exact method in the *Camb. Trans.* Vol. 6; 3, for the rays D and C only, by Sir W. R. Hamilton in the *Phil. Mag.*, 3d series, Vol. 8; 4, by M. Cauchy in the *Nouv. Exerc.* livr. 3–6, by a most exact and elaborate process. The second series has been computed only by the author, by the same approximative method as the first, in the *Phil. Trans.* 1836, whence it was reprinted in *Poggendorff's Annalen.* Some of the first results belonging to the third series were computed by the author, by Sir W. R. Hamilton's method, in the *Phil. Trans.* 1837, and three of the higher cases, in which discrepancies appeared, were recomputed by Mr. Kelland's method in the ***Phil. Trans.*** 1838. Thus it was desirable to recompute series 2, by an *exact* method, and necessary to calculate all the *new* and *improved* results of series 3. This the author has now done, by means of Sir W. R. Hamilton's formula, and for the sake of uniformity has included series 1. The results agree perfectly with observation, *except in the most highly dispersive cases.* But here it is found that if *an empirical change be allowed in one of the constants* for each medium, a sufficiently close accordance is obtained.

Prof. Powell also communicated a paper on the *refraction of heat*, and one on *certain points of the Wave Theory of Light.*

Prof. Whewell gave an abstract of a *Report on the present state of our theoretical and experimental knowledge of the laws of Conduction of Heat*, by Prof. Kelland.—The problem, in the solution of which consists the mathematical theory of heat, is the following:—Having given the state of heating, or the variation of that state from time to time, at one or more points of a homogeneous body of given form and dimensions, to find the permanent or variable temperature at every other point. Thus a ring is kept at a certain temperature at one point, and it is proposed to discover: 1. What is the variation from time to time of the temperature at every other point. 2. What is the ultimate temperature to which that at any given point approaches, as the time during which the constant heating of one point has been kept up, is increased. From this statement it will appear that the experimental facts on which the theory must rest, are the answers to the following questions. 1. According to what law does a heated body lose its temperature to the air, or other medium or space, by which it is surrounded? 2. According to what law is the temperature transmitted from point to point of a body? On the correctness of the answers which may be assumed as given to these questions, depends the applicability of the results obtained to the state of things in nature. The Report then proceeded to show what answers have been given to the above questions by different theorists, and to explain the evidence on which their truth was supposed to be established.

*On the temperature of the Air in York Minster*, by Prof. Phillips. It may be remarked that the vastness and loftiness of the interior of York Minster renders the air within it, in a great degree, free from violent local draughts, and yet subject to a continual gentle circulation. While the observations were taken, (1808–1811,) the building was not heated, and the lights used were a few scattered tapers. It appears, that from nearly the end of March to nearly the end of August, the air within the Minster was colder than the mean temperature of the air without; and from nearly the end of August to nearly the end of March, it was warmer. Dr. Robinson remarked, that by a slight modification, these observations might be made subservient to the purpose of determining the rate at which the several strata of air as you ascend, alter their temperatures as the conditions upon which their equilibrium depend, is varied; which determination would have an important bearing on the subject of atmospheric refractions.

Prof. Lloyd communicated a paper containing the *Results of some investigations on the phenomena of thin plates in Polarized Light.*

Prof. Wartmann, of Lausanne, read a paper on what he calls, *Daltonism.* One of the most extraordinary affections to which the eye is subject, is an incomplete vision of colors, which has been called *Daltonism*, after the celebrated Professor, who was the first to describe it in an exact manner. He then laid before the meeting, an extract from a more extended work, containing in substance, the following observations. The Daltonians form two classes;—that of the *dichromatics*, who discern only two colors, generally black and white, and who appear endowed with a remarkable faculty of vision in a state of darkness: and that of the *polychromatics*, who have the definite perception of at least three colors. Daltonism is not always hereditary; it does not, even, always date from birth. Decided colors appear black to many Daltonians, if they be not illuminated by a very brilliant light. The number of colors of which the polychromatic Daltonians are sensitive, is not constant; some only see three, others four, among which blue and red may be expressly mentioned. The extremes of red and violet are often not distinct; a fact which the Professor thought to have a connection with the question of the number of elementary colors. The degree of polish of the colored surface has an influence on the appreciation of colors. Some Daltonians have an equal cognizance of the brightness and the discoloration of *supplementary* tints, which we do not recognize as such. Two colors appear to us blended by a succession of intermediate tints, which the Daltonians see in contrast. The Daltonians see exactly as we do, the mixed rays discovered in the spectrum by Fraunhofer, at least in all that portion which appears to them illuminated.

Prof. Whewell, after mentioning some cases of persons affected with this peculiarity, remarked that he doubted the propriety of the name now given to this defect: few persons would desire to be immortalized through the medium of their defects; and Dalton, least of all, requires such a means of handing down his name to posterity.

Mr. Dent presented a paper on the *preservation of steel chronometer balance springs*, by forming upon them a thin coat of pure gold, by means of the electrotype process. Prof. Christie read a paper on the preservation of *magnetic needles and bars from oxidation*, by the same process.

On the *relation of Sturm's Auxiliary Functions to the Roots of an Algebraic Equation, by Prof. Sylvester.* The author wished to bring to the more general notice of mathematicians, his discovery of the real nature and condition of the auxiliary functions, so called, which Sturm makes use of in *locating* the roots of an equation: these are obtained by proceeding with the left hand side of the equation, and its first differential co-efficient, as if it were our object to obtain their greatest common factor; the successive remainders, with their signs *alternately* changed and preserved, constitute the functions in question. Each of these may be put under the form of a fraction, the denominator of which is a perfect square, or in fact the product of many; likewise the numerator contains a huge heap of fractions of a similar form. These, therefore, as well as the denominator, since they cannot influence the series of *signs*, may be rejected; and furthermore, we may, if we please, again make every other function, beginning from the last but one, change its sign, if we consent to use changes, wherever Sturm speaks of calculations of sign, and *vice versa*. The functions of Sturm thus modified and purged of irrelevancy, the author, by way of distinction, and still to attribute honor where it is really most due, proposes to call "Sturm's Determinators," and proceeded to lay bare the internal anatomy of these remarkable forms.

Prof. Moseley gave an account and drawing of a *machine for calculating the numerical values of Definite Integrals.* The object of the machine is to apply to the numerical calculation of definite integrals, a principle first suggested by M. Poncelet for the registration of dynamometrical admeasurements, which has been applied by M. Morin to an instrument called the *Compteur*, for registering the traction of loaded carriages upon common roads, and during the last year, by a committee of the Association, to a permanent registration of the work of the steam upon the piston of a steam engine.

*On determining distances by the aid of the Telescope, by Mr. Bowman.* The principle of this method was to observe the number of divisions of a graduated staff placed at a distance; and considerable ingenuity is shown in determining the distance by making the necessary corrections on this observed number. The author thinks his method would be more accurate in surveying than the actual measurement by the chain, particularly in uneven ground; and asserts that the error in taking any distance could not exceed the thousandth part of the entire distance; hence, by dividing the entire distance, even when large, into a number of parts, he conceives that great precision would be attained.

Sir J. Herschel transmitted fifteen specimens of *colored photographic copies of engravings* and mezzotintos, into the preparation of which no metallic ingredient enters, the whole being tinted with substances of vegetable origin variously prepared. The rays of the spectrum which have eaten away the lights in these photographs, are neither the so-called chemical rays beyond the violet, nor the calorific rays beyond the red. The action is confined almost entirely to *the luminous rays*, and of these more especially to those rays of the spectrum whose union forms a color supplementary to that of the ground-tint; a circumstance, which, considering the great command of color which this new variety of the photographic art affords, holds out no slight hope of a solution of the problem of a photographic representation of natural objects in their proper colors.

(*To be concluded in the next number.*)

ART. XIX.—*On the Removal of Carbonic Acid Gas from Wells, &c., and Spontaneous Combustion in Wood Ashes;* by OLIVER P. HUBBARD, M. D., Prof. of Chem., Min. and Geol. in Dartmouth College.

*Combustibility of Wood Ashes;* by Dr. JOHN T. PLUMMER, of Richmond, Indiana.

THE following verbal statement I received from Dr. S. E. Hale, a graduate of the Medical School of Dartmouth College. While a student at Burlington, Vt., a deep well in the yard of the stable connected with the hotel was to be cleaned. A man was about to descend for this purpose, but, at the suggestion of Mr. Hale, waited till he could test the well for carbonic acid gas. A lighted candle was adjusted, and on lowering it with a cord, it was extinguished at *the very mouth* of the well. He then applied the remedy, *ignited charcoal*, as recommended by me in this Journal, (Vol. XXXVIII, p. 206,) and entirely removed the gas, so that the candle burned clearly in every part above the water, which was some twenty or more feet from the surface of the ground; and the man descended with impunity and accomplished his object. This well was situated at nearly the lowest part of the yard, and in the vicinity of abundant sources of carbonic acid from the decomposition of animal manures, and may be a constant reservoir for the accumulation of the gas. Though this be a strong case, yet in all cases the successful use of the charcoal once should not prevent its repeated application, even at short intervals, if occasion required.

1. *Spontaneous Combustion in Wood Ashes.*—In September, 1840, my attention was called by a soap-boiler, who was removing ashes from a brick arch in my cellar, to a remarkable phenomenon he had just observed in the ashes in his cart he had last brought out. I applied my hand to a spot as directed, and found the *heat so great* I could hold it there but a moment at a time; and on examination of the ashes in the arch from which these last had been taken, I found the same heat limited to a small area in the centre of the bottom, which was now covered by a small quantity of ashes remaining, from twelve to fourteen bushels. The ashes formed a heap two feet thick on an area of about four feet by two feet. They were made of *maple* wood alone, burned in close stoves, and were very heavy, and the

heat was found in no other portion of them. Those at the bottom were at least *one year old*, and my family having been absent during the summer, none had been added, excepting a very small quantity on the surface a few days previous, for more than three months.

The burning of boxes and casks in which ashes are very commonly kept, is usually, perhaps generally with truth, attributed to the burning coals taken up with the ashes. Suspecting this cause, I searched thoroughly for ignited coals among the heated ashes in the cart and also in the arch, and found no vestige of coals in any state. It is not probable that any small quantity of ashes removed at one time from the stoves, even if hot and mingled with live coals, and added to a heap on its surface as usual, should have retained its heat till covered by succeeding additions, and this heat have remained so pent up for a year, and not rather have been conducted to the whole mass, and thus entirely dissipated. Besides, the combustion of the wood in my stoves is very complete—the coals are consumed, and the ashes are commonly removed before making the fire in the morning, and at considerable intervals; so that, though I made no examination, it seems there could have been but an extremely small portion of combustible vegetable matter remaining unconsumed. The floor of the arch and cellar is sand, and unusually dry; there is nothing peculiar in the circumstances of the arch, and I cannot but attribute the occurrence to an unknown cause, which in time would have resulted, as in the following instance, in

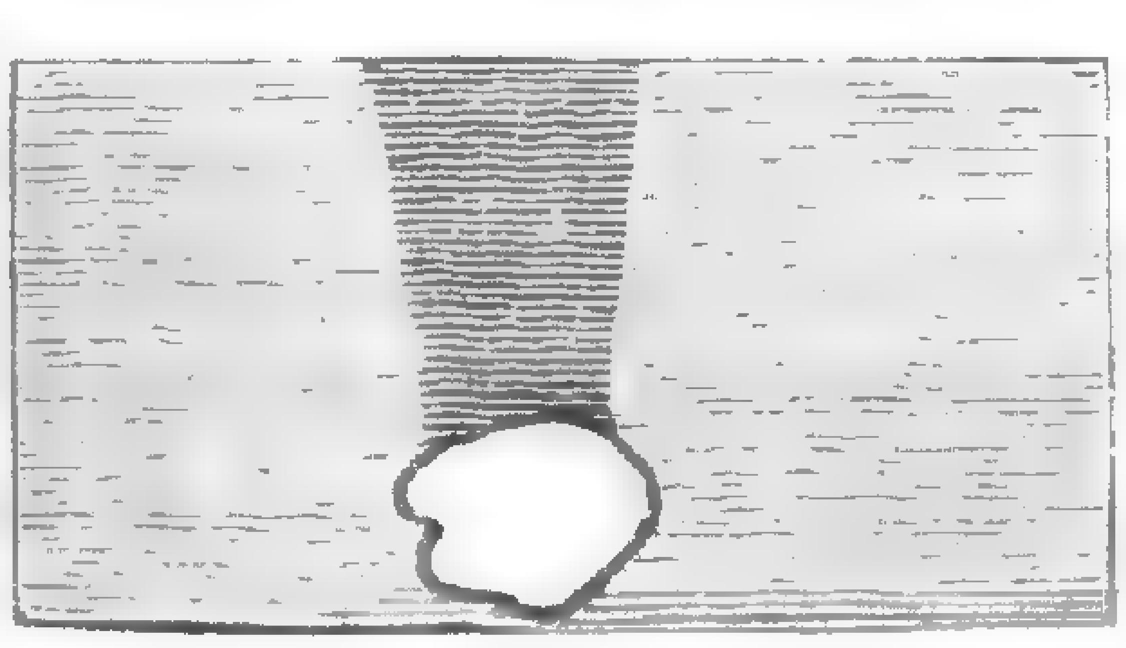
2. *Spontaneous Combustion.*—This instance came under the immediate observation of Rev. President Lord, of Dartmouth College, a few years since. He noticed for two or three days, throughout his house, that well known and peculiar odor of hot or ignited ashes, unaccompanied by smoke or the odor of burning wood. After repeated and unsuccessful examinations had been made for the cause, attention was finally drawn to the ashes in a corner of the cellar, which were found in a state of complete ignition. On being stirred with a stick, the fire, it was found, pervaded the whole mass, some twenty five bushels, and it was extinguished by an abundance of water. This heap had been accumulated during the two years previous. They lay upon the bottom of the cellar, which was moist, and surrounded on three sides with brick; nothing intervened between them and the floor above, and there seemed great reason to fear the house

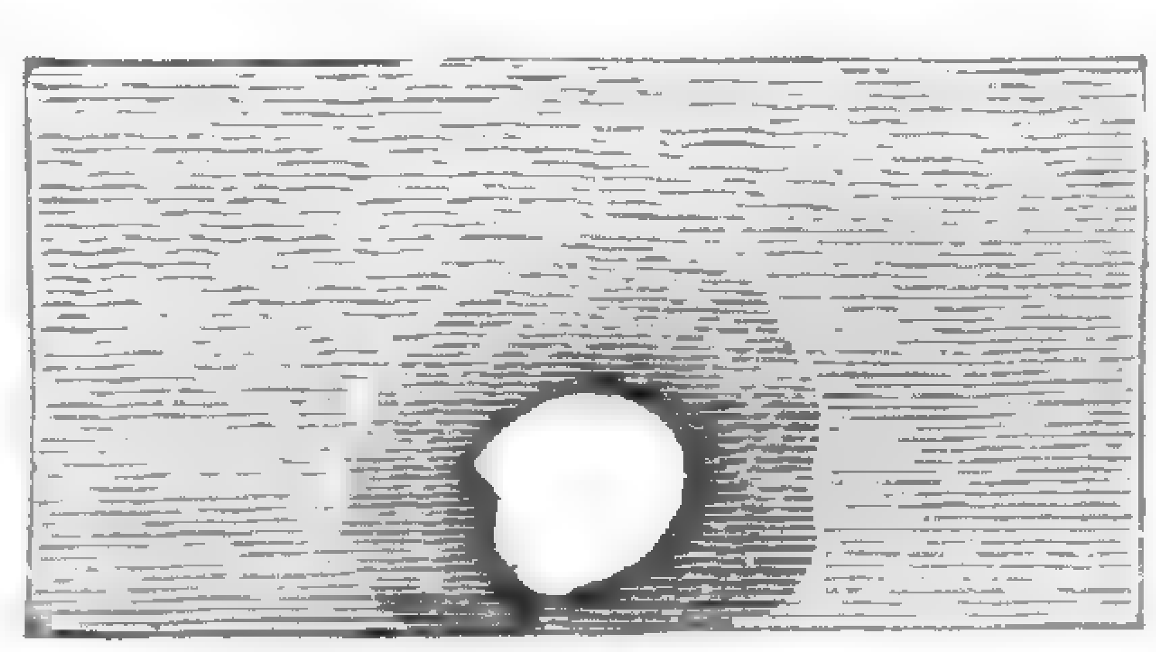
would have been burned but for this timely discovery. If ashes are liable to such spontaneous ignition, and there is nothing in these cases known that is peculiar, it suggests the propriety of arching all receptacles for them if in a cellar, and the necessity of keeping them *always* in receptacles constructed of incombustible materials. It is hoped that similar occurrences will be recorded for the more clear elucidation of this obscure subject.

The editors have received a notice of two similar occurrences, in a letter from Dr. John T. Plummer, Richmond, Indiana.

3. *Combustibility of Wood Ashes.*—Several years ago, a large wooden box, standing in an old frame building, back of my dwelling house, and containing ashes, was discovered to be on fire. Before the fire was extinguished, a hole ten or twelve inches in diameter had been burned through one side of the box, and the flames had seized the building. On strict inquiry of the family that then lived in my house, I was assured by every individual with one accord, that no ashes had been emptied into the box for at least two weeks; the box having been filled for that length of time, the ashes had been thrown elsewhere. I could not doubt the veracity of my tenants, and therefore was led to attribute the phenomenon to an incendiary act, to some chemical change in the contents of the box, or to hot ashes thrown in and the fact being forgotten by the members of the family.

To satisfy myself respecting the origin of the fire, I emptied the box, and was at once convinced that the combustion had commenced *within* it. The hole burned through the side of it, was near the bottom, and widened inward like a funnel, presenting some resemblance to the holes in the shelf of a pneumatic cistern. The outside of the box was charred where the flames passed up.


Outside view.


Inside view.

The inquiry having been conducted thus far, I was induced to reflect whether an ignited coal could remain buried in ashes to the depth of two feet, in a state of inaction for a fortnight. If this were possible, why should it ultimately become such a source of danger, while the box and its contents continued undisturbed? With this inquiry in my mind, I made a memorandum of the event in my common-place book, and left the subject for future reflection and research. Years passed, and the memorandum frequently met my eye as I occasionally turned over the leaves of my manuscripts; but it did not obtain any particular attention.

4. A few months ago, however, I had cause to congratulate myself for having made a careful record of the phenomenon referred to. Our domestic informed me, perhaps two months since, that the ash-box, (a transverse section of the trunk of a very large sycamore,) had "burnt through near the bottom." The former occurrence of the same kind, presented itself vividly to mind, and I eagerly repaired to the late scene of combustion to pursue my original inquiry, believing the cause, whatever it might be, to be the same in both instances. The domestic had poured a large quantity of water upon the ashes in the morning when she detected the fire, and she supposed every spark had been extinguished. I found, however, that the ashes were now, in the evening, insupportably hot; and by means of a spade, I ascertained that the heat extended throughout the mass; the blade when drawn out, hissed when spit upon. I thoroughly drenched the ashes, and then sat down to reflect upon the phenomenon.

It soon occurred to me, as highly probable, that ashes, when taken from the fire-place, contain a considerable quantity of carbonaceous matter in a state of minute division; that ignition of these particles might exist without being apparent to the eye; that this ignition might be communicated very slowly to the carbonaceous powder in surrounding cold or extinguished ashes, and thus fire be conducted gradually to large coals, and to the wooden vessel containing the ashes.

To determine the correctness of my conjecture, I sifted through the finest Chinese sieve I could procure, some ashes which had been taken from the fire-place the day before, and weighing 642 grs. subjected them to heat in a Hessian crucible. In a short time the crucible became red hot; but *no redness was visible in the ashes.* At this stage of the process, I thrust a beech splinter into the ashes, (being careful not to touch the crucible,) and *it immediately took fire.* After allowing the crucible to cool, I weighed the contents, and found they *had lost* 12 grs. The quantity of comminuted carbon no doubt varies in different parcels of ashes; it is sufficient, if it exists in ignitible quantities, and the particles are in ignitible proximity. It must be remembered, that we should add to this fine combustible matter the large coals and coarse powder separated by the sieve.

It may be proper to add, that the wood we consume, is principally beech, sugar tree, and hickory.

Thus it appears:

1. That wood ashes contain a considerable quantity of finely divided coal.

2. That the ashes may be sufficiently hot to ignite this coal, without themselves being at red heat.

3. That the progress of this ignition is slow; and the combustion may extend throughout a large mass of ashes, without warning, until it reach some inflammable material.

I have assumed as true, for I suppose it will scarcely be denied, that the loss in the contents of the crucible, was owing to the consumption of carbon.*

If my deductions from this humble, but I hope useful research, are correct, it is not safe to deposit hot ashes even in the middle of the largest bulk of cold ashes; for although the fresh ashes may not rest against wood, and may appear securely remote from it, yet it is surrounded by and reposes upon combustible materials, which may, as in these two instances, conduct the invisible fire to inflammable bodies around, and box and buildings be involved in sheets of flame. JOHN. T. PLUMMER.

June 12th, 1841.

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## ART. XX.—*On the use of Hot Blast in the Smelting of Lead.*

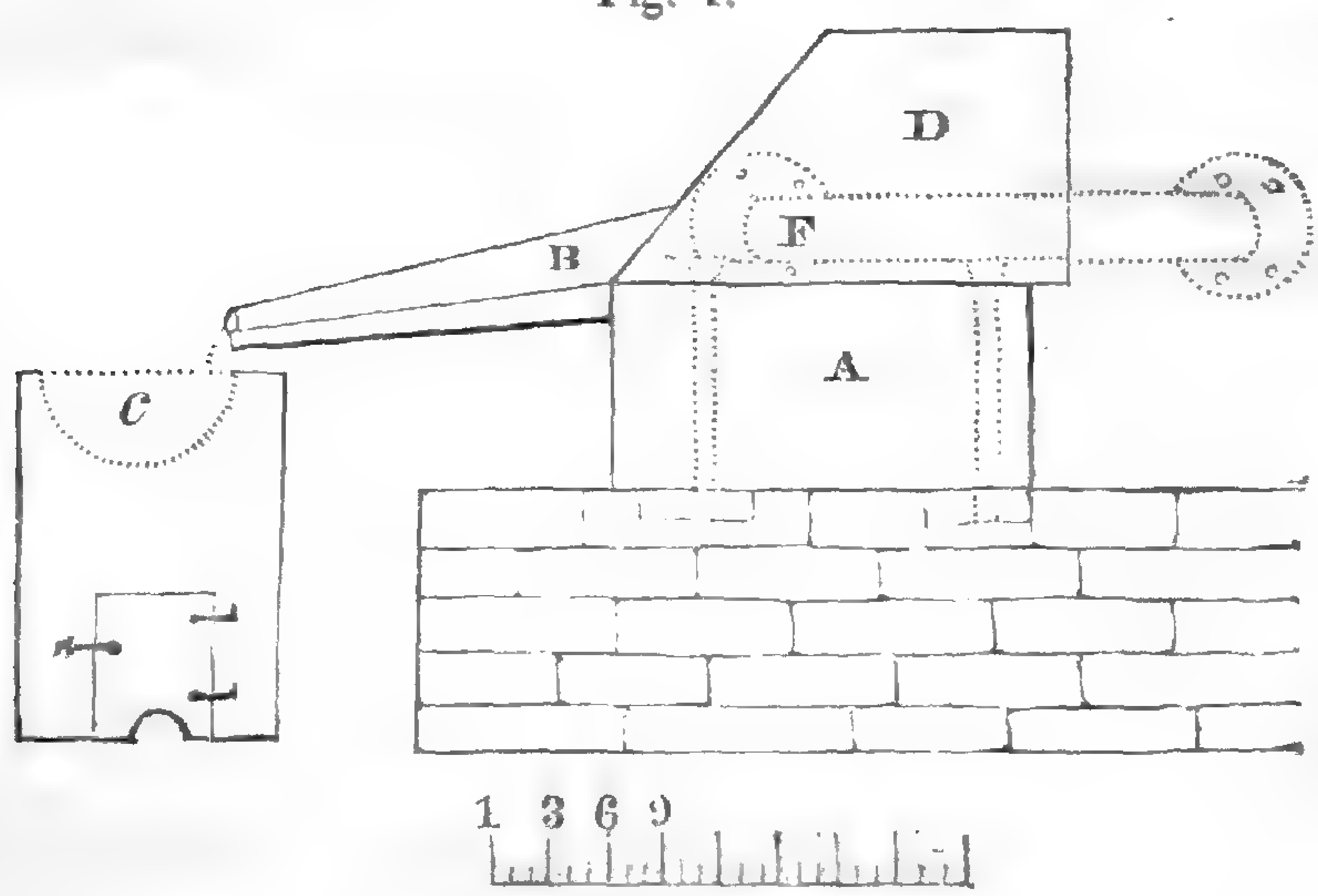
THE reduction of lead ore is effected in a great variety of furnaces, many of them primitive and simple; others requiring great expense in erection, and much practical experience in the management. Yet these latter often give no better results than the original 'log furnaces' of our western pioneers. The great saving of labor and certainty of product effected by the furnace described below, induces the preparation of this article for publication.

* Dr. Plummer does not state whether the ashes employed in his trial, were heated to expel hygrometric moisture before weighing, which seems essential to the accuracy of the results.—*Eds.*

Should the writer be able to repay thereby a moiety of debt which is constantly accruing against him by the scientific labors of others, as published in your Journal, he will be much gratified.

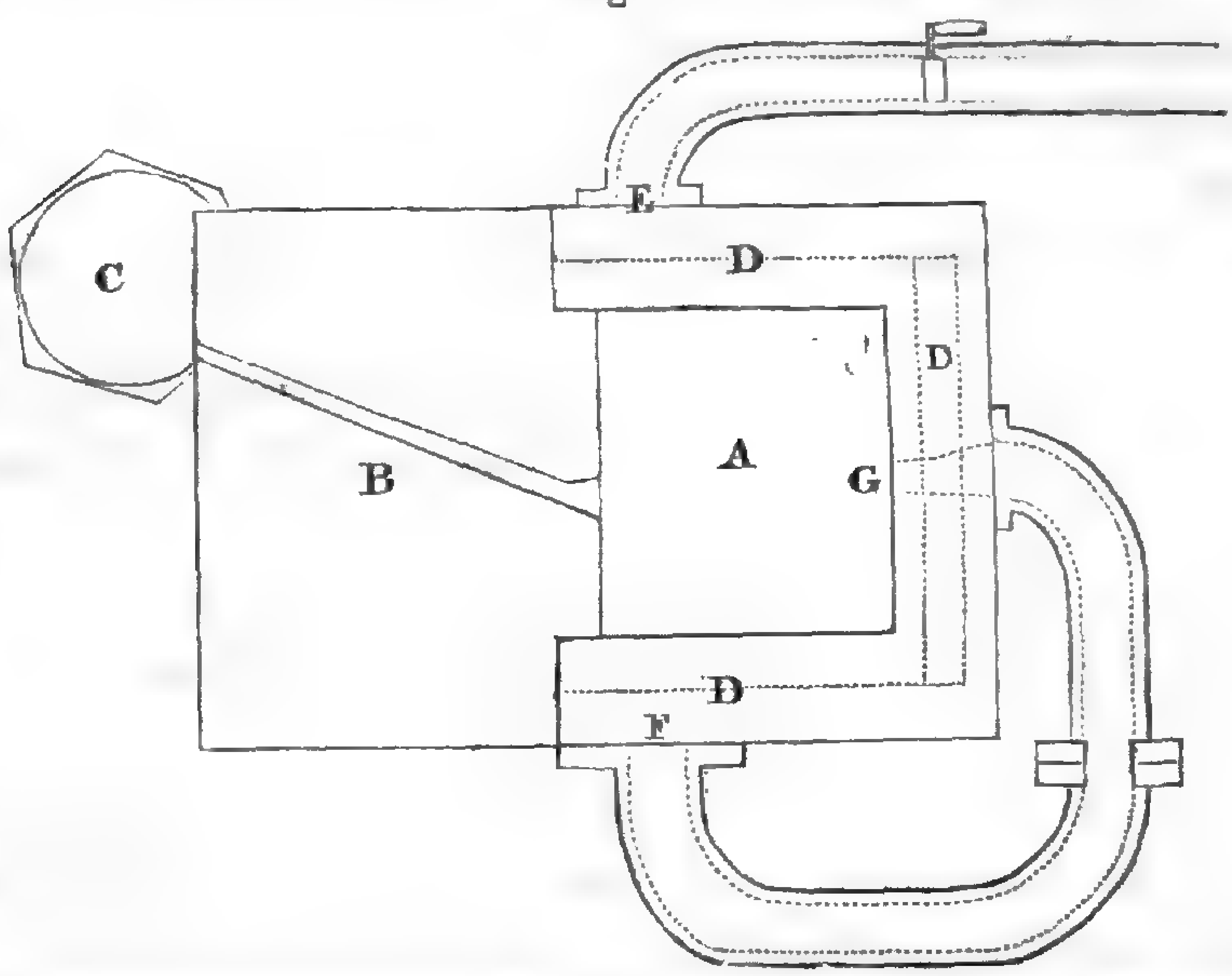
To reduce the sulphuret of lead, merely requires that the sulphur should be disposed of by combustion; hence a process so simple is *partially* effected by the most simple means. Yet it can only continue successful, when the heat is not so high as to fuse the galena, and when all parts of the ore undergoing the process, are well supplied with atmospheric air to effect this combustion. If the blast be heated and made to diffuse itself equally through the whole 'charge,' carrying with it the flame of light fuel, pine or other light wood leaving but little coal, the reduction of the ore is effected with an economy and dispatch, hitherto unknown in the processes of reducing this metal. The following is a description of the hot blast furnace, used at Rossie in the state of New York. The form of the furnace is not new.

Fig. 1.




A (fig. 1,) is a cast iron reservoir twenty four inches square and twelve inches deep, the iron of the sides and bottom is two inches thick; to this is attached the hearth B, with flanges projecting at the sides, the whole twenty two inches in length, and including the flanges thirty two inches wide. The hearth descends about one inch in twelve, and has a groove for the melted lead to discharge into the reservoir C, in which it is kept fused by a small fire under it. D, is a cast iron air-chest, making an iron wall fourteen inches high, above the sides of the reservoir. It is six inches thick outside; the iron being about three fourths of an inch thick, leaves the inside space about four and a half inches by twelve and a half. The blast passes into this chest by a pipe at E and out at F, whence by a curved pipe it is discharged into the fire through a 'twyer' cast in the air-chest at G, two inches above the level of the lead reservoir.

Fig. 2.




The lead reservoir A (fig. 2,) is filled with metallic lead, which in the process of smelting continues in a state of fusion, and while the furnace is used is not withdrawn. The 'charge' in the process of smelting, floats upon the melted lead, and the metal as smelted falls into it, flows over and discharges through the groove in the hearth. In working the furnace, the smelter throws immediately in front of the blast, two or three billets of light wood, say two inches in diameter and sixteen inches long, upon which are thrown up the 'charge' in process, and fresh galena, filling the furnace near even with the top of the air-chest and sloping down to the hearth. The blast being let on, strikes upon the billets of wood and is thus diffused evenly through the whole charge, carrying with it the flame of the fuel.

It will be perceived that the air passing into the hollow chest, acts as a refrigerator upon the inner walls, and thereby prevents their being heated so high as to combine with the sulphur, by which they would soon be destroyed; and also by preventing an accumulation of heat in the walls, keeps the furnace of a uniform temperature, which if not thus moderated would soon run so high as to fuse the galena and thus check the smelting.

The air by thus passing through the hollow chest, becomes heated, and being thrown in this state through the mass of burning sulphuret, reduces it in a great measure, by the combustion of its own fuel, the sulphur, the quantity of wood consumed being less than one fourth of a cord for the product of 2000 lbs. pig lead. The fuel used is wood only, and that of the lightest kind; coal or other *concentrated* fuel gives a heat too intense near the blast, and reduces the product in a given time, from one third to one half.

In operating the furnace, it is necessary to charge it about once in ten minutes, which is done by drawing the 'charge' forward upon the hearth, (the blast having been previously shut off by a valve, to protect the smelters,) billets of wood are thrown in, in front of the 'twyer,' and the charge thrown back with the requisite quantity of fresh mineral, when the blast is again let on. The furnaces continue to run thus, without intermission, night and day for six days in the week.

The economy and efficiency of this furnace will be understood from the following facts. In smelting about 5,000,000 lbs. of lead at the Rossie smelting works, the average product at each furnace was about 7,500 lbs. for each day of twenty four hours. Number of men employed, two at a time, four in all at each furnace. Amount of wood consumed, three fourths of a cord per day. The cost of *mere smelting*, not reckoning use of works, cost of creating blast or superintendence, was as follows:

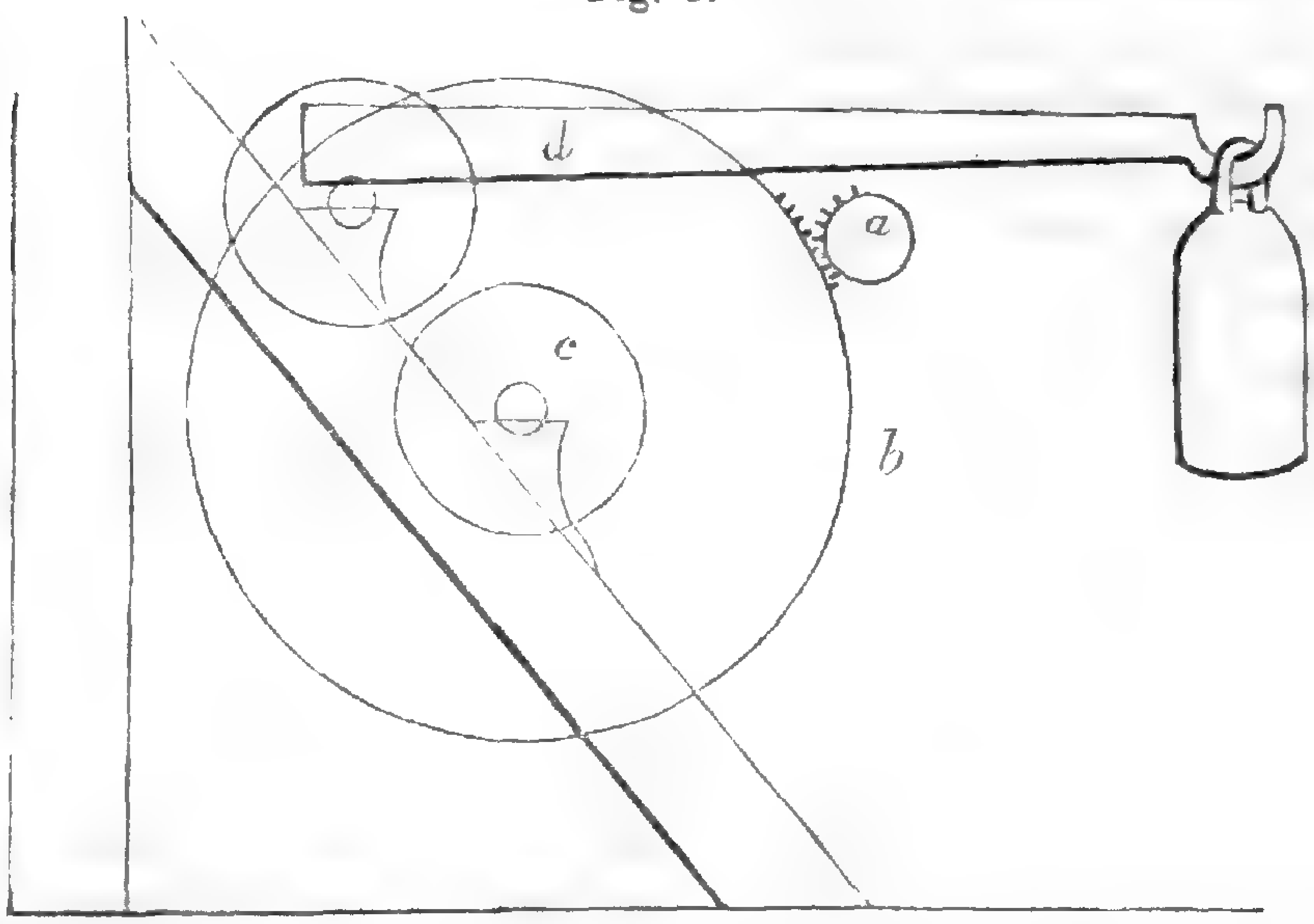
| | |
|---|---|
| Two smelters at $1,50 per day, . . | $3,00 |
| Two assistant do. 1,00 " . . | 2,00 |
| Three fourths cord prepared wood, at $2,00, | 1,50 |
| | $6,50 |

for a product of 7,500 lbs. or about $1,75 per ton.

*Preparation of the ore.*—Where saving of labor is so great an object as it is in this country, it may not be uninteresting to describe the method and machinery used for preparing the ore at Rossie. The smelting works are situated at a water power upon Indian River, at a convenient distance from the mines. The ore in the mines lies in a matrix of calc spar, through which it is scattered in crystals of all sizes and proportions, from galena with a small per cent. of gangue, to gangue with a very small per cent. of galena, so that a large proportion of the diggings require to be crushed and washed in order to procure the whole product of the mines.

Fig. 3 is a crusher of cast iron. Into this the ore and gangue is thrown, and reduced so that none of it is larger than half inch cubes, and as little of it crushed very fine, as possible.

Fig. 3.




*Single crusher used at Rossie.*—*a*, driving pinion. *b*, wheel attached to lower crusher *c*. *d*, upper crusher, filled with lead and weighed down by lever *d*. Whole pressure of the crusher, say 4000 lbs.

Fig. 4.

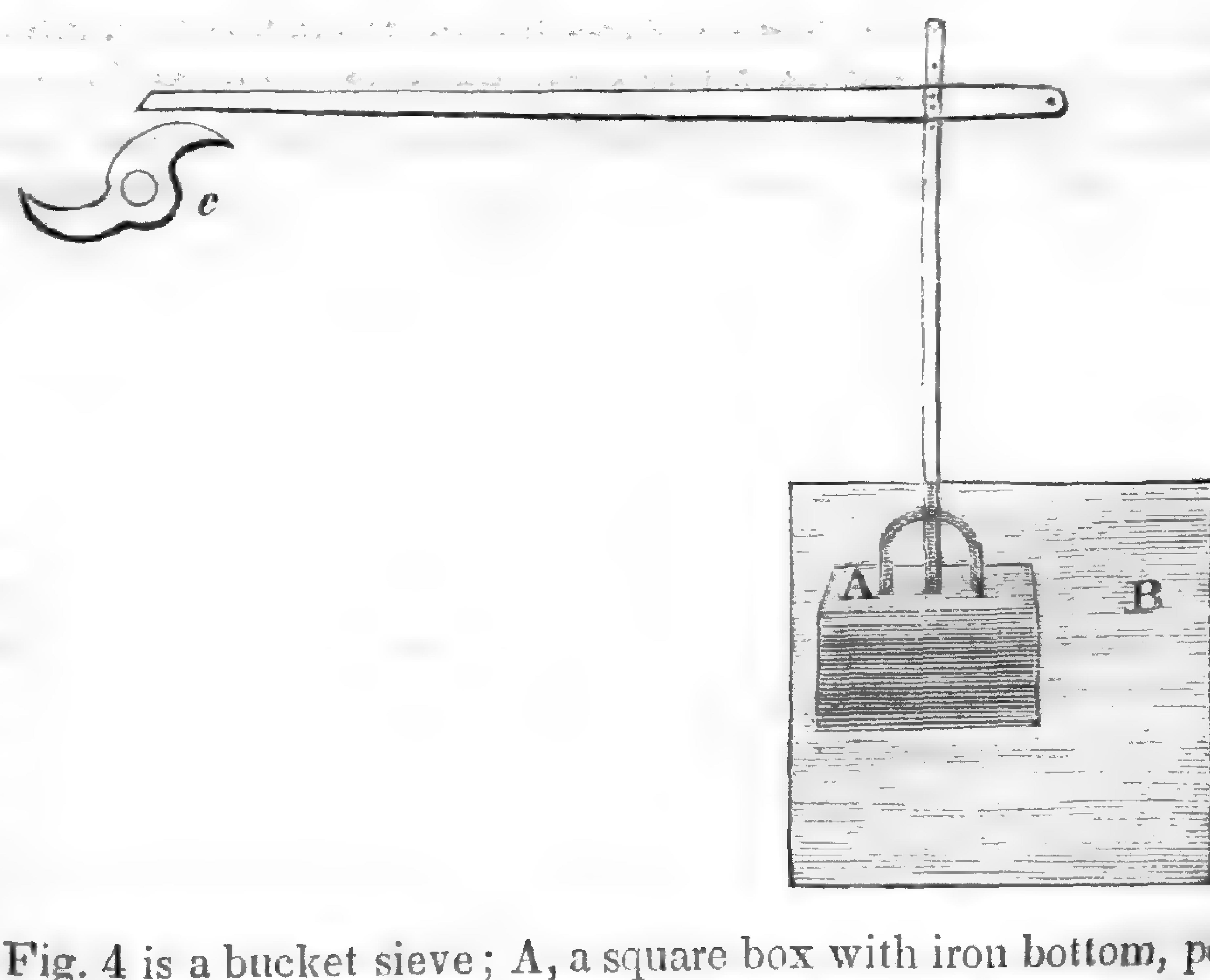



Fig. 4 is a bucket sieve; A, a square box with iron bottom, perforated with small holes, suspended in the vat of water, B, in which it is agitated by cam C. The diggings from the crusher being thrown into this sieve and the lever let into the cam, the contents of the sieve immediately arrange themselves in strata according to their relative gravities; first, clean gangue on the surface, next, 'middlings,' being spar with particles of ore attached, (these are thrown back to be recrushed,) next, lead ore, the surface of which has more or less gangue adhering, the lower strata nearly pure. The ore as smelted, contains from five to ten per cent. of calc spar adhering and scattered through it. The mineral which passes through the sieve is taken from the vat and washed in a stream of water upon an inclined table, both so graduated that the ore remains near the stream and the impurities may be carried off.

*The Rossie Lead Mines.*—Of the bubbles of '36 and '37, perhaps none was more *unmercifully* inflated than that of the Rossie lead stock. It is unfortunate for the mining interest in that very interesting and promising region, that this remarkable mine should have become by a ten years' lease the property of a company, and thus made at once the victim of speculation. In taking out the ore for the first one hundred feet in depth, little expense was necessary, and the product and profits were large. At the depth now attained, say from one hundred and seventy five to two hundred feet, permanent and adequate machinery and good engineering are required, having reference to working the mine for a long series of years. The investments necessary for this can hardly be looked for until the fee of the land and the rights to the mine are owned by the same person or company. The amount of lead smelted from these mines in 1837 and 1838, was 4,137,871 lbs.; in 1839, about 1,200,000 lbs.; in 1840, about 400,000 lbs.

The primitive rock, (hornblende gneiss,) in which this mine lies, has but few fissures through which water is discharged, and hence is easily kept free. It is already wrought one hundred feet below Indian River, which flows some eighty rods distant. Whatever may be the difficulties of the present unfortunate tenure of this valuable mine, there is little doubt that it will eventually be efficiently wrought and yield a uniform and adequate return. The vein descends perpendicularly; the quantity of ore in a given space holds about the same, and in all probability is inexhaustible.

## Art. XXI.—*On the Solar Eclipse of July 8th,* 1842.

A total eclipse of the sun at any particular place is so unfrequent, that only a small part of the inhabitants of the earth ever has an opportunity of beholding this, the most sublime of celestial phenomena. In April, 1715, the sun was totally eclipsed in London, and in May, 1724, in Paris; but from those years to 1900, or during nearly two centuries, the shadow of the moon neither has, or will pass over either of those cities. Nor have we been in this respect, more fortunate. A total eclipse took place in Massachusetts and the central part of New York on June 16th, 1806; another occurred in part of South Carolina and Georgia on Nov. 30th, 1834; the third, during this century, will be total in part of North Carolina, and will happen on Aug. 7th, 1869; the fourth, on May 27th, 1900, will be total in part of Virginia; and as the *average* width or diameter of the moon's shadow on the earth, may be considered about one hundred miles, it is evident that during the nineteenth century, not more than one quarter of our territory between Maine and Florida, will see a total eclipse. Strictly speaking, the darkness during a total eclipse, is not as has been supposed, nearly or quite total; since the moment the moon completely obscures the sun, she appears to be surrounded by a mild but beautiful effulgence, which though not too brilliant to be beheld by the naked eye, sheds sufficient light to render objects distinctly visible. At Boston, in 1806, it is said, about as much light remained, during the total obscuration, as is given by the moon when full, and in Beaufort, S. C., Nov. 30, 1834, only two planets and four stars of the first magnitude were seen, though one of them, Antares, was then only six degrees from the sun. But, although nearly twenty eight years will elapse before the next passage of the moon's shadow over the United States, on the eighth of next July, in a considerable portion of continental Europe, the sun will be totally eclipsed. That this phenomenon will be observed with interest by those of our countrymen, favorably situated, cannot be doubted, and it is therefore hoped that the following results, deduced from a long and careful computation, may be useful to those readers of the Journal, who may wish to behold the complete obscuration of the sun, and who are in doubt whither to proceed. On this occasion the centre of the shadow will first touch the earth at sunrise, at a point in the Atlantic Ocean situated in lat. 37° N., long. 10° W. from Greenwich, or two degrees west of Portugal; it thence passes across the southern part of that kingdom, diagonally across Spain, the south of France, Sardinia, Lombardy, Austria, the north of Hungary, Austrian Galicia, the south of European Russia, the southwest of Russia in Asia, the Chinese Empire and part of the North Pacific, to a point in lat. 15° N., long. 148° E., where it will leave the earth at sunset, three hours and five minutes after it first touched it, on the coast of Portugal, and after describing a circuit of about ten thousand miles. The width of the shadow will, as usual, vary somewhat in its passage across the earth, but in Italy and Germany, it will be a little more than one hundred geographical miles, so that if the path of the centre be carefully marked on a good map, and other lines be drawn parallel thereto, to the north and to the south, at the distance of about fifty miles therefrom, the places at which the eclipse will be total, will be easily ascertained, unless situated like Venice, just within, or like Ofen, just without, the limit of the shadow, about which there is some doubt, in consequence of a possible difference between the tabular and observed latitude of the moon. In this manner it will be seen, that in addition to the places herein after enumerated, the eclipse will probably be total at St. Ubes, Evora, and Elvas in Portugal; at Badajos, Truxillo, Toledo, Urgel and Gerona in Spain; at Perpignan, Carcassone, Montpelier, Avignon, Nismes and Toulon in France; at Alessandria, Asti, Cremona, Lodi, Mantua, Parma, Placenza, Saluzzo, Savona and Tortona in Italy; at Brixen, Bruck, Clagenfurth, Judenburgh, Marburg, Trent and Villach in Austria; at Orel, Penza and Tambow in Russia; and that the shadow will pass near the city of Nankin and the island of Chusan, in China.

As the approaching eclipse will excite great interest throughout Europe, and especially in those places where it will be total, it is earnestly hoped that particular attention will be paid by those favorably situated, and in possession of suitable instruments, to the determination of the correctness of a recent suggestion, that the irregularities so frequently noticed at the second and third contacts of nearly central eclipses, and at all the contacts of the transits of Venus, may be seen or not at the pleasure of the observer, according as the color of the dark glass, he applies to his telescope, is red or green. These irregularities, as seen by many, have been minutely described by Francis Baily, Esq. of London, in an article in the tenth volume of the Memoirs of the Astronomical Society, although it particularly relates to the appearances, observed by himself, in the south part of Scotland, during the eclipse of May 15th, 1836, which was annular there. Many of the appearances described by Mr. Baily, were seen through a *red* glass at the second and third contacts of the eclipse of Feb. 12th, 1831, which was annular in the southeastern part of this State. Shortly afterwards, however, it having been ascertained that a double screen, composed of one light red and one light green glass, would not only render the light of the sun very pleasant to the eye, but would far better define the limbs, and would sometimes even enable me to see a small spot, that was invisible through the dark red alone, a screen of that kind was adapted to the telescope, and was used for the partial eclipses of 1832 and 1836, and those that were central in 1834 and 1838. Through this screen no one of the irregularities described by Mr. Baily, has ever been perceived, although carefully looked for. Indeed so remarkable was the difference between the observed and expected appearances of the sun's limbs at the second and third contacts at Beaufort, S. C. on Nov. 30th, 1834, that even then, a suspicion was excited that the entire absence of all distortion or irregularity in the cusps, just before and after the total obscuration, was to be attributed to the color of the screen; especially since other observers in the vicinity of Beaufort saw through red screens, many or most of the usual phenomena. This suspicion was strengthened by the observations on the large but not central eclipse of May, 1836; it was therefore communicated to several of our astronomers, who paid particular attention to it, at the formation and rupture of the ring on Sept. 18th, 1838. In Philadelphia and its vicinity there were many observers, provided with telescopes of nearly equal optical capacity, but protected by screens of different colors. The result appears to be, that in every, or nearly every instance in which the red glass was used, many or all of the usual irregularities were seen, whilst those observers who used yellow or green screens, saw these appearances either greatly modified or not at all. At Princeton, near the northern boundary of the ring, two skilful astronomers, provided with 3½ feet telescopes by Dollond and Fraunhofer, were enabled distinctly to see some of these appearances through the red eye-piece of the former, though none was visible through the green screen of the latter instrument. At Washington, where the eclipse was nearly central, no distortion of the limb of the moon could be seen through the double screen above mentioned, and the cusps of the sun just before and after the ring, were as pointed as needles. The Committee of the Philosophical Society of Philadelphia, in their report on this eclipse, say, "This suggestion is one of great importance, as it seems to furnish evidence of the existence of a lunar atmosphere, through which, as through our own, the red rays have the greatest penetrative power. It also leads to new views concerning the cause of the remarkable appearances of the beads of light and the dark lines frequently noticed; since it shows that their appearance may be completely modified by a change in the color, and consequently in the absorbing power of the screen glass through which they are observed." It is believed that on another account will this suggestion if well founded be of great importance, viz. in its obvious tendency to diminish if not wholly remove, the discordancies not unfrequently found in the best observations on solar eclipses and transits of Venus, and which with regard to the latter in 1761 and 1769, were so great as materially to diminish the value of this method of determining the distance between the earth and the sun.

The elements of the eclipse were computed from the lunar tables, both of Burckhardt and Damoiseau, and as they appeared to differ in their results by about 13″ of longitude, the mean or average of the results was adopted, which it is hoped will be found more conformable to observation. As these tables are adapted to the meridian of Paris, the time of that meridian has been retained, but the longitudes of the places are counted from Greenwich, which is 2° 20′ 23″ west of the former. The ellipticity was considered $\frac{1}{305}$th. But no correction was applied for irradiation and inflection, which if allowed would cause the eclipse at each place to begin about ten seconds later, and to end about eleven seconds earlier than the time herein after stated. The latitudes and longitudes of the several places, were with a few exceptions, taken from the English and French Nautical Almanacs.

*Path of the Centre* of the Moon's Shadow over the Earth, during the Total Eclipse of the Sun of July 7th, (July 8th, Civil Time,) 1842, Mean Astronomical Time.*

| Eclipse Central, at | Latitude. | Longitude. | Eclipse Central, at | Latitude. | Longitude. |
|---|---|---|---|---|---|
| h. m. s. | ° ′ | ° ′ | h. m. s. | ° ′ | ° ′ |
| 17 42 40 | 37 6.7 N. | 10 22.1 W. | 18 10 0 | 52 19.2 N. | 35 30.5 E. |
| 17 42 45 | 38 5.3 | 8 7.9 | 18 11 0 | 52 28.8 | 36 23.6 |
| 17 42 50 | 38 29.7 | 7 11.5 | 18 12 0 | 52 37.8 | 37 26.0 |
| 17 42 55 | 38 49.9 | 6 24.9 | 18 13 0 | 52 46.3 | 38 22.8 |
| 17 43 0 | 39 6.9 | 5 45.7 | 18 14 0 | 52 54.2 | 39 19.1 |
| 17 43 5 | 39 21.2 | 5 12.5 | 18 15 0 | 53 1.6 | 40 14.8 |
| 17 43 15 | 39 45.8 | 4 15.0 | 18 16 0 | 53 8.5 | 41 10.0 |
| 17 43 30 | 40 16.8 | 3 1.9 | 18 17 0 | 53 14.9 | 42 4.7 |
| 17 43 45 | 40 43.1 | 1 59.7 | 18 18 0 | 53 20.9 | 42 58.8 |
| 17 44 0 | 41 6.6 | 1 4.0 | 18 19 0 | 53 26.4 | 43 52.4 |
| 17 44 15 | 41 28.0 | 0 12.8 | 18 20 0 | 53 31.5 | 44 45.5 |
| 17 44 30 | 41 47.5 | 0 34.4 E. | 18 21 0 | 53 36.1 | 45 38.2 |
| 17 44 45 | 42 5.4 | 1 18.5 | 18 22 0 | 53 40.3 | 46 30.4 |
| 17 45 0 | 42 22.1 | 2 0.0 | 18 23 0 | 53 44.2 | 47 22.1 |
| 17 45 30 | 42 52.8 | 3 17.5 | 18 24 0 | 53 47.6 | 48 13.4 |
| 17 46 0 | 43 21.2 | 4 28.5 | 18 25 0 | 53 50.7 | 49 4.2 |
| 17 46 30 | 43 47.0 | 5 34.5 | 18 26 0 | 53 53.5 | 49 54.5 |
| 17 47 0 | 44 10.9 | 6 36.6 | 18 27 0 | 53 55.9 | 50 44.3 |
| 17 47 30 | 44 33.3 | 7 35.7 | 18 28 0 | 53 58.0 | 51 33.7 |
| 17 48 0 | 44 54.3 | 8 32.2 | 18 29 0 | 53 59.8 | 52 22.7 |
| 17 48 30 | 45 14.2 | 9 26.3 | 18 30 0 | 54 1.3 | 53 11.3 |
| 17 49 0 | 45 33.0 | 10 18.2 | 18 31 0 | 54 2.1 | 53 59.7 |
| 17 49 30 | 45 50.9 | 11 8.3 | 18 32 0 | 54 2.5 | 54 47.7 |
| 17 50 0 | 46 8.0 | 11 56.7 | 18 33 0 | 54 2.6 | 55 35.3 |
| 17 50 30 | 46 24.4 | 12 43.7 | 18 34 0 | 54 2.4 | 56 22.6 |
| 17 51 0 | 46 40.1 | 13 29.6 | 18 35 0 | 54 1.7 | 57 9.5 |
| 17 51 30 | 46 55.2 | 14 14.3 | 18 37 30 | 53 58.8 | 59 5.1 |
| 17 52 0 | 47 9.7 | 14 57.9 | 18 40 0 | 53 54.1 | 60 58.4 |
| 17 52 30 | 47 23.7 | 15 40.6 | 18 42 30 | 53 47.7 | 62 49.3 |
| 17 53 0 | 47 37.2 | 16 22.4 | 18 45 0 | 53 39.6 | 64 37.8 |
| 17 53 30 | 47 50.2 | 17 3.5 | 18 47 30 | 53 30.0 | 66 24.1 |
| 17 54 0 | 48 2.7 | 17 43.8 | 18 50 0 | 53 18.8 | 68 8.1 |
| 17 54 30 | 48 14.8 | 18 23.5 | 18 52 30 | 53 6.1 | 69 50.0 |
| 17 55 0 | 48 26.6 | 19 2.5 | 18 55 0 | 52 51.9 | 71 29.7 |
| 17 55 30 | 48 38.0 | 19 40.9 | 18 57 30 | 52 36.2 | 73 7.4 |
| 17 56 0 | 48 49.1 | 20 18.7 | 19 0 0 | 52 19.0 | 74 43.0 |
| 17 56 30 | 48 59.9 | 20 55.9 | 19 2 30 | 52 0.5 | 76 16.6 |
| 17 57 0 | 49 10.3 | 21 32.6 | 19 5 0 | 51 40.9 | 77 48.3 |
| 17 57 30 | 49 20.4 | 22 8.8 | 19 7 30 | 51 20.0 | 79 18.0 |
| 17 58 0 | 49 30.2 | 22 44.5 | 19 10 0 | 50 57.8 | 80 46.0 |
| 17 58 30 | 49 39.7 | 23 19.8 | 19 12 30 | 50 34.5 | 82 12.2 |
| 17 59 0 | 49 49.0 | 23 54.7 | 19 15 0 | 50 10.0 | 83 36.8 |
| 17 59 30 | 49 58.0 | 24 29.2 | 19 17 30 | 49 44.4 | 84 59.7 |
| 18 0 0 | 50 6.7 | 25 3.3 | 19 20 0 | 49 17.8 | 86 21.1 |
| 18 1 0 | 59 23.5 | 26 10.6 | 19 22 30 | 48 50.2 | 87 41.1 |
| 18 2 0 | 50 39.4 | 27 16.8 | 19 25 0 | 48 21.5 | 88 59.6 |
| 18 3 0 | 50 54.4 | 28 21.8 | 19 27 30 | 47 51.8 | 90 16.8 |
| 18 4 0 | 51 8.6 | 29 25.7 | 19 30 0 | 47 21.0 | 91 32.8 |
| 18 5 0 | 51 22.1 | 30 28.6 | 19 32 30 | 46 49.3 | 92 47.7 |
| 18 6 0 | 51 34.8 | 31 30.6 | 19 35 0 | 46 16.5 | 94 1.5 |
| 18 7 0 | 51 46.9 | 32 31.8 | 19 37 30 | 45 42.7 | 95 14.4 |
| 18 8 0 | 51 58.3 | 33 32.1 | 19 40 0 | 45 8.0 | 96 26.4 |
| 18 9 0 | 52 9.1 | 34 31.7 | 19 42 30 | 44 32.3 | 97 37.7 |

* The path of the centre is expressed, not in degrees, minutes, and seconds, but in degrees, minutes, and *tenths of a minute*.

*Table continued.*

| Eclipse Central, at | Latitude. | Longitude. | Eclipse Central, at | Latitude. | Longitude. |
|---|---|---|---|---|---|
| h. m. s. | ° ′ | ° ′ | h. m. s. | ° ′ | ° ′ |
| 19 45 0 | 43 55.6 N. | 98 48.5 E. | 20 27 30 | 30 20.1 N. | 120 0.7 E. |
| 19 47 30 | 43 17.9 | 99 58.7 | 20 30 0 | 29 14.1 | 121 37.8 |
| 19 50 0 | 42 39.3 | 101 8.5 | 20 32 30 | 28 4.1 | 123 22.3 |
| 19 52 30 | 41 59.5 | 102 18.1 | 20 35 0 | 26 49.3 | 125 16.8 |
| 19 55 0 | 41 18.7 | 103 27.6 | 20 37 30 | 25 28.0 | 127 24.5 |
| 19 57 30 | 40 36.8 | 104 37.1 | 20 38 45 | 24 44 2 | 128 34.4 |
| 20 0 0 | 39 53.7 | 105 46.8 | 20 40 0 | 23 57.7 | 129 49.5 |
| 20 2 30 | 39 9.4 | 106 57.1 | 20 41 15 | 23 8 1 | 131 12.0 |
| 20 5 0 | 38 23.9 | 108 7.9 | 20 42 30 | 22 14.0 | 132 44.5 |
| 20 7 30 | 37 37.1 | 109 19.4 | 20 43 45 | 21 13.9 | 134 30.5 |
| 20 10 0 | 36 49.0 | 110 31.8 | 20 45 0 | 20 5.8 | 136 34.9 |
| 20 12 30 | 35 59.4 | 111 45.6 | 20 46 15 | 18 42 0 | 139 15.1 |
| 20 15 0 | 35 8.0 | 113 1.2 | 20 47 0 | 17 36.1 | 141 27.8 |
| 20 17 30 | 34 14 8 | 114 18.8 | 20 47 30 | 16 34.8 | 143 35.3 |
| 20 20 0 | 33 19.7 | 115 38.9 | 20 47 50 | 15 16.1 | 146 33.8 |
| 20 22 30 | 32 22.4 | 117 2.1 | 20 47 52 | 14 45.5 | 147 44.2 |
| 20 25 0 | 31 22.7 | 118 29.1 | | | |

Duration of the central eclipse on the earth, 3h. 5m. 12s.

*Phases of the Eclipse at some of the principal Cities of Europe at which it will be Total, in Mean Time.*

| | Brescia. | Genoa. | Gratz. | Lemberg. | Madrid. |
|---|---|---|---|---|---|
| Latitude, . . . | 45°32′19″ | 44°24′18″ | 47° 4′ 9″ | 49°51′42″ | 40°24′57″ |
| Longitude, . . . | 10 13 31 | 8 54 23 | 15 27 23 | 24 2 53 | 3 41 52 |
| | h. m. s. | h. m. s. | h. m. s. | h. m. s. | h. m. s. |
| Beginning, . . . | 5 24 3 | 5 17 45 | 5 46 12 | 6 24 38 | before S.R. |
| Beginning of total darkness, | 6 19 18 | 6 12 53 | 6 43 14 | 7 24 33 | 5 18 45 |
| Nearest approach, . | 6 20 31 | 6 13 42 | 6 44 29 | 7 25 58 | 5 19 38 |
| End of total darkness, | 6 21 44 | 6 14 31 | 6 45 44 | 7 27 24 | 5 20 30 |
| Eclipse ends, . . | 7 21 49 | 7 14 27 | 7 47 52 | 8 32 32 | 6 15 36 |
| Duration of total darkness, | 2 26 | 1 38 | 2 30 | 2 51 | 1 45 |
| Duration of eclipse, . | 1 57 46 | 1 56 42 | 2 1 40 | 2 7 54 | |
| Distance of north limbs, | 39.″11 | 68.″50 | 52.″88 | 42.″47 | 17.″80 |
| Distance of centres, . | 1. 00 | 28. 81 | 11. 53 | 0. 84 | 18. 70 |
| Distance of south limbs, | 41. 11 | 10. 88 | 29. 82 | 44. 15 | 55. 20 |
| Point first touched, . | 40.°4 | 39.°1 | 39.°9 | 40.°4 | |

| | Marseilles. | Milan. | Nice. | Padua. | Pavia. |
|---|---|---|---|---|---|
| Latitude, . . . | 43°17′50″ | 45°28′ 1″ | 43°41′58″ | 45°24′ 2″ | 45°11′ 6″ |
| Longitude, . . . | 5 22 15 | 9 11 48 | 7 16 55 | 11 52 18 | 9 9 25 |
| | h. m. s. | h. m. s. | h. m. s. | h. m. s. | h. m. s. |
| Beginning, . . . | 5 3 16 | 5 20 2 | 5 10 51 | 5 30 14 | 5 19 34 |
| Beginning of total darkness, | 5 57 3 | 6 15 4 | 6 5 36 | 6 26 28 | 6 14 28 |
| Nearest approach, . | 5 58 4 | 6 16 11 | 6 6 14 | 6 27 12 | 6 15 40 |
| End of total darkness, | 5 59 5 | 6 17 18 | 6 6 52 | 6 27 56 | 6 16 52 |
| Eclipse ends, . . | 6 57 25 | 7 17 4 | 7 6 20 | 7 29 9 | 7 16 32 |
| Duration of total darkness, | 2 2 | 2 14 | 1 16 | 1 28 | 2 24 |
| Duration of eclipse, . | 1 54 9 | 1 57 2 | 1 55 29 | 1 58 55 | 1 56 58 |
| Distance of north limbs, | 56.″77 | 25.″06 | 72.″28 | 72.″91 | 37.″25 |
| Distance of centres, . | 17. 96 | 14. 83 | 33. 05 | 32. 47 | 2. 60 |
| Distance of south limbs, | 20. 85 | 54. 72 | 6. 18 | 7. 97 | 42. 45 |
| Point first touched, . | 39.°8 | 41.°3 | 38.°9 | 38.°9 | 40.°5 |

*Table continued.*

| | Pressburg. | Turin. | Venice. | Verona. | Vienna. |
|---|---|---|---|---|---|
| Latitude, | 48° 8′ 30″ | 45° 4′ 6″ | 45° 25′ 55″ | 45° 26′ 8″ | 48° 12′ 35″ |
| Longitude, | 17 6 28 | 7 42 6 | 12 20 21 | 10 59 13 | 16 22 58 |
| | h. m. s. | h. m. s. | h. m. s. | h. m. s. | h. m. s. |
| Beginning, | 5 54 6 | 5 13 55 | 5 32 6 | 5 26 50 | 5 51 18 |
| Beginning of total darkness, | 6 51 44 | 6 8 35 | 6 28 49 | 6 22 26 | 6 48 58 |
| Nearest approach, | 6 52 59 | 6 9 35 | 6 29 11 | 6 23 33 | 6 49 57 |
| End of total darkness, | 6 54 14 | 6 10 34 | 6 29 33 | 6 24 40 | 6 50 55 |
| Eclipse ends, | 7 56 56 | 7 9 53 | 7 31 23 | 7 25 9 | 7 53 36 |
| Duration of total darkness, | 2 30 | 1 59 | 0 44 | 2 14 | 1 57 |
| Duration of eclipse, | 2 2 50 | 1 55 58 | 1 59 17 | 1 58 19 | 2 2 18 |
| Distance of north limbs, | 27.″76 | 17.″72 | 79.″25 | 56.″55 | 13.″66 |
| Distance of centres, | 14. 03 | 21. 82 | 38. 72 | 16. 29 | 28. 00 |
| Distance of south limbs, | 55. 82 | 61. 36 | 1. 81 | 23. 97 | 69. 66 |
| Point first touched, | 41.°0 | 41.°5 | 38.°7 | 39.°6 | 41.°5 |

The point on the sun's disc first touched by the moon, or at which the eclipse will begin, is counted from the vertex to the right hand, as seen through a telescope that does *not* invert. The longitudes of all the places, except Lisbon and Madrid, are *east* of Greenwich. At Lisbon the sun will rise at 4h. 44m., nearly totally eclipsed. At the following places the eclipse will be nearly, but not quite, total.

| Places. | Nearest approach. | Dist. of centres. | Difference S. D. |
|---|---|---|---|
| | h. m. s. | ″ | ″ |
| Cracow, | 7 8 0 | 64.62 | 42.53 |
| Innspruck, | 6 27 33 | 61.09 | 40.59 |
| Kremmunster, | 6 40 3 | 55.30 | 41.16 |
| Lisbon, | 4 57 42 | 46.49 | 35.15 |
| Ofen (Buda), | 7 0 38 | 45.76 | 42.12 |
| Trieste, | 6 35 33 | 51.93 | 40.84 |

*Elements of the Eclipse, Mean Time at Paris. Solar Elements.*

| h. m. | Longitude. ° ′ ″ | Right Ascen. ° ′ ″ | Declination. ° ′ ″ | Sidereal time. h. m. sec. | |
|---|---|---|---|---|---|
| 16 40 | 105 32 15.86 | 106 51 41.32 | 22 33 17.89 | 7 2 52.81 | ☉'s Latitude +0″.06 |
| 17 00 | 105 33 3.48 | 106 52 32.60 | 22 33 12.35 | 7 2 56.10 | " Hor. Paral. 8″ 44 |
| 18 00 | 105 35 26.51 | 106 55 6.45 | 22 32 55.74 | 7 3 5.95 | " S. diam. 15′ 45″.37 |
| 19 00 | 105 37 49.55 | 106 57 40.26 | 22 32 39.11 | 7 3 15.81 | Obliquity 23° 27′ 38″ 28 |
| 20 00 | 105 40 12.59 | 107 00 14.04 | 22 32 22.45 | 7 3 25.66 | |
| 21 00 | 105 42 35.63 | 107 2 47.86 | 22 32 5.76 | 7 3 35.52 | |
| 22 00 | 105 44 58.68 | 107 5 21.69 | 22 31 49.05 | 7 3 45.38 | |

*Lunar Elements.*

| h. m. | Longitude. ° ′ ″ | Latitude. ′ ″ | Right Ascen. ° ′ ″ | Declination. ° ′ ″ | Hor. Par. ′ ″ | Semi-Diam. ′ ″ |
|---|---|---|---|---|---|---|
| 16 40 | 104 07 18.17 | +36 49.34 | 105 24 25.38 | 23 19 17.51 | 59 54.77 | 16 19.56 |
| 17 00 | 104 19 23.66 | 35 42.61 | 105 37 23.05 | 23 16 53.97 | 59 55.22 | 16 19.68 |
| 18 00 | 104 55 41.24 | 32 22.20 | 106 16 14.40 | 23 9 36.59 | 59 56.50 | 16 20.04 |
| 19 00 | 105 32 0.30 | 29 1.51 | 106 55 3.26 | 23 2 9.46 | 59 57.77 | 16 20.39 |
| 20 00 | 106 8 21.03 | 25 40.54 | 107 33 49.30 | 22 54 32.56 | 59 59.01 | 16 20.72 |
| 21 00 | 106 44 43.09 | 22 19.31 | 108 12 32.55 | 22 46 46.02 | 60 00.21 | 16 21.04 |
| 22 00 | 107 20 6.51 | 18 57.73 | 108 51 12.70 | 22 38 49.83 | 60 01.41 | 16 21.35 |

Boston, December 6, 1841. R. T. P.

## Art. XXII.—*Bibliographical Notices.*

1. *Enchiridion Botanicum exhibens Classes et Ordines Plantarum, accedit Nomenclator Generum et officinalium vel usualium indicatio;* auctore Steph. Endlicher, M. D. Botanices in facult. med. Vindob. Prof. Leipsic and Vienna, 1841. pp. 763, 8vo.—This distinguished botanist, having taken the chair in the University of Vienna, so long filled by the late Baron Jacquin, has prepared an excellent text-book, on the same plan as Lindley's Introduction to the Natural System. The author's own arrangement in his *Genera Plantarum*, is of course followed, and the detailed characters of the classes and orders are taken from that work. A list of the genera, with their subdivisions and principal synonyms, is given under each order; the affinities of the latter are briefly discussed; its geographical distribution noticed; its general properties and uses indicated, followed by a condensed but carefully digested account of all its useful products, and especially those employed in medicine. We know not where so much important information is to be found within such a narrow compass. We observe that Prof. Endlicher, following out his views upon the subject of vegetable impregnation, viz. that the pollen-grains are the veritable *ovula*, has in this work substituted the term *gemmulæ* in place of the latter, and restored the old name of *germen* for the *ovarium!*

2. *Flora Medica; a Botanical Account of all the more important Plants used in Medicine, in different parts of the world;* by John Lindley, Ph. D. &c. London, 1838. pp. 656, 8vo.—Our notice of this work is somewhat tardy; but it is probably not yet as well known in this country, at least to the medical profession, as it deserves to be. Its object is to furnish good systematical descriptions of medicinal plants, including those employed in the popular practice in different countries, as well as those which have found a place in treatises on materia medica. Not being himself a medical man, the author adopts the motto: "Certa feram certis autoribus; haud ego vates"—but there is no lack of original investigation in the discussion of numerous questions, which must be settled rather by botanical than pharmaceutical inquiry. The arrangement of the author's Introduction to the Natural System, second edition, is followed; but, in order to suit the convenience of those readers who may prefer some other mode, the work is so printed that the different natural orders may be cut asunder and rearranged; in consequence of which many blank pages are left, and the size and expense of the work are unduly increased. Throughout Europe, we believe, no medical faculty exists without a professorship of botany;

and every candidate for the doctorate, as well as every licensed apothecary, is required to sustain an examination upon this science. In the United States, on the contrary, no medical college within our knowledge, has a separate botanical professorship, or requires any knowledge of the science as a requisite for graduation; and very few, indeed, make provision for a course of botanical lectures! It would not be difficult to assign the principal causes of this neglect amongst us, of what is elsewhere deemed not only an important, but an indispensable branch of medical instruction; but however this may be, we cannot believe that such a state of things will be much longer permitted to exist.

3. *Elements of Botany, structural, physiological, systematical, and medical; being a fourth edition of the Outline of the First Principles of Botany;* by John Lindley, Ph. D., F. R. S., &c. &c. London, 1841. pp. 292, 8vo.—The first part of this excellent text-book, consists of an amplified and corrected edition of Dr. Lindley's celebrated Outlines of the First Principles of Botany. In its original form, this terse and perspicuous statement of the leading propositions of structural botany, having been annexed to the American reprint of the first edition of the *Introduction to the Natural System*, is well known to the botanists of this country; many of whom, like the writer of this notice, derived from it their earliest ideas of the science, and have not forgotten the intense gratification which the first glimpse of the fundamental principles of structural and physiological botany afforded them. The third English edition was extended, so as to include a similar sketch of systematical botany, and the *alliances of plants*, in a tabular form; the latter being an amended translation of the author's *Nixus Plantarum:* this formed the *Key to Botany for the use of Classes*, (80 pages, 8vo.) published in the year 1835. In the present form, "the whole of the structural and physiological part has been corrected with great care, and made to include the most important views of modern physiologists, so as to present the reader with a view of the state of botanical knowledge, in these departments in the spring of 1841;" and the whole is very fully illustrated with excellent wood engravings. The second part is devoted to systematical botany, which is defined to be, "the science of arranging plants in such a manner that their names may be ascertained, their affinities determined, their true place in a natural system fixed, their sensible properties judged of, and their whole history elucidated with certainty and accuracy." It is principally occupied with a plain and simple account of the natural families, as arranged by the lamented De Candolle, with their characters and leading subdivisions, an enumeration of their typical genera, (which are mostly

illustrated by wood cuts,) and a brief notice of their properties and uses. This is followed by the Alliances of Plants, a conspectus of the method for grouping the orders employed in the second edition of the author's *Introduction to the Natural System.* To this succeeds a sketch of a new distribution of the vegetable kingdom; in which the author gives prominence to some characters employed by Jussieu, &c., but which he had until lately deemed of minor comparative importance. The plan now suggested may be easily made to harmonize with that of Endlicher. The portion denominated Medical Botany, consists of a list of the principal medicinal plants which are known in a living state in Europe, arranged and numbered according to the author's *Flora Medica*, with a brief indication of their properties and uses.

4. *Botanical Teacher for North America, in which are described the indigenous and common exotic plants growing north of Mexico;* by Laura Johnson, under the supervision of Prof. A. Eaton. Second edition, Troy, 1840. pp. 268, 12mo.—On the first page of this work, our attention was arrested by a sweeping charge against the teachers of botany in this country, which in justice we shall extract verbatim: "The second set [of authors] are actuated by the *sinecurism of botany.* Their books are incongruous compilations, *to be forced upon pupils by teachers. The teachers are mostly rewarded by book-pedlars, who are authorized to present them with a few copies and many compliments for this service.* Neither of these kind of authors or teachers conceive it a duty to make practical botanists of their puplis. Students are made to believe, and so teach their students in turn, that said-off lessons make the botanist. Perhaps a few garden plants are sometimes shown as a fallacious pretence. *Many hundreds of our schools, of fair names, have been occupied for years in this manner.*" This is a very serious charge, if true, which we trust it is not, and is preferred in a very unqualified manner. But if the books which these teachers impose upon their pupils are as worthless as the present volume, pitiable indeed is their condition, and small the benefit they are likely to derive from their study. The following *morceau*, extracted from the fourth page, will enable our botanical readers to judge for themselves.

"The student, before he studies vegetable physiology, and natural alliances of plants, must understand the seed, with its *astigmatous sacs or testæ.* The ovule (with all its appendages within the *stigmiferous tunic* or carpel) becomes the seed, with its testa or tripple [*sic*] cuticle, and its outer sacks. In case of the peach, the white meat is the seed; and the thin, brownish covering inside of the shell, and the very smooth outside of the white meat, are, by some authors, called the *quintine, quartine,* and *tertine* coats. The shell (putamen) is the *secundine,* and the outside rind is the *primine.* Between the rind (*primine*) and shell (*secundine*) is the fleshy mass, or edible part. This is not considered as one of the coats, being the fungus-like thickening of the rind. As an edible fruit, the naming is different. Then the primine is called the *exocarp;* the secundine, *endocarp;* and the interposed fleshy mass is the *sarcocarp.* The five coats which are made of the ovule, if it is true that they are always present, are exceedingly different in thickness. It may be well to imagine their existence, for the sake of convenient analogy, whether or not they have always been found. In case of the wheat, we find that a coat or two, (perhaps the whole five,) and the outside achenous or stigma-bearing one, produce, in miller's language, shorts, bran, and kernelle, by grinding. But who can make out the achenous tunic, bearing the stigma, and within it the *primine*, *secundine*, *tertine*, *quartine*, and *quintine?* The nucleus or simple seed, (wheat,) we know to be principally amylaceous and glutinous albumen, from the quantity of flour it gives, which is almost a pure mixture of starch and gluten (paste)."

Other parts of the work are consistent with this ludicrous jumble. Thus, on page 236, we read of the peach, &c. that the "seed is the putamen and its contents within the sarcocarp (fleshy part) of a drupe:" and on page 234, "all seeds have this outer tegument, (testa or primines,) excepting the *coniferecæ*, as pine trees, &c." Also page 253, where the Coniferæ are said to have "seeds purely naked, not covered by testa, nor a skin-like envelope;" and, lest the idea should not be distinctly apprehended, a note informs us, that "all seeds but those of this order have a testa, skin, or membranous covering. These, *and these only*, are truly naked. The gymnospermia of Class Didynamia are naked as it respects the pericarp. But the seeds of that order have the covering here referred to." Parietal placenta, we learn from page 6, "means that the placenta forms a kind of wall about ovules." It can hardly be necessary to make further extracts to justify the remark which we premised. Ignorance of the rudiments of structural botany is of itself no disgrace; but when young ladies write, and learned professors supervise such books as that before us, we are reminded of the title of a chapter, we believe in Fielding, "showing that an author writes all the better for having some knowledge of the subject of which he treats."

5. *Hooker's Journal of Botany.*—The fourth volume of this interesting periodical commenced with the number for June last; which is occupied with a translation of a paper by Martius, on the Botany of Brazil, and with the first portion of a very important paper, by Mr. J. Smith, of Kew, entitled "An arrangement and definition of the Genera

of Ferns, with observations on the affinities of each genus." The latter is continued in the numbers for July, August, and September; comprising five of the seven tribes into which the Ferns of the first division, or *Polypodiaceæ*, (those with a vertical elastic ring to the sporangia,) are divided. The work exhibits infinitely more care and consideration than Presl's *Tentamen Pteridographiæ;* although some genera appear to be founded upon very slight technical distinctions. The first tribe, *Polypodieæ*, is represented in the United States by *Polypodium*, *Struthiopteris*, *Allosorus*, (A. gracilis, *J. Sm.* = Pteris gracilis, *Michx.*) *Notholæna*, (N. vestita, *J. Sm.* = Cheilanthes vestita, &c.) *Tæniopsis*, (T. lineata = Vittaria lineata, *Swartz*,); 2d. *Acrosticheæ*, by a single *Acrostichum;* 3d. *Pterideæ*, by *Pteris*, *Doodia*, (Woodwardia Virginica, *Swartz*,) and *Woodwardia*, (W. onocleioides and W. thelypterioides, *Pursh;* but is the latter different from *Doodia Virginica?*); the 4th. *Asplenieæ*, by *Scolopendrium*, *Asplenium*, (of which *Athyrium* is considered a section,) and *Antigramma*, (Asplenium rhizophyllum, *Linn.*,) but why was not the prior name of *Camptosorus* retained for the genus? The 5th tribe, *Aspidieæ*, includes *Onoclea*, [for the confirmation of Mr. Smith's conjecture respecting the *Rhagiopteris* of Presl's *Tent. Pterid.* see notice of the latter work in a former number of this Journal,] *Woodsia*, *Cystopteris*, (C. fragilis and C. bulbifera,) *Lastrea* (= Nephrodium marginale, *Michx.*, N. Goldianum, *Hook. & Grev.*, N. Noveboracense, dilatatum, &c.,) and *Polystichum*, (Aspidium (Nephrodium, *Michx.*,) acrostichoides and A. aculeatum.) It is but just that the name of *Nephrodium*, established by Michaux, should be employed, if employed at all, for some of the species originally comprised in that genus; this name should therefore have been retained for either *Polystichum* or *Lastrea*, if the two last are really distinct genera. The October number is nearly filled with a biographical sketch of the late Allan Cunningham, the botanical collector. It also contains an announcement of the death of Professor De Candolle, which mournful event took place at Geneva on the 9th of September last.

6. *The Annals and Magazine of Natural History*, (London: conducted by Sir W. Jardine, Mr. Selby, Dr. Johnston, Prof. Don, and Mr. Taylor,) for July last, contains an elaborate paper by Mr. Schomburgk, on the *Urari or Arrow poison of the Indians of Guiana*, the *Wouraly* of 'Waterton's Wanderings,' with a description of the plant from which it is extracted. Mr. Schomburgk appears to be the first European who has seen the plant, (for neither Baron Humboldt nor Mr. Waterton met with it,) and gathered specimens: from the latter the plant has recently been figured in the eighth part of Hooker's *Icones Plantarum*.

7. The *Archiv für Naturgeschichte*, established and for the last six years conducted by the late Prof. Wiegmann of Berlin, is to be continued, as we learn from a late number of the *Linnæa*, by Dr. Erichson, assisted by Dr. Grisebach of Göttingen, Prof. Siebold of Erlangen, Dr. Troschel of Berlin, Prof. A. Wagner of Munich, and Prof. R. Wagner of Göttingen. Annual zoological and botanical reports will still be given: the latter, furnished for some years past by the late Professor Meyen, will hereafter be executed by Prof. Link.

8. A *Repertorium für Anatomie und Physiologie der Gewächse*, with annual reports, nearly on the plan of those of the late Prof. Meyen, (generally known to English readers, through the translation published in the *Annals and Magazine of Natural History*,) is announced by the accomplished vegetable anatomist, Prof. Mohl of Tübingen, in the *Linnæa*, part 3, for 1841.

9. *Lectures on the Applications of Chemistry and Geology to Agriculture;* by James F. W. Johnston, Professor of Chemistry and Geology in the University of Durham. Part I. On the Organic Elements of Plants. New York, Wiley & Putnam. 12mo. 1842.—It is a just remark, and those whom it chiefly concerns are beginning to appreciate it, "that no department of natural science is incapable of yielding instruction,—that scarcely any knowledge is superfluous,—to the tiller of the soil." The botanist, the chemist, or the geologist may, and indeed commonly does prosecute his laborious researches from the mere love of his favorite science: whatever personal advantage he may perchance derive, is small indeed, compared with what he might reasonably expect from the same industry and talent devoted to other pursuits. But to no class, perhaps, are the results of scientific research so practically important as to the proprietors and cultivators of the soil; for no art is so connected with all the natural sciences, and so dependent upon them for its advancement, as agriculture. Would the farmer know what vegetables, or what varieties are best adapted to a particular climate or soil; which require his richest, and which will thrive upon his poorest soils; which exhaust, and which on the contrary may be made to enrich his land; what treatment is necessary to perpetuate the choice varieties, produced by long cultivation, but which are continually liable to 'run out,' that is, to revert to their original state; how the properties of poisonous plants may be ascertained, or noxious weeds eradicated; to these and numerous similar questions botany and vegetable physiology must render the only satisfactory answer. If his crops are threatened with destruction by insects, zoology alone can throw light upon their nature and habits, and instruct him how to extirpate

them. Would he know what varieties of domestic animals may be most advantageously raised for any particular purpose, or how certain qualities may be obtained by cross-breeding; zoological knowledge will afford him important assistance. If it be desirable to ascertain whether a certain crop, or kind of fruit, may be expected to succeed in a given district; meteorology provides the data for resolving the enquiry, by giving the mean temperature of the year, recording the greatest heat of summer and cold of winter for a series of years, the liability to sudden and great changes of temperature at particular seasons, the average quantity of rain which falls during each year, or month. These data, compared with the atmospheric condition of a country where the crop in question is successfully cultivated, afford the requisite information. The nature of the soil no less demands the farmer's attention; the character of the subsoil, and the results that may be expected from bringing it to the surface; the cause of the diversities which different portions even of the same field exhibit, where the land is to ordinary observation similar; these and similar points geology offers to explain.

Moreover, if a soil be naturally barren, or be rendered so by a long-continued system of wretched tillage, like that which has impoverished extensive portions of our Southern States, it is very important to know whether it may be improved or reclaimed so as to repay the outlay, and how this may best be effected. Barrenness may be owing to the presence of some injurious substance, or it may arise from the absence of an element that is essential to the production of a given crop. How is the cultivator to distinguish between these two cases, and apply to each the proper remedy? When a field is exhausted by over-cropping, how are we to ascertain what is exhausted, and consequently what must be restored to the soil before it can recover its former fertility? To these and to a thousand such questions, "chemistry alone can and will give a satisfactory answer." It is true that many useful results have been attained by mere accident, and pursued apart from all considerations of the *why* and *wherefore;* but it is no less true that we know not half the value of any such discovery, until we understand the principles upon which it rests, and can apply them intelligently to analogous cases. Gypsum, for instance, is found wonderfully to fertilize certain soils, while upon others it produces no good effect whatever. It is obvious that the farmer cannot derive the fullest advantages from this agent, nor be acquainted with all its useful applications, until he understands how its fertilizing effects are produced, and under what circumstances it is useless or even injurious. And so likewise with respect to the use of marl, lime, and various manures; the mode of whose operation can only be learned from chemistry and vegetable physiology.

We need not therefore insist upon the utility of such works as the *Agricultural Chemistry* of Liebig, and the still more practical treatise of Prof. Johnston. The latter is addressed, not to the philosopher, nor the student, but to the tiller of the soil himself. It consists of a series of lectures, delivered before a society of practical agriculturists; most of whom doubtless possess little or no knowledge of chemistry or geology. It was therefore necessary to begin with the simplest facts and principles of these sciences, to employ the most familiar illustrations, to use no unnecessary technical terms, and none at all without previous explanation. In pursuance of this plan, Prof. Johnston has produced a work of the most interesting and popular character, completely adapted to the end in view, and fully worthy of his reputation as a chemist. The first part of these lectures, the only portion which has yet been issued in this country, is devoted to a consideration of the organic elements and parts of plants, the properties of the elementary and compound bodies which enter into their substance, or contribute to their growth and nourishment; to the general structure and uses of the several parts of plants; their mode of growth, and the manner in which their food is absorbed and assimilated.

The second part, which we understand will soon appear, is to be devoted to the inorganic elements of plants, and to the study of the soils from which these are derived; the constitution, origin, and methods of improving soils in different districts, and under unlike conditions, with the general relations of geology to agriculture. The third, to the nature of manures, their mode of action, &c.: the fourth and last, to the results of vegetation, the nature, constitution, and nutritive properties of different kinds of produce, especially in reference to their several equivalents or powers of supporting animal life; the feeding of cattle, the making of cheese, &c.; the constitution and differences of various kinds of wood, and the circumstances which favor their growth. After this general view of the plan and scope of the work, we think it quite unnecessary to give an analysis of the eight lectures of which the present portion is composed. In the first lecture, which is chiefly preliminary, the author bestows a few thoughts upon the importance of agriculture:

"That art on which a thousand millions of men are dependent for their very sustenance—in the prosecution of which nine tenths of the fixed capital of all civilized nations is embarked—and probably two hundred millions of men expend their daily toil—that art must confessedly be the most important of all; the parent and precursor of all other arts. In every country then, and at every period, the investigation of the principles on which the rational practice of this art is founded, ought to have commanded the principal attention of the greatest minds. To what other object could they have been more beneficially directed? But there are periods in the history of every country when the study of agriculture becomes more urgent, and in that country acquires a vastly superior importance. When a tract of land is thinly peopled, like the newly settled districts of North America, New Holland, or New Zealand, a very defective system of culture will produce food enough not only for the wants of the inhabitants, but for the partial supply of other countries also. But when the population becomes more dense, the same imperfect or sluggish system will no longer suffice. The land must be better tilled, its special qualities and defects must be studied, and means must gradually be adopted for extracting the maximum produce from every portion susceptible of cultivation."

The British Islands are in the latter condition. Supposing importation from abroad not to have increased to any important extent, it appears that the soil of Great Britain has, by improved management, been made to yield twice the quantity of food it afforded half a century ago; and the important question arises, whether the domestic supply may be expected still to increase in the same ratio with the population, or whether the demands of the latter will not soon overtake the productive powers of the land. In view of what has already been accomplished, and of the abundant room for further improvement, our author hints, that a portion of the strength expended by the agricultural interest in attempting to secure or maintain important political advantages in the state, might with propriety be devoted to the encouragement of experimental agriculture. The suggestion is as important as it is opportune. After presenting a plain account of the difference between simple and compound bodies, organic and inorganic matter, and briefly exhibiting the properties of the four organic elements of plants, viz. carbon, oxygen, hydrogen and nitrogen, Prof. Johnston concludes his first lecture with the following remarks:

"Such are the several elementary bodies of which the organic or destructible part of vegetable substances is formed. With one exception they are known to us only in the form of gases; and yet out of these gases much of the solid parts of animals and of plants are made up. When alone, at the ordinary temperature of the atmosphere they form invisible kinds of air; when united, they constitute those various forms of vegetable matter which it is the aim and end of the art of culture to raise with rapidity, with certainty, and in abundance. How difficult to understand the intricate processes by which nature works up these raw materials into her many beautiful productions—yet how interesting it must be to know her ways, how useful even partially to find them out! Permit me, in conclusion, to submit to you one reflection. We have seen that oxygen, hydrogen, and nitrogen, are all gaseous substances, which when pure are destitute of color, taste, and smell. They cannot be distinguished by the aid of our senses. Man in a state of nature—uneducated man—cannot discern that they are different. Yet so simple an instrument as a lighted taper at once shows them to be totally unlike each other. This simple instrument, therefore, serves us instead of a new sense, and makes us acquainted with properties the existence of which, without such aid, we should not even have suspected. Has the Deity then been unkind to man, or stinted in his benevolence, in withholding the gift of such a sense? On the contrary, he has given us an understanding, which, when cultivated, is better than twenty new senses.

The chemist in his laboratory, is better armed for the investigation of nature than if his organs of sense had been many times multiplied. He has many instruments at his command, each of which, like the taper, tells him of properties which neither his senses nor any other of his instruments can discover; and the further his researches are carried, the more willing does nature seem to reveal her secrets to him, and the more rapidly do his chemical senses increase. Do you think that the rewards of study and patient experimental research are confined to the laboratory of the chemist, and that the Deity will prove less kind to you, whose daily toil is in the great laboratory of nature? As yet you see but faintly the reason of many of your commonest operations, and over the results you have comparatively little control: but the light is ready to spring up, the means are within your reach; you have only to employ your minds as diligently as you labor with your hands, and ultimate success is sure."

Did our limits allow, we should be pleased to give, as specimens of the author's happy style of discoursing popularly on scientific subjects, copious extracts from different portions of these lectures; and especially from the sections on the relations of water to vegetable life; on the source whence plants derive their carbon, nitrogen, &c.; on the absorbing and excretory powers of the root; and on the mutual transformations of lignin, starch, gum, cane-sugar, and grape-sugar; all of which subjects are treated with great clearness, and with consummate ability. But it is unnecessary to make large extracts from a book which we hope and trust will soon be in the hands of nearly all our readers. Considering it as unquestionably the most important contribution that has recently been made to popular science, and as destined to exert an extensively beneficial influence in this country, we shall not fail to notice the forthcoming portions, as soon as they appear from the press.

10. Principles of Geology; *or the modern changes of the Earth and its inhabitants, considered as illustrative of Geology;* by Charles Lyell, Esq., F. R. S. Reprinted from the sixth English edition, from the original plates, and wood cuts, under the direction of the author. Boston, Hilliard, Gray & Co.: 1842. 3 vols. 12mo.

*Elements of Geology;* by Charles Lyell, Esq., F. R. S., &c. Reprinted from the second London edition, from the original plates and wood cuts, under the direction of the author. Boston, Hilliard, Gray & Co.: 1841. 2 vols. 12mo.

Our favorable opinion of the above productions has long since and repeatedly been expressed in former numbers of this Journal. Every geologist will be glad to find that we have now new and greatly improved editions of both, brought out in the exact form and appearance of the original. The principal changes are the removal from the Principles of the fourth book, which treated of tertiary strata, and the incorporation of the most prominent facts in it with the Elements. The two works therefore now occupy ground entirely distinct. The Elements has grown from one volume, in which the first edition was published, into two, each equal to the former; while the Principles have been brought down to the latest dates by the addition of much new matter, which has appeared since 1837, and some opinions formerly advocated are reclaimed as having been superseded by the advance of "a philosophy which never rests—its law is progress: a point which yesterday was invisible is its goal to-day, and will be its starting point to-morrow."

11. *Notes on the use of Anthracite in the Manufacture of Iron, with some remarks on its evaporating power;* by WALTER R. JOHNSON, A. M., &c. Boston, 1841. 12mo. pp. 156. C. C. Little & Jas. Brown.

Every gleam of light on this important subject is most welcome to all who are interested in the prosperity and permanent advancement of this country. That which three or four years since was deemed impossible, is now the subject of daily practice; and the day is not far distant when the anthracite iron of Pennsylvania will supersede to a great extent the importation of the foreign article, by substituting at home a cheaper and better.

As the amount of experience in this new branch of metallurgic art is not great, there was no call for a great book. Prof. Johnson has therefore brought into a compact form all the information which could be collected on the subject, and tabulated the results of those blast furnaces in Pennsylvania which are driven by anthracite, under all the heads most valuable to the practical man. Our limits do not admit any extension of this notice, or we would give an analysis of the contents of the volume, which we are now obliged to defer to another opportunity.

12. *American Almanac and Repository of Useful Knowledge for the year* 1842. Vol. XIII. Second Series, Vol. 3. Boston: D. H. Williams.—This volume contains the usual amount of interesting statistical matter, with the results of the new census, statistics of education, &c. The astronomical portion has changed hands this year, from Mr. R. T. Paine, who has so long and ably conducted it, to Prof. Peirce, of Harvard University. The high reputation of Prof. Peirce will insure every attention and improvement.

13. *Prof. Park's Pantology.*—In our last, we inadvertently misstated Prof. Park's classification of human knowledge, being misled by an error in the divisions of his tree of knowledge. We now give the order correctly.

*First Province*, PSYCHONOMY.—I. Department, GLOSSOLOGY, including Grammar and Languages. II. PSYCHOLOGY, including Rhetoric, Logic, Phrenics, Ethics, and Education. III. NOMOLOGY, including Law and Government, and Political Economy. IV. THEOLOGY, including Paganism, Mahomedanism, Judaism, and Christianity.

*Second Province*, ETHNOLOGY.—V. GEOGRAPHY, including Statistics, and Voyages and Travels. VI. CHRONOGRAPHY, including Civil History, Chronology, and Antiquities. VII. BIOGRAPHY, including Heraldry, Autographics, and Sphragistics. VIII. CALLOGRAPHY, including Poetry, Romance, and Miscellaneous Literature.

*Third Province*, PHYSICONOMY.—IX. MATHEMATICS, including Descriptive and Analytic Geometry, and the Calculus. X. ACROPHYSICS, or Natural Philosophy, including Astronomy and Chemistry. XI. IDIOPHYSICS, or Natural History, including Geology. XII. ANDROPHYSICS, or the Medical Sciences, including Surgery.

*Fourth Province*, TECHNOLOGY.—XIII. ARCHITECHNICS, or the Arts of Construction and Conveyance. XIV. CHREOTECHNICS, Agriculture, Manufactures, and Commerce. XV. MACHETECHNICS, or the Arts of War, by land and by sea. XVI. CALLOTECHNICS, or the Fine Arts, exclusive of Poetry.

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## MISCELLANIES.

### FOREIGN AND DOMESTIC.

1. *On the supposed conversion of Carbon into Silicon, as stated to the Philosophical Society of Edinburgh, by Dr. Brown.* See this Journal, Vol. XLI, p. 208.

TO PROFESSOR SILLIMAN.

*Dear Sir*—You are already aware, that in the beginning of last summer, a paper written by Mr. Brown, and asserting as the result of a series of experiments, the formation of silicon, and its consequent identity with carbon, was presented to the Royal Society of Edinburgh by Dr. Christison. Notwithstanding the improbability of this result, the high reputation of Dr. Christison as a chemist, and the belief that he must have entertained a very favorable opinion of the scientific acquirements of an experimenter whose conclusions, although of a character so extraordinary, he was willing to introduce to the world, impressed Dr. Mitchell of this city with the belief that the facts thus brought before the public, merited an examination, which might serve either to detect their error or confirm their truth. As I understand that you have expressed a desire to receive some account of the experiments which he undertook for this purpose, in which I had the honor of acting as an assistant, I have taken up my pen to give you a brief statement of their results.

A considerable quantity of paracyanogen was obtained by exposing the bicyanide of mercury to a low red heat, according to the direction given by Brown, in an iron tube closed air tight by a plug of the same metal, traversed by a perforation filled with stucco. During the operation the vapor of mercury with a part of the cyanogen, escaped through the orifice by passing through the pores of the stucco, while the remainder of that gas was converted into paracyanogen and remained in the tube in the shape of a black porous mass. So far, as might easily have been anticipated, the results obtained agreed with those indicated by Brown, as his coincided with those of previous experimenters. On exposing however the paracyanogen resulting from this process to heat in glass tubes, instead of the evolution of nitrogen and the conversion of the carbon into silicon, carburets of nitrogen, in which more or less cyanogen was present, were given off, and the residue appeared to consist of carbon and not of silicon. This result entirely agreed with the habitudes of paracyanogen, as described in works on chemistry, and was equally inconsistent with the statements of Mr. Brown.

With the view of making an experiment on a larger scale, which should prove decisive of the facts in question, the iron tube above described was again charged with five or six ounces of the bicyanide of mercury, and kept for several days at a heat just below redness. The vapor of mercury was given off through the stucco during the whole period, but as far as could be determined by the absence of odor and the application of a lighted taper of flame, unaccompanied by any cyanogen. This treatment should, according to the experiments of Mr. Brown, when continued during such a length of time, have been alone sufficient to determine the formation of silicon. The tube was then heated to redness in a wind furnace for four hours, and subsequently kept at a white heat for as many more. On opening it, the whole of the materials were found to have been volatilized, while the iron of the tube remained unchanged, except that in one or two places a few scales had been formed. These, when detached and dissolved in muriatic acid, left a small quantity of the carbonaceous residue which remains after the solution of iron in that solvent.

As the heat applied to the bicyanide before it was placed in the furnace, must necessarily have converted the greater portion of the cyanogen which it contained into paracyanogen, and according to the experiments of Mr. Brown, should have worked the farther change of a considerable portion of the carbon into silicon, while the succeeding part of the process, if his views were correct, would have completed the latter transformation, the conclusion seems irresistible, that the escape of all the materials in the state of gas, while silicon, if produced, would necessarily have remained in the fixed and solid form, proves, as far as a negative is capable of being proved, the incorrectness of that gentleman's experiments. Respectfully yours, CLARK HARE.

Philadelphia, Sept. 12, 1841.

2. *Curious Microscopic Fungus, Craterium pyriforme.*

To B. SILLIMAN, Jr.: *Dear Sir*—Specimens of this beautiful microscopic fungus, which were gathered on Clapham Common, England, by Dr. Mantell, in August, were received by me in a *living state* on the 13th of November. In the letter accompanying them, Dr. M. remarks: "I send you a pebble or two of flint, to which is adhering that exquisite microscopic fungus, the *Craterium pyriforme*, which is as white as snow, and upon being punctured gives out a bright scarlet fluid. I have had pebbles on my mantlepiece for months, and yet the vegetable was alive and *bled* as usual. I therefore hope a voyage across the Atlantic will not destroy them, and that you will be able to see the phenomenon, which to those who have not seen it before is most striking. But probably you have the species in your own country."

The specimens received were still alive, and exhibited the bleeding very beautifully.

These specimens having made me acquainted with the form and mode of growth of this interesting plant, I was led to seek for it on our own rocks, and on the very first stone which I examined, and which I picked up within a hundred yards of my house at West Point, I found it growing abundantly. Further search showed that it is very frequent on the loose fragments of primitive rocks in this vicinity. To the naked eye it appears like snow-white specks, not more than one fourth the size of a pin's head; when magnified it appears like a little cup, with a cover beautifully marked with radiating lines. On being punctured, it emits a blood-red liquid filled with sporules. It grows most abundantly in small crevices in hard siliceous stones. I do not find this species mentioned in Schweinitz's Catalogue of American Fungi. J. W. BAILEY.

West Point, November 15, 1841.

3. *Yellow Showers of Pollen.*—In Vol. XXXIX, page 399, of this Journal, we gave an account of a yellow substance fallen at Troy, N. Y., and then conjectured to be the sporules of Lycopodium. Subsequently, our correspondent, W. G. of Otisco, N. Y., sent us a note, suggesting that such showers of yellow matter were due to the pollen of the forest trees, and that they were more frequently observed after thunder gusts than at other times, because the pollen shaken from the

trees by the wind, was collected by the rain and thrown up into masses. That this conjecture was correct, will be seen by what follows.

Last June our respected correspondent, Mr. W. H. Blake, of Boston, sent us an account of a shower of yellow matter which fell on board a vessel in Pictou harbor, on a serene night in June, and was collected by the bucket full and thrown overboard; some small portions came into Mr. Blake's hands, and was by him examined chemically. It was found, on subjecting it to destructive distillation, to give off nitrogen and ammonia, and an animal odor; to form hydrocyanic acid by passing through hydrochloric acid, and to leave a considerable amount of phosphate of lime on incineration. From these facts, Mr. Blake was inclined to infer that it might be of animal origin—perhaps the ova of some insect.

From the occurrence of these showers always in May or June, or about the time of the inflorescence of trees, we were inclined to believe that they were due to the pollen of plants, while the fact that nitrogen exists always in the albuminous parts of plants, served to account sufficiently for the chemical observations of Mr. Blake. We therefore sent to our friend, Prof. J. W. Bailey, both the powders of Troy and Pictou, that he might examine them by his powerful microscopes. In return we received the following satisfactory letter, addressed to the junior editor.

**West Point, September 22, 1841.**

*My dear Sir*—I received a few days since, your letter of the 17th, and its enclosures, which I hastened to subject, as you requested, to microscopic examination. The powder which fell at Pictou, proved to be, as you suggested, of vegetable origin, being wholly composed of the pollen of some species of pine. That this is its real nature, there can be no doubt; to convince you of this, I send you the following comparative sketches.

Fig. 1.

Fig. 2.

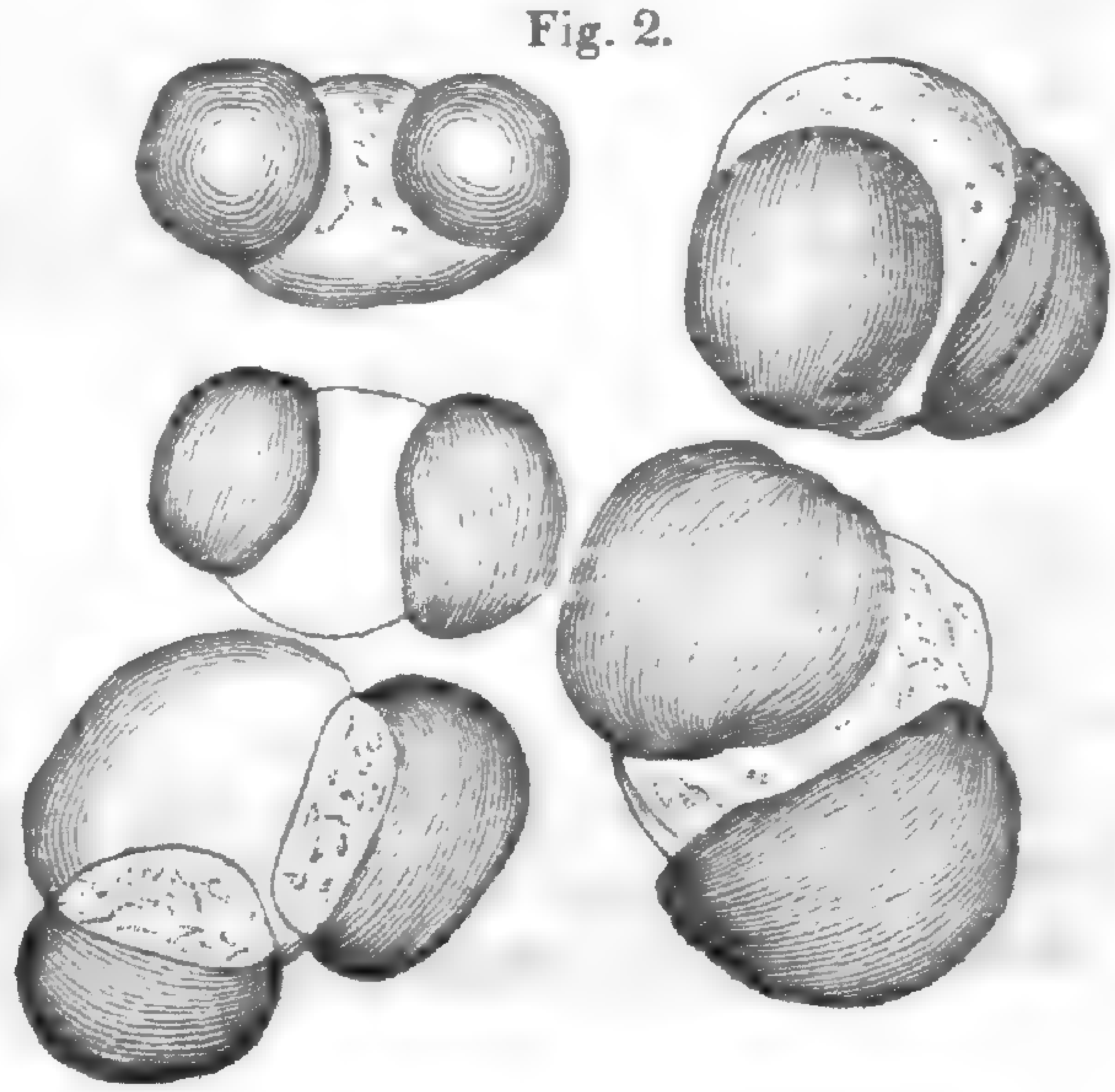
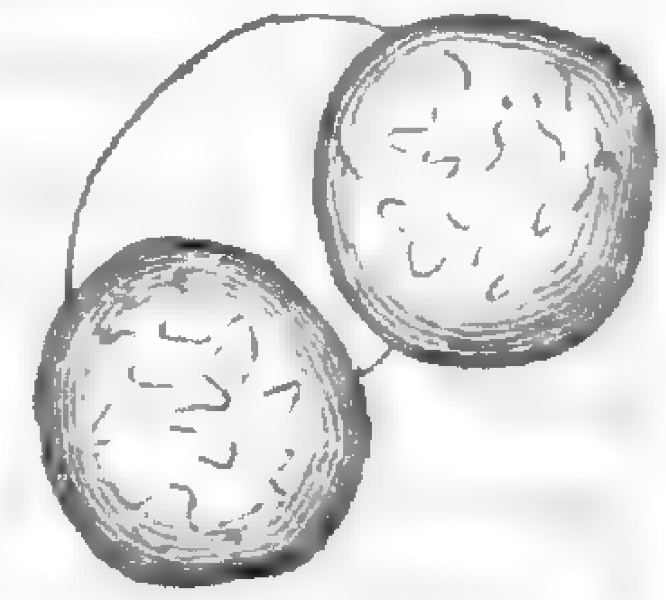


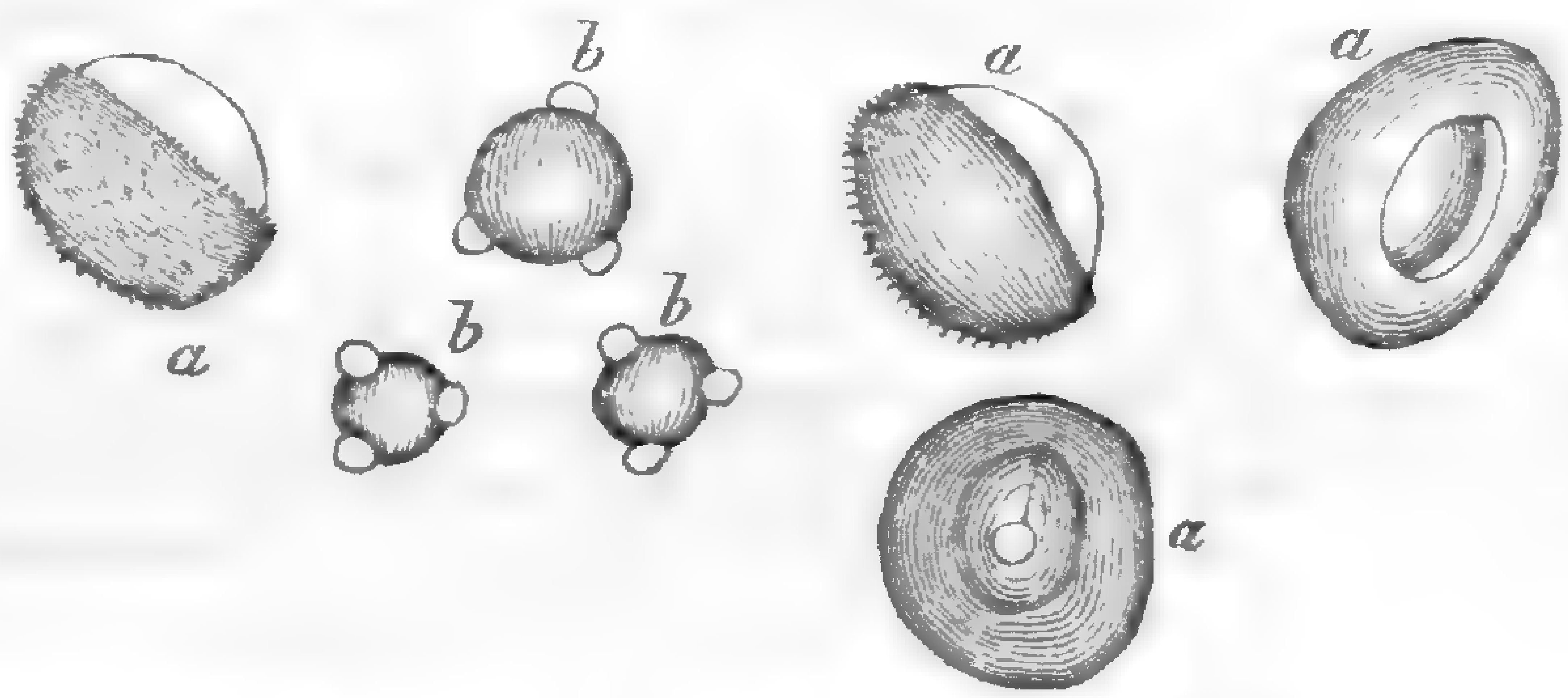
Fig. 1, represents pollen grains of Pinus rigida, taken from the flowers. Fig. 2, various pollen grains from the powder of Pictou. Fig. 3, pollen found with fossil infusoria at West Point. That these are all pollen grains of various species of pine, no one familiar with the peculiar pollen of Pinus can doubt. The analysis given by Mr. Blake, is not at all incompatible with this statement. Phosphate of lime is a well known ingredient of pollen of pine. Dr. Dana found 3 per cent. of it in Pinus abies. The presence of nitrogen in pollen, is, as you remark, well known.

Fig. 3.



With regard to the pollen from Troy, I believe it to be all pollen of various trees, but am not able to state positively what plants furnished it. I think no part of it can be sporules of Lycopodium, as our species of that genus do not flower until July or August; whereas the powder in question fell in May. The species too of Lycopodium are scarcely abundant enough, I should think, to furnish such large amounts of the powder. I send you some sketches of the pollen grains of which the Troy powder is composed. The larger particles, (Fig. 4,) *a*, *a*, *a*, *a*,

Fig. 4.




compose the greater portion of the powder; I presume there would be no difficulty in identifying them with the pollen of some tree growing near Troy and flowering in May. The smaller particles *b*, *b*, *b*, in their triangular shape, and the protrusion of pollen tubes from the angles, resemble the pollen of various plants of the natural family Onagrariæ. The last figures are drawn to the same scale as those preceding, and were all sketched with the camera lucida eye-piece, and a moderate power of my Chevalier's microscope. You will notice that there is no pollen of pine in the Troy powder. Believe me, very sincerely, your friend, J. W. Bailey.

4. *Brief Strictures on Art. XV, Vol.* xxxiv, *p.* 169, *of this Journal.*—Looking over the thirty fourth volume of the Journal, I met with a very interesting article on the Dry Rot. At variance with the pre-

vailing opinion, the writer of that article believes that timber is most durable when obtained from trees cut during summer. I am not prepared to call in question the correctness of his belief; but on the contrary, I am able to say, that as far as my observations have been extended, they have proved corroborative of it. There are some points, however, affecting his *theory*, which, I think, require further consideration.

Agreeably to his view, the sap of vegetables is confined to the alburnum during summer, but on the approach of frost, it retreats to the heart-wood, where it remains during winter. And thus, he supposes, the fluids of the tree continue to circulate between the heart-wood and alburnum year after year while the tree lives. As the writer speaks of the "exact thickness of the alburnum," I presume he means by the term alburnum, *all* the white-wood, or all those concentric layers which lie exterior to the colored central portion of the trunk; and from which they are separated by a well defined circle. If this presumption be true, it appears to me that grave objections rest against his theory. The summer and winter reservoirs, which he appropriates to the sap, are not always of equal capacity; indeed, they are very rarely, if ever, precisely so. Some trees between one and two feet in diameter, have, as I find by calculation, thirty eight times more alburnum than colored wood. Others, of smaller dimensions, on a transverse section of the trunk, show a mere speck of heart-wood, capable of holding not more than a two hundredth part of the fluids of the alburnum. If a deduction be made from the capacity of the central wood, on account of superior density of structure, the difference will be still greater in the contents of the two reservoirs. The author of this theory, (perhaps I ought to say hypothesis,) must then either find an autumnal outlet for the excess of moisture, or abandon his opinion.

Again, phytologists tell us, without reserve, that heart-wood consists of "*dead* and fully formed central layers." If all vital action has ceased in this portion of the tree, it is not only unnatural to suppose that living fluids are deposited for preservation in a dead receptacle, but it is difficult to conceive how these fluids are to be conveyed through lifeless channels.

In his ninth paragraph, I was struck with the following extraordinary assertion: "The results of these experiments accord with a known fact in regard to the sugar maple, namely, that no sap can be obtained from the tubes of the alburnum of that tree, and therefore they are obliged to bore the hole for the tube through the alburnum, into the heart-wood before it will run." The truth is, that if the bark be removed from any part of the sugar tree, the slightest laceration of the alburnal vessels will produce, at the season of the year alluded to, a copious flow of "water." By means of a penknife, I have often cut through the bark of this tree and barely wounded the wood below, yet at this trifling outlet, the sugar water has continued to discharge itself all day. Waggons not unfrequently are driven over the exposed roots, so as to grind off the bark; and the hub is as often brought into contact with the tree, so as to rub the bark off from the trunk: from these wounds, there always flows, at the close of winter, sugar water enough to moisten the road for a considerable distance from the tree. Our farmers in the west, where the *Acer saccharinum* abounds, never think of boring more than an inch or two into the tree; the object being merely to secure a hold for the inserted tube. Were they to extend the boring into the heart-wood, they would not only soon destroy the tree, but they would never be compensated for this additional labor; and I venture to say, they would not obtain one drop of fluid from the heart-wood; whence, on the contrary, the writer before us, imagines all the sugar water is derived. On warm days in winter, I have seen the stump and trunk of sugar trees cut down in that season, moistened from the bark to the central colored layers, by the water oozing from all parts of the alburnum; while the heart-wood, to all appearance, was as "dry as a broomstick." I may add: it is well known that in summer, when the writer quoted supposes the sap to be restored to the alburnum, no fluid can be obtained from the tree by boring into it.

The *Acer saccharinum* is one of those trees, whose colored centres, bear a very small proportion to the bulk of the alburnum.

Perhaps in this connection, I may be allowed to make a collateral criticism upon a wood-cut in one of the early numbers of the Family Magazine. The engraver, designing to illustrate the process of sugar-making, a very correct account of which is given in the text, has represented a laborer holding a tub with both hands, at the foot of a tree, from which issues a stream with such force as to form a parabolic curve: if I recollect rightly, another individual stands near with another vessel to slip under the jet, the moment the tub should become filled. We have no such trees as this, in the west. It is questionable whether the engraver ever made acquaintance with a sugar tree. There is perhaps no art or study which is not facilitated or enhanced by the acquisition of general knowledge.

The writer, in order to sustain his opinion, further remarks, proof "may be found in the practice of the pioneers of our western hard wood forests; there, as I have been informed, they used to girdle their trees in the winter, for the very purpose of having them rot and fall down, and thereby save the necessity of cutting them." The practice of girdling trees, is still prevalent throughout the west; the object being to get rid of the timber with the least labor. But I am not aware that any theoretical views influence the workmen in selecting the winter for this purpose; that season is chosen, as far as I have learned, simply because it is the most leisure period in the year. For the same reason, fire-wood is generally cut at that time.

The hop-hornbeam (*Ostrya Virginica*) is considered a very unfit species of wood for durability; and is scarcely ever used on that account. On the 26th of June, 1830, I had a tree of this kind cut down, the bark taken off, and the trunk, whose widest diameter was seven inches, converted into two posts and a rail. The posts, supporting the rail, were set in the ground the next day. Here they remained, exposed to all the vicissitudes of weather, till last fall, when they were removed to make way for a neater fabric. The parts inserted in the earth, were very much decayed and worm-eaten; but the exposed portions of the posts and the rail, although deeply cracked while seasoning in the air, were almost perfectly sound from the centre to the very exterior layers. Thus, contrary to the theory before us, the alburnum proved to be as durable as the heart-wood. A transverse section of one of the posts, shows an area of heart-wood, one third less than the alburnal area.

This is an interesting question; and I hope it will receive a more accurate investigation. JOHN T. PLUMMER.

**Richmond, Ind., February, 1841.**

5. *Sunset at the West.**—In a former number of this Journal, the fact of the splendid radiations of light at sunset, as it occurs in the state of Illinois and west of several of the great lakes, was mentioned to show that the cause exists in the atmosphere or *above* the earth. One of these splendid sunsets was seen in this city on the 21st of August, 1840, The western horizon for 40° perhaps on the east side of the sun, and as many above it, was of a bright blood-red color immediately after sunset, except where the blue light in three distinct radiations passed, as from the sun, in a perfectly straight line through it, and widening of course as it passed upwards. No line could appear more straight than that which bounded the blue light. The whole was brilliant.

In Illinois, a similar appearance is often seen on the east side of the horizon, directly opposite the sun, and as it has just disappeared below the horizon. My attention had been called to this fact by a friend from that state, a few days before I visited Niagara Falls. On the evening of September 9th, at the Falls, I had the pleasure of seeing this same phenomenon in the east. The sun set with no uncommon appearance, except the stream of white light which rose high towards the zenith from a thunder cloud behind which the sun disappeared a little before it came to the horizon. As I crossed from Goat Island just after sun-

* This communication has been in our hands more than a year, but was overlooked until now.—EDS.

set, a strong red light over the sky south of east was limited on the north by a bright blue radiation. On the north of that was a yellowish red radiation, then a radiation of blue light, and then a pale yellow light which extended quite across to the thunder cloud in the northwest, at an elevation of about 35°. This appearance was seen at the same time in this city. Is it not connected with the aurora borealis?

C. Dewey.

Rochester, N. Y., Sept. 17, 1840.

6. *Shooting Stars in June.*—The following extracts from various sources, relating to shooting stars seen in different years about the 15th of June, are perhaps worthy of being published in connection, for the purpose of calling the attention of observers to this period.

E. C. Herrick.

(1.) "When we were between the Isle of Madeira and the coasts of Africa, we had slight breezes and dead calms, very favorable for the magnetic observations which occupied me during this passage. We were never wearied of admiring the beauty of the nights; nothing can be compared to the transparency and serenity of an African sky. *We were struck with the innumerable quantity of falling stars which appeared every instant. The farther progress we made towards the south, the more frequent was this phenomenon, especially near the Canaries.* I have observed during my excursions that these igneous meteors are in general more common and luminous in some regions of the globe than in others; I have never beheld them so multiplied as in the vicinity of the volcanoes of the province of Quito, and in the part of the Pacific Ocean which bathes the volcanic coasts of Guatimala. The influence which place, climate, and seasons appear to have on the falling stars, distinguishes this class of meteors from those which give birth to stones that fall from the sky, (aërolites,) and which probably exist beyond the boundaries of our atmosphere."—*A. Von Humboldt's Personal Narrative, trans. by Helen M. Williams.* 3d ed. Lond. 1822–9, Vol. I, pp. 75, 76.

The season which appears to be referred to in that part which I have put in italics, is from the 15th to the 20th of June, 1799. Possibly the original is somewhat exaggerated in the translation.

(2.) "We did not, in consequence, reach Koum Kalé, till two in the morning, [of June 18, 1812,] when we found a boat waiting for us in which we went immediately on board the frigate, [anchored off the entrance into the Dardanelles.] During our passage there, I was surprised at the number of meteors, called falling stars, which I observed in the clear sky: we were only half an hour rowing to the ship, and in that time I counted nineteen."—*Journal of a Tour in the Levant, by William Turner, Esq.* Lond. 1820, 3 v. 8vo., Vol. I, p. 41.

(3.) "Here in the torrid zone, the sea of an indigo blue color, rolled in uniform waves, and began to shine generally, and with great splendor, during the night; a phenomenon which we had hitherto seldom observed. This magnificent appearance, the frequent lightnings, *and innumerable falling stars*, together with the greater sultriness of the air, seemed to indicate a higher degree of electricity in the element," &c.—*Spix and Von Martius's Travels in Brazil*, 1817–20, *trans. by Lloyd.* Lond. 1824, Vol. I, p. 105. [Refers to a date between June 12 and 15, 1817.]

A day or two later, in lat. 10° N., lon. 23½° W.:

"Variable winds cool the atmosphere; numerous falling stars, coming particularly from the south, shed a magic light," &c.—*Ib.* p. 110.

About the first of July, 1817, when a little south of the equator:

"Falling stars illumined the night more frequently than in the northern zone, and generally fell towards midnight in the south, and towards morning in the northeast.—*Ib.* p. 118.

(4.) In an account of the meteoric shower of Nov. 13, 1832, as seen at Brussels, is this remark:—

"Il en est qui ont prétendu se rappeler que les mêmes signes avoient précédé de quelques jours la bataille de Waterloo;"—[June 18, 1815.] *Gautier, in Bib. Univ. de Genève,* 51: 198.

7. *Shooting Stars of August* 10, 1841.—A few observations made in this country on the meteors of August 10, 1841, were published at p. 399, of the last volume. The following European observations, communicated to me, with others, by M. Quetelet, agree with those above mentioned, in showing that the meteoric sprinkle of August 10th, did not fail the present year. It will be remembered that after 10h. 45m. P. M. on the 10th, the moon, sixteen days old, was above the horizon; and further, that of the meteors visible at any time, one person cannot detect more than a fourth part. E. C. H.

1. *Ghent*, Belgium. Professor Duprez, watching in the S. W. quadrant, saw alone, during three hours, *fifty eight* shooting stars, as follows: viz. from 9h. 30m. to 10h. six; 10h. to 11h. fifteen; 11h. to 12h. twenty four; 12h. to 12h. 30m. thirteen. Nearly all were very brilliant; moving from N. E. to S. W. and leaving luminous trains behind them.

2. *Parma*, Italy. M. Colla, with a friend, observed on the night of Aug. 9, 1841, *eighty* shooting stars between 8h. 44m. and 2h. 14m. of the next morning; on the night of the 10th, *two hundred and eighty three*, as follows: viz. from 8h. 47m. to 8h. 59m. five; 9h. to 9h. 58m. thirty five; 10h. 1m. to 10h. 56m. forty one; 11h. 1m. to 11h. 59m. thirty seven; 0h. 1m. to 0h. 58m. forty four; 1h. 2m. to 1h. 59m. forty four; 2h. 2m. to 2h. 58m. forty three; 3h. 2m. to 3h. 40m. thirty four. On the night of the 11th, he observed *eighty two*, between 8h. 37m. and midnight.

8. *Meteorology.*—In Vol. XL, p. 402, we gave a notice of the labors of M. Morin, of Vesoul in France, relative to a grand generalization of meteorological phenomena and the resulting laws, and added an extract of a letter from M. Morin to the senior editor.

In a subsequent letter dated Vesoul, (220 miles northeast of Paris,) Oct. 5, 1840, the author earnestly solicits from American sources, exact and ample information, as far as attainable, relative to the meteoric phenomena in North America for the years 1719, 1721, 1724, 1726, 1731, 1733, 1738, 1749, 1763, 1764, 1766, 1769, 1776.

If it should be in the power of any person to furnish the information to M. Morin, either through this Journal or the mail, he will promote the common cause. His address is Vesoul, France, or care of M. Caroliare Jeewry, Bookseller, Quai des Augustins, No. 111.

9. *Fall of a Meteoric Stone at Grüneberg in Silesia.*—On the 22d of March, 1841, at 3½ P. M., the inhabitants of Heinrichau, who were abroad in the fields, heard three heavy reports like thunder-claps in the air, and soon after, a whizzing noise which ended in a sound like that of a heavy body falling to the ground. The sky at the time was almost wholly clear. Some persons went in the direction from which the sound came, and after proceeding about one hundred and fifty paces, found a fresh hole in the earth, at the bottom of which, about half a foot below the surface, they found the stone which had just fallen. The stone (which is of the form of a four-sided pyramid) is evidently a fragment of a larger one which burst in the air; three of its sides are broken, the fourth is covered with the thin black crust peculiar to meteorites. It weighs two pounds four ounces. A fuller account of the occurrence, and of a chemical examination of the meteorite by Weimann, will be given hereafter.—*Poggendorff's Annalen, Mch.* 1841.

10. *Meteorite in France.*—Galignani's Messenger mentions that at a late session of the French Academy, a communication was received from M. Delavaux, stating that on the 12th of June, (1841,) between one and two o'clock in the afternoon, the sky being without a cloud, an explosion was heard at Chateau Renard, in the department of Loiret, louder than several pieces of artillery firing together. He suspected that this must have proceeded from an aërolite; and on going to the spot where the noise had been loudest, found there the marks where the aërolite had struck the earth, as well as several fragments of such a body, lying about. Most of these fragments were small, but one weighed thirty pounds, and another six pounds.—*New York Observer, Aug.* 14, 1841.

11. *Another Meteorite in France.*—A meteor of unusual size, being, according to some accounts, as big as a tun, fell near Bethune, (N. lat. 50¼°, E. lon. 2⅓°,) in the Pas de Calais, France, making a rushing noise like the passage of a hurricane.—*Ib., Nov.* 13, 1841.

12. *Remarks and suggestions with regard to the proper construction and use of apparatus for solidifying carbonic acid;* by J. Johnston,

A. M., Professor of Natural Science in the Wesleyan University, Middletown, Ct.—The remarks I have to make, have reference to the conditions required in order to obtain the greatest quantity of liquid, and, as a matter of course, of solid carbonic acid, from a given quantity of materials.

The different sets of apparatus for solidifying carbonic acid that have been made in this country, with one or two exceptions only, it is believed, have been constructed in every essential particular, precisely like that of Dr. Mitchell,* who enjoys the honor of having been the first in America to repeat the beautiful experiment of Thilorier. This apparatus accomplishes the object perfectly; but the quantity of solid acid obtained from it at a single charge, as it is ordinarily used, is probably considerably less than the same materials are capable of affording, by a little different management.

In order to obtain the greatest quantity of the acid, in the liquid form, from a given quantity of materials, it seems to be requisite that three points be particularly attended to. First, the capacity of the receiver should sustain a proper ratio to that of the generator;† secondly, the quantity of materials used should be sufficient *very nearly* to fill the generator; and thirdly, the difference of temperature between the receiver and generator, when the liquid acid is distilled over, should be as great as practicable.

As it regards the first point, without presuming to speak positively on the subject, my experience leads me to think the capacity of the receiver should be about one sixth of that of the generator; certainly it should not exceed one fifth. In the apparatus used in this institution,‡ the receiver is but little more than one seventh of the capacity of the generator, but at every operation, when the generator is properly charged, it is completely filled with the liquid acid, and the probability is that more might be obtained if it was a little larger. If however the capacity were more than just sufficient to contain the acid in the liquid form that distills over, all the additional space would of course be filled with the same acid in the form of gas but exceedingly dense, so as to cause an essential diminution in the quantity of liquid. In

* Journal of the Franklin Institute, Vol. xx, p. 289, and Vol. xxx, p. 346, of this Journal.

† Dr. Mitchell gave the name, *generator*, to the vessel into which the bicarbonate of soda, sulphuric acid, &c. for forming the carbonic acid, are placed; and called that the *receiver*, into which the liquid acid is distilled; and his terms have been universally adopted.

‡ Described in Vol. xxxviii, p. 297, of this Journal. It is there stated that the capacity of the receiver is about one pint, but it should have been three gills. The mistake was made by attempting to ascertain its capacity by external measurement, and calculating its solid inches.

Dr. Mitchell's apparatus, the capacity of the receiver is about one fourth of that of the generator, which is probably so large as to occasion considerable loss in this way.

But it is important also that there should be no unnecessary space in the generator, or in other words, that the materials used to charge it, should *very nearly* fill it. After introducing the vessel of sulphuric acid and inserting the plug, there must of course remain a little space filled only with air ; and this probably is necessary, for after chemical action takes place, the several substances formed appear to occupy a little more space than before. But if possible, the quantity of soda, &c. used, should be such that the sulphate of soda which is formed, and carbonic acid *in the liquid state*, should entirely fill the generator. If then the receiver is of the proper capacity, after the liquid acid is distilled over into it, there will remain only the space it previously occupied in the generator to contain the gaseous acid, which of course must be lost ; but this is the least loss which the nature of the case admits of.

When our apparatus was first constructed, (the generator of which holds five pints,) we were accustomed to use at a charge two pounds of the bicarbonate, and sulphuric acid and water in proportion, from which we obtained but a very little of the liquid in the bottom of the receiver ; but upon increasing the quantity to two and a half pounds of soda, with sulphuric acid, &c. in proportion, we were at first a little surprised to see the liquid come over until the receiver was *entirely full*, and with such rapidity as to leave the impression upon the mind, that more might have been obtained if the receiver had been a little larger. Once or twice only we have made use of two charges of two ponnds of soda each, condensing the whole of the liquid acid obtained into the receiver, which, however, was then scarcely filled. If therefore we may put confidence in these results—and we believe they may be relied on—we arrive at this conclusion, that two and a half pounds of the bicarbonate of soda, with sulphuric acid, &c. in proportion, used at a single charge in an apparatus of the capacity of ours, will afford quite as much or more liquid carbonic acid, than five pounds of soda, &c. used at two separate charges.

The third point mentioned above as requiring attention, is the difference of temperature between the receiver and generator during the distillation of the liquid acid into the receiver. This may be accomplished either by heating the generator or cooling the receiver, but the last is much the best method. Dr. Torrey informs me that he has sometimes surrounded the receiver with a powerful freezing mixture, with excellent effect. We might even unite the two methods, using proper precautions, but the enormous pressure of the gas increases so rapidly with the increase of temperature, that it can scarcely be considered safe to apply heat to any part of the apparatus.

After the liquid acid is obtained in the receiver, in order to prevent the waste of the solid by being blown from the cup as it forms, I find considerable advantage in having the cup made quite deep in proportion to its diameter, and allowing the liquid acid to escape from the receiver by as small a jet as possible.

13. *Alabaster in the Mammoth Cave of Kentucky.*—After crossing within the cave, several streams in boats, an apartment has been reached, the roof of which is decorated with the most gorgeous ornaments of alabaster, so much like a work of art as to surpass credibility. They are white and semi-transparent, and are thrown out from the rock in the form of rosettes, leaves, and curled enrichments of the composite capital in architecture. I have not had the pleasure of visiting the locality myself, but send you this sketch from a collection of the ornaments which I have just seen in the cabinet of Miss Longworth of our city. These were procured in a recent visit to the caves, by her sister, Mrs. Anderson, who has given me a verbal description of "Cleaveland's cabinet," as the compartment has been denominated. I was at first at a loss to account for such beautiful formations, and especially for the elegance of the curves exhibited. It is however evident that the substances have grown from the rocks by increments or additions to the base; the solid parts already formed being continually pushed forward. If the growth be a little more rapid on one side than on the other, a well proportioned curve will be the result; should the increased action on one side diminish or increase, then all the beauties of the conic and mixed curves would be produced. The masses are often evenly and longitudinally striated by a kind of columnar structure, exhibiting a fascicle of small prisms, and some of these prisms ending sooner than others, give a broken termination of great beauty, similar to our form of the emblem of "the order of the star." The rosettes formed by a mammillary disk surrounded by a circle of leaves, rolled elegantly outward, are from four inches to a foot in diameter. Tortuous vines, throwing off curled leaves at every flexure, like the branches of a chandelier, running more than a foot in length, and not thicker than the finger, are among the varied frost-work of the alabaster grottoes; common stalactites of carbonate of lime, although beautiful objects, lose by contrast with these ornaments, all of their effect, and dwindle into mere clumsy awkward icicles. In order to give yourselves and your readers some idea of the acanthus-like curl of some of the leaves, I send you a pencil sketch of one of them. It is the original scrap, and does the subject great injustice; you will readily see that there are several "unconformable" lines, as at *a*, not in the original, but mere awkward attempts to hit the curve of beauty before me. Besides these there are

tufts of "hair salt," native sulphate of magnesia, depending like adhering snowballs from the roof, and periodically detaching themselves by their own increasing weight. Indeed the more solid alabaster ornaments become at last overgrown, and fall upon the floor of the grotto,


which was found covered with numbers quite entire, besides fragments of others broken by the fall. It seems to me that *geologically* these elaborate works of fairy gnomes may be considered in part the effect of unbalanced pressure, either hydrostatic or solid, modifying chemical and mechanical action. While the arch of the dome sustains the solid mass above, any liquid or semi-liquid would be forced through the pores with a power proportionate to the depth of the cave beneath the surface, counter pressure being removed by the cavernous opening. Have the dynamics of deep pressure, liquefying or perhaps solidifying gases, &c. received the attention which is due to them in a geological point of view? Your much obliged friend, JOHN LOCKE.

Medical College of Ohio, Cincinnati, Oct. 26, 1841.

14. *Tubular concretions of Iron and Sand from Florida.*—The following statements respecting the subject named at the head of this ar-

ticle, are contained in a letter to the senior editor from Lt. James T. Gerry, of the navy, dated United States ship Warren, Pensacola, Sept. 14, 1840.

The soil in the vicinity, as well as for half a league in the interior, is ferruginous, and large detached pieces of good iron ore are frequently found. The most remarkable character of the specimens is, that they form strata of regular horizontal tubes, proceeding from a bank of red sand into the river, and becoming harder in the water and in the weather. In every instance they were hollow, but when the specimens were taken from the vicinity of the bank, the cavity was filled with sand.

Many tubes that appeared well formed in the bank, with the exterior covering apparently perfect, would not bear removal, but crumbled with the pressure of the hand. The specimens taken from the river, three or four feet under water, were the most compact, and always exhibited the horizontal position like those above tide water.

The beach is composed of sand, with the addition of the river deposit of soft mud; the "Rocky Point" being the only exception in the neighborhood, which extends about eighty yards into the river.

After pulverizing any of the hardest masses of these ferruginous concretions, the resulting substance was, in every particular, like the great mass in the bank, except that it contained more iron. Nothing like petrifaction could be discovered in these concretions or in any body in the vicinity. Thus far Lt. Gerry.

His last remark precludes the supposition that these concretions were formed around vegetable stems which have since decayed and been removed; and indeed there is not the smallest appearance of any foreign body in these remarkable tubes. They are of various dimensions, from the size of a goose quill to that of a finger, and even of a human arm; we actually slipped one of them upon the fore arm to the elbow like a coat sleeve. Several tubes of different sizes sometimes occur in the same mass—some of them are straight and you can look through them; others are tortuous and irregular in size as well as form; sometimes flat, and again collapsing into a continuous mass without a cavity. In some of them there is recorded on the exterior the perfect ripple mark, waving in graceful curves as the waters flowed with ceaseless attrition over their surfaces.

Some of the tubes are very firm, like a strongly coherent sandstone fully soaked with oxide of iron; but in all, the magnifier, if not the naked eye, detects the grains of sand, invested with or penetrated by iron.

The iron is in the condition of peroxide, and it is blended with the quartzose sand in every proportion, some of the sand and especially that in the tubes being almost white.

Ferruginous concretions are not uncommon, as in the columnar and pea-shaped argillaceous iron ores, in the bog ore, the œtite or eagle stone, and the hollow balls resembling bomb-shells; but for the form of the latter, and for the tubular structure now under consideration, it is not, perhaps, easy to offer a reasonable solution.

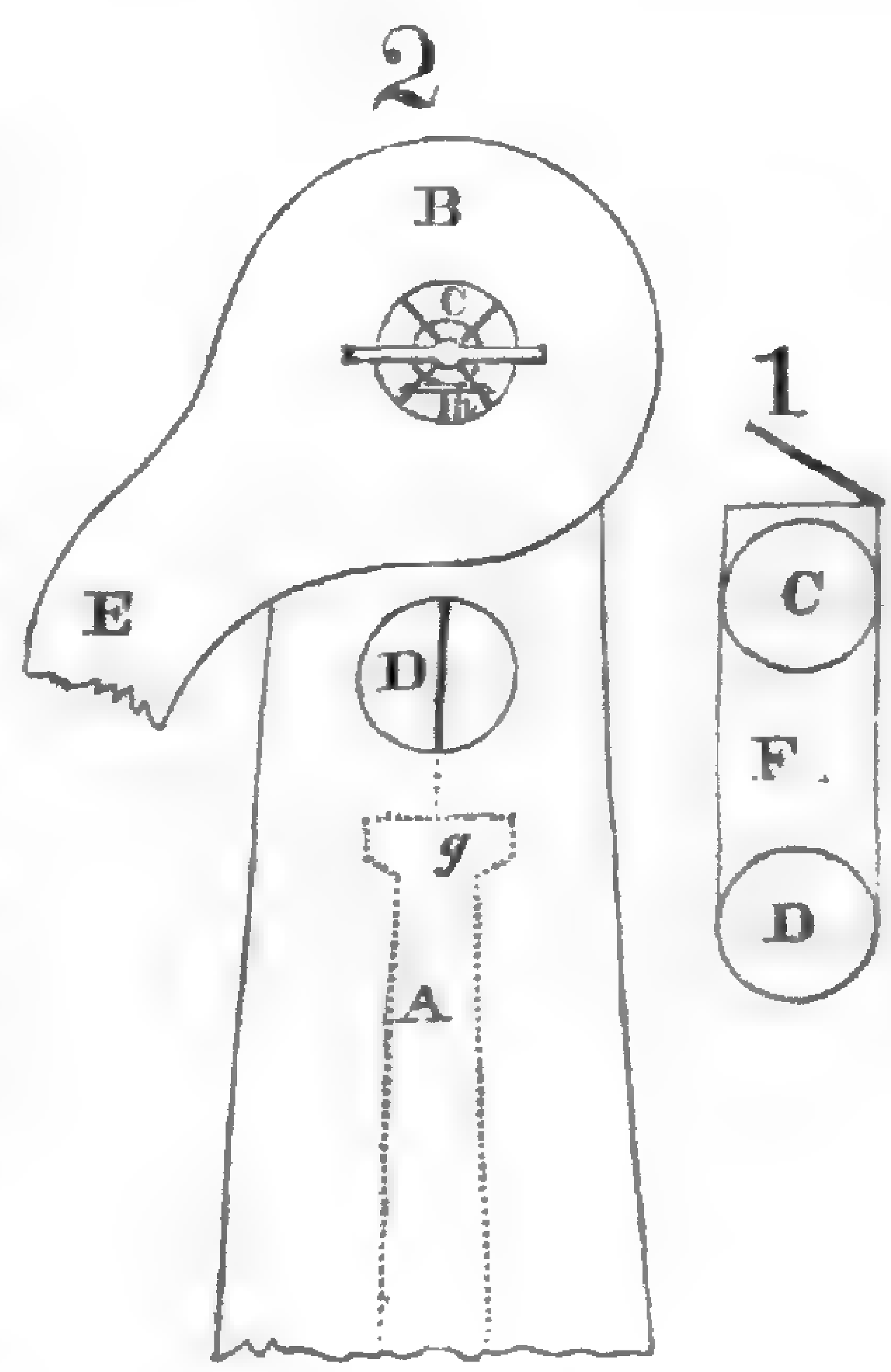
There cannot, however, be a doubt that the iron has been brought in by water, and that the form which the concretion assumed has been determined by extraneous causes.—Senior Editor.

### 15. *Spark Extinguisher.*

Keene, N. H., July 19, 1841.

To the Editors of the American Journal of Science and Arts.

*Gentlemen*—Annexed is a drawing of an apparatus, which I have tried on a small scale, for destroying the smoke and sparks of locomotive engines, and it operates effectually. It consists of a revolving fan, operating in a cylinder on the top of the chimney, or it may be placed in any other situation if it communicates with the smoke chest. B, the cylinder in which the fan revolves. A, the chimney of the engine. When the fan is in motion, there is a rush of air through the apertures, C, into the cylinder, from whence it is driven through the funnel E. Now if a communication be made between the chimney and the opening C, by means of a funnel F, the operation will be manifest; all the smoke and sparks will be drawn out of the chimney at D, through the funnel F, into the fan cylinder, from whence the pipe E may conduct them on the ground or to the fire; the wings of my fan are semi-cylindrical, with the concave side to the air. This form will throw off more air, and cause a stronger draught through C, which may be regulated by the velocity of the fan. The fan may be driven by the steam after it passes the piston, by placing a small float wheel at the top of the eduction pipe; this pipe may be enlarged at the top so that the passage may not be diminished when the wheel is placed there; the dotted lines in the drawing show the position of this pipe in the chimney; the wheel is placed in the large part *g*, and propels the fan by means of a gear at the top of its shaft, shown at *h* in the figure; the doors at the top of the funnel F may be raised while raising the steam.



I trust, through the medium of your Journal, this will meet the eyes of some who are engaged in locomotive machinery, and will test my plan on a large scale. F. G. WOODWARD.

16. *Destructive Thunder Shower.*—The thunder storm of the evening of September 14th, 1840, will long be remembered in the counties of Onedia, Madison, and Onondaga, in central New York, for the damage it occasioned in the burning of buildings and the destruction of animal life. There were several circumstances attending this storm, which, from their peculiar character, appear to deserve a particular notice.

The first of these was the low temperature, which had existed for several days previous, as the following table will show.

| | 9 o'clock. | 2 o'clock. | Wind. |
|---|---|---|---|
| September 11, | 48° | 48° | N. W. |
| " 12, | 43° | 55° | N. |
| " 13, | 62° | 68° | N. |
| " 14, | 56° | 65° | N. |
| " 15, | 50° | 66° | S. W. |

A temperature as low as this, has generally been deemed incompatible with the formation of thunder showers, much less of such an astonishing development of electricity as the evening of the 14th exhibited. All the days noted, with the exception of the first, which was cloudy with a little rain, were clear, and remarkably fine.

Another novel circumstance was the firmness of the wind in the north for so long a period, and the approach of the shower from that quarter. A thunder shower in central New York from the north is a very rare occurrence, not witnessed oftener perhaps than once in fifteen years. The most common point of their appearance is from W. to S. W., eight out of ten perhaps rising within that part of the heavens. Observation has shown, that whatever may be the course of the lower currents of air, (and no less than four have been distinctly noticed, existing at the same time,) the upper is almost invariably from the west; and from some cause not perhaps as yet well understood, thunder storms rarely deviate essentially from this direction.

Another remarkable feature of the shower was the total absence of any wind, so far as we observed, or have heard. The clouds moved very slowly; the rain poured down perpendicularly, and there were none of those fitful gusts, or sudden changes, that generally mark the violence and duration of our thunder showers. Very little commotion of any kind could be observed in the clouds, although the continued electric blaze showed their whole outlines distinctly. The development of electricity was wholly unprecedented, and considering the low temperature, and the quarter of the heavens in which the shower originated, is difficult to account for. It resembled one of those tropical storms which announce the breaking up of the dry, and the commencement of the wet season.

About the middle of the afternoon of the 14th, masses of clouds were observed low in the N. and N. E., and the presence of the cirri connected with them, clearly indicated their character. At 5 o'clock distant thunder could be heard; and at dusk the horizon from N. to N. E. was almost constantly illuminated by continued flashes of lightning. These seemed to originate mostly from two points, one nearly N. and the other about N. E.* The movement of these clouds was so very slow, that the storm did not commence until past 9 o'clock in the evening, and was at its height from half past 9 till 10 o'clock. During the approach and continuance of the shower, the appearance was strikingly sublime. There was scarce a moment in which streams of electric fluid were not pouring from the clouds in dazzling brilliancy; and peal after peal succeeded each other with such rapidity, that the roar and rattle was continuous and deafening, and so violent that windows, buildings, and even the solid earth, trembled with the concussions. It was not the deep rolling thunder of the summer cloud, in which only an occasional discharge of electricity reaches the earth; but those sharp, instantaneous and crashing reports, which told that the fire of heaven's artillery was as effective as it was rapid. That such was the case is evident from the fact, that at one point in the south part of Onondaga, the lightning struck no less than eight or ten times within a circle of a mile in diameter; and in another case, in a wood of only about thirty acres, it struck in no less than five different places. As already observed, there was no wind, and the rain poured perpendicularly in sudden dashes; now, as though the sluices of the clouds were opened, and then ceasing as totally as if they had been instantaneously closed.

The destructive effects of the lightning show that the central points of the storm passed from the north; one, a little west of the central part of Onondaga county, and the other crossed in the same direction over Oneida and Madison counties. We have noticed in the journals of these three counties the destruction of no less than nineteen barns, with sheds, cowhouses, &c., and in the county of Cortland, two barns, one dwelling house, and several outhouses; and every where in the course of the showers, great numbers of horses, cattle, sheep, and swine were killed. Fortunately, although several dwelling houses were struck, and many persons were knocked down or severely stunned, there were none killed, so far as we have learned.

---

*It will be remembered that the place of observation was about fifteen miles W. of S. from Syracuse, Onondaga Co.

According to the record of an eastern paper, the number of buildings destroyed in the United States by lightning up to the first of September, had been about fifty; and of these, four fifths were barns. Several houses had been struck that were not burned, while a barn so visited rarely escaped. These facts, taken in connection with the destructive results of the storm of the 14th on barns, and the very great loss of property sustained, would seem to point out the imperative necessity of securing these buildings by rods, or the owners from loss by insurance. It cannot be too forcibly impressed on the mind of the farmer, who of all others is most liable to suffer in this way, that the danger of losing his barn is much greater than that of having his house destroyed; and that their liability to destruction by lightning is most imminent at precisely that period when, by the labors of the year, the greatest value is accumulated in them.

It may be mentioned here as a singular fact, that on the evening of the 13th, cold and severe frost occurred at several points in the Carolinas; indicating a remarkable departure from the ordinary meteorological condition of the atmosphere at that season of the year, and possibly having some direct connection with that state of things which generated such an unusual quantity of electricity at the north. W. G.

Otisco, N. Y., January, 1841.

17. *Elementary composition of vegetable tissue.*—M. Payen, has been engaged in the microscopical and chemical investigation of the different tissues, and has read some memoirs on the subject before the French Institute. He concludes, 1. That *cellulose*, which constitutes the membranes of plants, when purified from all encrusting or deposited matters, is perfectly homogeneous in chemical composition throughout the whole extent of the vegetable kingdom. 2. That this substance, which may be represented by the formula $C^{24}H^{18}O^{9}, H^{2}O$, is isomeric with starch, dextrine, and inuline. 3. That its physical properties, and doubtless its nutritive qualities, are modified by the degree of aggregation; when very dense, it resists different chemical agents and the digestive powers in a remarkable manner. 4. Medulline, fungine, lichenine, have no existence as distinct proximate principles; properly purified, they prove to be identical with *cellulose*. 5. Gluten does not form a tissue, but is an immediate principle, enclosed in the cells of the albumen of the seeds of many Cerealia. 6. Azotized substances accompany all vegetable productions, and are found in all cells in their forming state; but they are not a constituent of the membrane of cellular tissue, nor of any vegetable tissue. 7. Vegetable membrane may be thus distinguished from animal membrane: the former have a ternary composition, from which nitrogen is excluded; the latter constantly offer a quaternary composition including nitrogen.—Vid. *Ann. Sci. Nat.* Aug. 1840.

18. *Mr. Lyell and Mr. Murchison.*—Mr. Lyell, the distinguished English geologist, now in the United States, having finished his course of lectures in the Lowell Institute in Boston, is warmly solicited by many of the first citizens of Philadelphia, to repeat his lectures in that city; we understand that he will comply with their wishes, and thus afford to them, as he has done to the citizens of Boston, a rich intellectual treat. Mr. Lyell's lectures, like his writings, are analytical; unfolding the copious and accurate results of his own wide-spread and scrutinizing researches in many countries, he leads his audience forward through the very paths which, for twenty years he has himself trod, in acquiring the knowledge whose rich stores he lucidly displays along with that which others have contributed. The elementary information which he imparts, is the result rather than the text of his instructions.

It were to be desired that this highly gifted philosopher were allowed sufficient time to follow out this most instructive mode of teaching, until every department of the science shall have been fully illustrated; when, in conclusion, a synthetical summary of general principles, founded on the ample basis of his own detailed and exact observations, combined with those of other geologists, would present in one perspicuous and convincing view, the grand elements of the science. His pictorial illustrations are ample, and some of them of magnificent dimensions and imposing splendor. Mr. Lyell's writings present a model of skillful analysis of geological phenomena, conducted with logical accuracy and with great candor. They are adorned by a style of elegant simplicity; his Principles and Elements must ever stand in the highest order of scientific classical literature, and we trust that his active and successful researches will be continued for many years, cheered and aided as they are by one to whom, as the companion of his travels, all his views and efforts are as familiar as they are interesting. He now proceeds to the Southern States, as far as South Carolina and Georgia, and will return to give his course in Philadelphia in February. The Middle, Western and Northern States, and Canada, will occupy his spring and summer; and he will embark for England in August, at the end of a year from the time of his arrival.

Mr. Lyell's visit is most acceptable to the American geologists, who expect his presence and assistance in Boston, at their meeting, April 25, 1842, and we trust that the subsequent year may afford them the additional gratification of the presence of Mr. Murchison, than whom no one is more eminent in active and successful labors in the common cause. This gentleman has just returned to England from a second visit to the Russian empire. "He has been to Moscow, and to the Asiatic flank of the Ural Mountains. His tour has been most successful, and he will be able to throw much light on the geology of a great part of Russia. The emperor loaded him with honors and gave him every facility for travelling to any part of his vast empire."* We understand that a canal was cut for his accommodation and that of M. Verneuil, his companion.

19. *Carburetted Hydrogen encased in spheres of Carbonate of Lime.*—Extract of a letter to the Junior Editor, dated Boston, Sept. 22, 1841.

*My dear Sir*—A short time since my attention was attracted by a few small white particles which had collected on some gas-light burners, and which on examination I was much surprised to find were lime. The burners were more than a mile from the works, and I was satisfied it could have proceeded only from the purifyers, which contain lime. Pursuing the enquiry, I have discovered a great number of hollow spherical bodies, formed of carbonate of lime, and filled with carburetted hydrogen. They are from $\frac{1}{40}$th to $\frac{1}{20}$th of an inch in diameter, and, the crust or shell being thin, they are easily conveyed, by the current of gas flowing through the pipes, even to burners in chambers more than a mile distant. Yours, truly, JOHN H. BLAKE.

20. *Society of Northern Antiquaries.*—Extract of a letter from Prof. Charles C. Rafn, Secretary of the Royal Society of Northern Antiquaries, to Dr. Jacob Porter, of Plainfield, Massachusetts, dated Copenhagen, May 19, 1840.

"Are Frode and Sæmund Frode are the first, we know, who, during the latter half of the eleventh and beginning of the twelfth century, exerted themselves for the preservation and promotion of the old Danish literature. After them, in the subsequent centuries, follow a series of meritorious individuals, in whose footsteps we are now treading, making strenuous efforts in the same direction, and for the attainment of the same end. Through the combined exertions of active men, we have the satisfaction of seeing this noble literature by degrees awaken a greater interest, and acquire more numerous cultivators in both hemispheres. It rejoices us that you are inclined to take an active share in such exertions."

21. *Barometrical Observations made to ascertain the Level of the Dead Sea.*†

TO PROFESSOR SILLIMAN.

*Sir*—Thinking the following observations, made to ascertain the level of the Dead Sea, might be interesting to you, I take the liberty to forward the same. They were made by Sir David Wilkie, W. Woodburn,

* Letter from Dr. Mantell to the Senior Editor, dated Nov. 9, 1841, near London.

† This interesting communication has come to our hands just at the moment of closing the present number, or it should have been placed among our articles.—EDS.

Esq. and myself, in March last, as you will see by reference to the dates.

You will be concerned to learn, that the talented gentleman who suggested these observations, (Sir David Wilkie,) recently died near Gibraltar, on his return from a visit to the Holy Land. He had secured a large amount of memoranda at Jerusalem, Dead Sea, Bethlehem, and other places in Palestine, from which he hoped to create a new and better order of scripture painting; in which, had his life been spared, he would undoubtedly have succeeded. But his work is done, and the gifted pencil which has so often made the canvass breathe, is forever laid aside. With sentiments of respect, I remain your obedient and humble servant, E. R. BEADLE.

Aleppo, August 27, 1841.

*Barometrical Observations.*

| Places. | Barom. | Therm. | Weather. | Time. | Remarks. |
|---|---|---|---|---|---|
| Jaffa, | 29.958 | 59½° | fine | Mar. 1st | Level of Mediter. |
| Jerusalem, | 27.438 | 55½ | fine | " 3d | |
| St. Saba, | 29.352 | 68 | threat'ning rain | " 4th | |
| Dead Sea, | 31.372 | 68 | do. wind N. | " 5th | level of Dead Sea. |
| One half hour above Jericho, | 30.575 | 76 | rain | " 5th | |
| Two hours farther up, | 29.106 | 67½ | foggy | " 6th | |
| Four and a half hours above Jericho, | 28.406 | 70 | fine | " 6th | |
| Jerusalem, | 27.278 | 64½ | high wind | " 6th | |

*Recapitulation, without reference to Thermometer.*

| | | | | |
|---|---|---|---|---|
| Jerusalem, higher than the Mediterranean, | | | . . | 2,520 feet. |
| St. Saba, | " | " | " . . | 0,606 " |
| Dead Sea, lower | " | " | . . | 1,414 " |
| Jericho " | " | " | . . | 0,617 " |

22. *Picture of a Parthian Archer, by David Scott.*—Mr. John Dunlop of Edinburgh, well known a few years ago as a most intelligent and amiable traveller in this country, has recently transmitted for the Trumbull Gallery of Yale College, a splendid picture by Mr. Scott, an artist of the Edinburgh school. This painting is three feet ten inches, by three feet three inches, and is superbly framed in the Elizabethan pattern. Mr. Scott completed his studies at Rome, where he imbibed a decided partiality for the works of Michael Angelo, to the most beautiful of whose Sybils some resemblance is traced in the face of the Parthian archer.

The figure is massy and powerful, like some of the forms of American Indians whom Mr. Dunlop had seen and admired beyond the Mississippi. In illustration of Mr. Scott's genius, Mr. Dunlop has been so kind as to forward to us a copy in folio of twenty four engravings of designs by this artist, illustrative of Coleridge's Ancient Mariner, which met the decided approbation of the author of the ballad. There is great muscular and intellectual character in these designs; indeed, Mr. Scott is said to have sacrificed much to form and character, foregoing the soft and beautiful contrasts which are generally more delightful. In the Art Union, of London, a paper devoted to the fine arts, the intellectual power of Mr. Scott's productions is fully appreciated. Among his late works, the Alchymist is distinguished. "The wily professor is swinging back in his chair amidst a crowd of votaries worthy of Chaucer's fancy, and holding in his hand some redoubtable elixir, whose virtues, known and unknown, are sufficiently impressed on the arch chemist's countenance." The Parthian Archer is a figure of great force, and the splendid bow which he holds bent, with the arrow drawn to its head and ready to let fly, is after the representations of the Parthian bow found on ancient vases. A drawing of it was furnished, last winter, to Mr. Dunlop, by Sir John Macniel, late ambassador to Persia. The bow is bent backward, and when unstrung takes the form of a C: "there is therefore more power exerted in the flexion than is apparent to the eye." The admirer of Young's Night Thoughts will recollect the allusion respecting our past thoughts and actions—

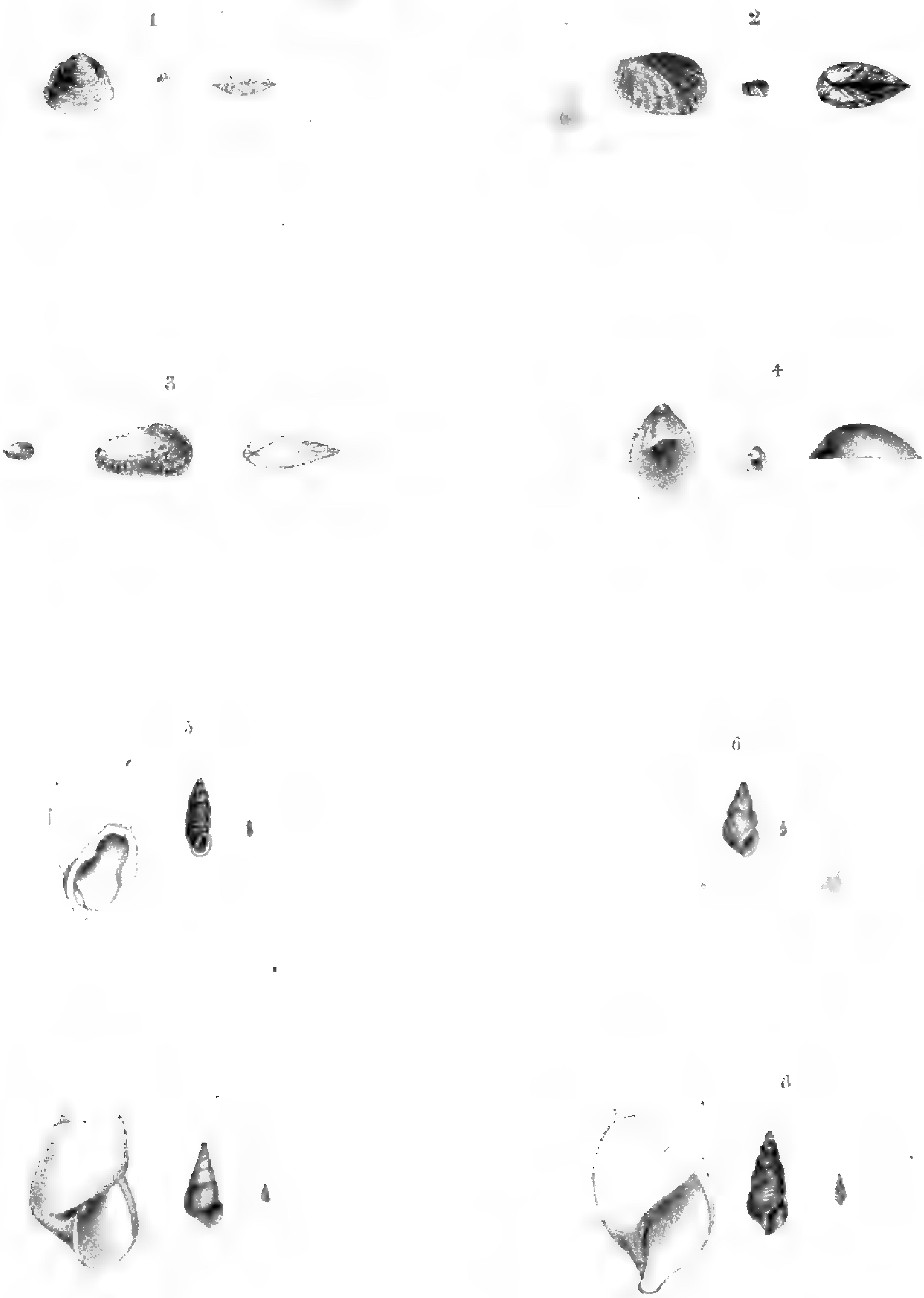
> "Whose yesterdays look backward with a smile,
> Nor like the Parthian wound him as they fly."

23. *Correction.*—Messrs. Editors: Since writing my article upon the Melanians, (Vol. XLI, p. 21,) I have been able to examine living individuals of Melania undulata, Say; and find that it is not congeneric with Nerita aurita, Müll., as I supposed from a comparison of the shells. The former is a true Melania, whilst the latter belongs to the Cerithidæ, of which it constitutes a new genus, next to Potamis.

Genus CLAVIGER. Shell like Melania, but with a sinuated labrum, and a sinus at its junction with the columella. Type, C. aurita: icon. Guerin's Mag. pl. 12 and 13, the latter being C. tuberculosa. The characters of the animal are those given to Melania by Deshayes in his edition of Lamarck, Vol. VIII, p. 427, 8.

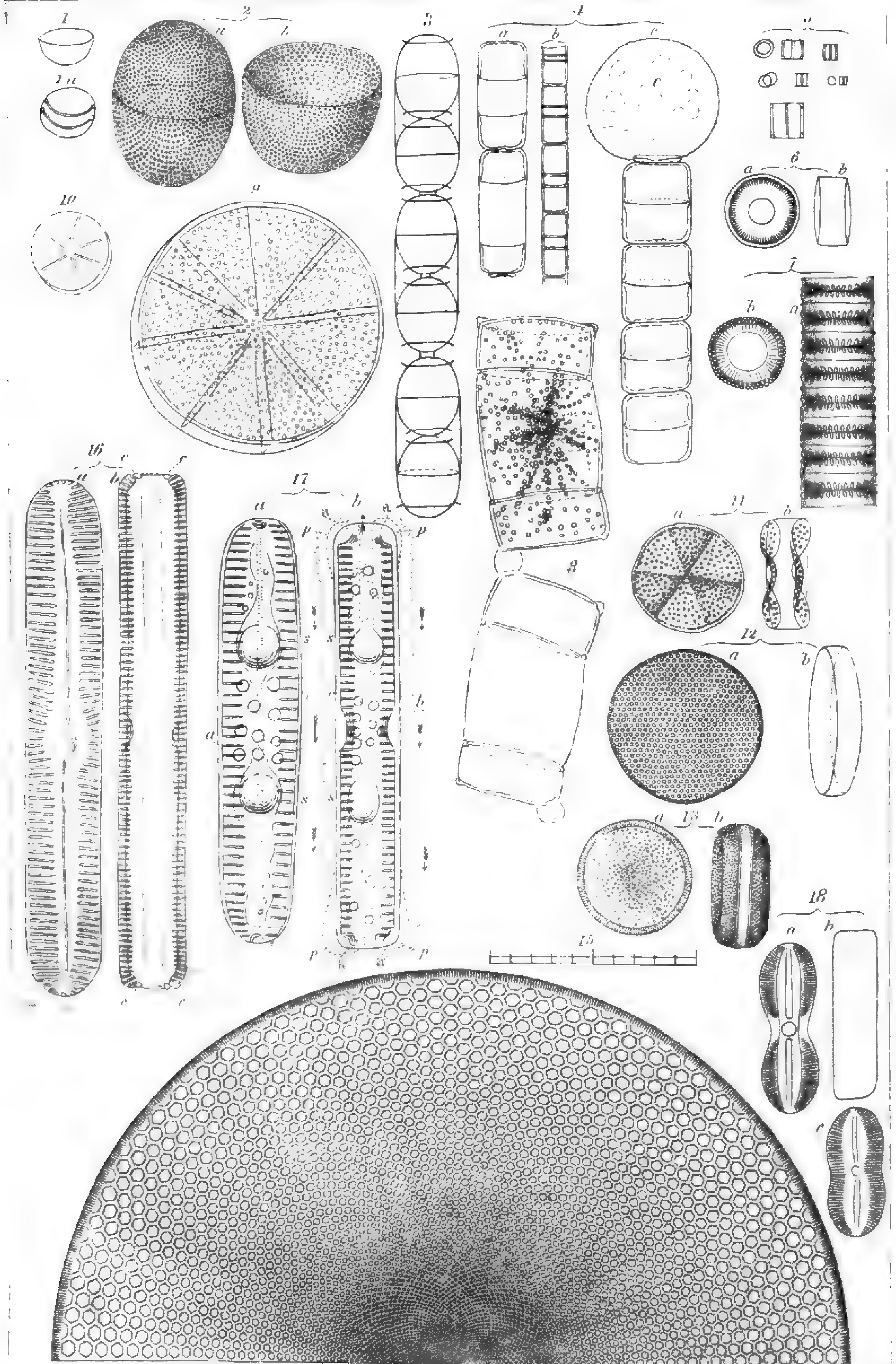
Genus TROCHLEA. I propose this name for the genus of shells called Planaria by Capt. Brown, the latter being preoccupied in zoology. Ex. T. alba, Brown's Zool. Text-Book, pl. 86, fig. 17; T. nitens, Lea's Contributions, pl. 4, fig. 113. Respectfully, S. S. HALDEMAN.

Near Marietta, Pa. September 20, 1841.




1. *Cyrena purpurea.*
2. *Modiola elliptica.*
3. „ *pulex.*
4. *Crepidula acuta.*
5. *Carychium exile.*
6. *Pasithea sordida.*
7. *Actæon parvus.*
8. *Cerithium cancellatum.*

H. C. Lea, del. P. S. Duval Lith. Phila



Prof. J. W. Bailey Del. Daggett, Hinman & Co. Sc.

Plate Second, Part Second, the Naviculaceæ.

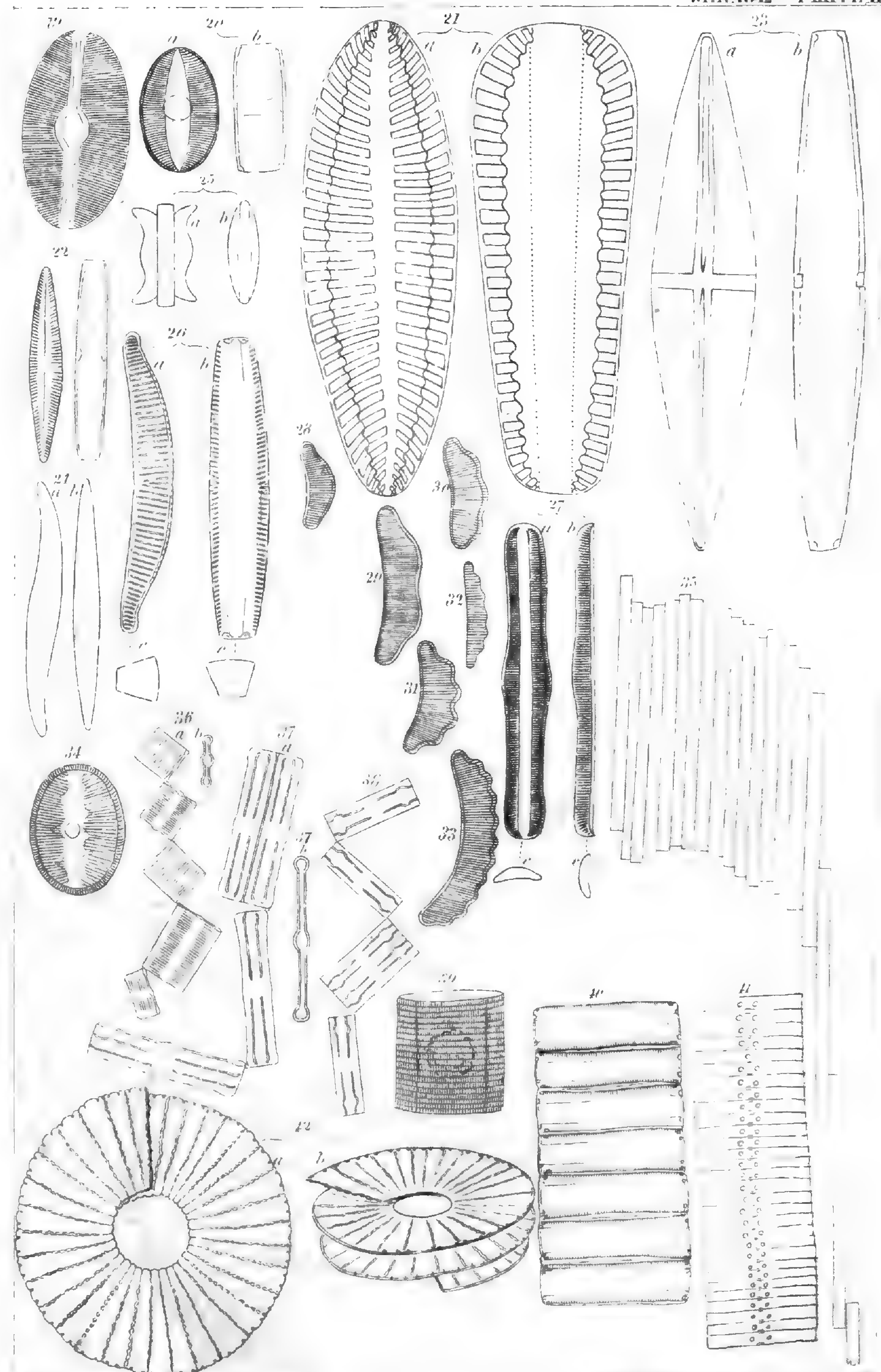


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Plate Second, Part Second, the Naviculaceæ.

ILLUSTRATIONS TO PROF. J. W. BAILEY'S PAPER ON AMERICAN BACILLARIA.

THE

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OF

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*CONDUCTED BY*

PROF. B. SILLIMAN AND B. SILLIMAN, JR.

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(TO BE CONTINUED QUARTERLY.)

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## TO CORRESPONDENTS.

Papers will appear in our next number, by Mr. D. D. Owen, *on the print of human feet in limestone*; by Mr. James T. Hodge, *on the lead regions of Wiskonsan and Missouri*; and by the Junior editor, *on the meteoric iron of Texas, together with an analysis of the Honolulu meteorite.* Also papers by Dr. Gray, and Dr. Engelmann.

Communications have been received from Rev. James H. Linsley, Drs. J. T. Plummer and Wm. H. Muller, Messrs. W. F. Channing and Jos. S. Travelli.

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April, 1842.

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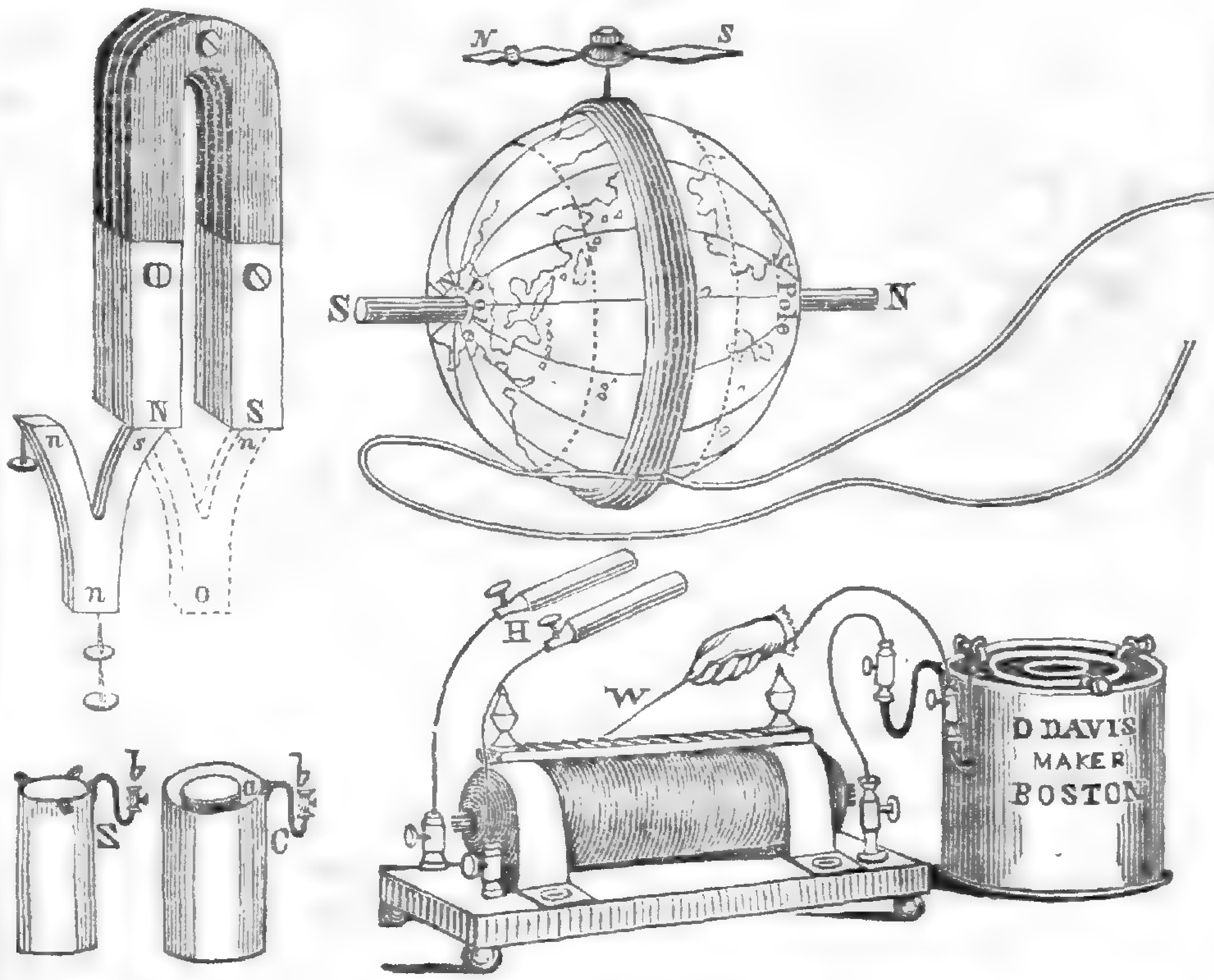


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THE

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## Art. I.—*A Notice of Prof. Augustine Pyrame De Candolle;* by George B. Emerson, Pres. of the Boston Soc. of Nat. Hist.

At a meeting of the Boston Society of Natural History, held in their hall, Nov. 17th, 1841, the President read portions of a letter from his friend, Edward Tuckerman, Jr., containing, together with many interesting facts relating to the botanists of England and France, the melancholy intelligence of the death of De Candolle. After reading this letter, the President went on to say:

Thus has set one of the great lights of botany—a man, who, for the vastness of his works and the comprehensive idea he had formed of the extent and ends of the science, has not left his superior, hardly his peer. May I be allowed to take this occasion to say a few words upon the works and character, as a botanist, of the man whose loss we are thus called to deplore.

Augustine Pyrame De Candolle was born in Geneva in 1778, of an ancient family, which, as long ago as the sixteenth century, was distinguished in the republic of letters. From his earliest years he seems to have devoted himself to botany; for already in his twenty first year, in 1798, he published his History of Succulent Plants.* In the preface to this work he asks, in the sim-

* Plantarum Historia Succulentarum, published in Paris by Dugour and Durand, in two folio volumes with colored plates. This contains descriptions of succulent plants, not of any one natural order, but of those having sufficient resemblance to be associated. They are mostly of the orders Crassulaceæ, Ficoideæ, and Cactaceæ, with some species of aloes, and a few others. They are precisely those plants of which it is important to have good figures, as of most of them it is nearly

plest manner, indulgence for the youth of its author, at the same time admitting that every book must plead its own cause, and promising to endeavor to make up in zeal for the deficiencies of his experience and knowledge. There certainly could have been no affectation in this modesty, for it shows itself just as clearly in every future work; and that zeal must have been no less real which held out to the last years of his laborious life.

Two years after, in April, 1800, he laid before the National Institute, in manuscript, his Astragologia.* This was committed to Lamarck and Desfontaines, at that time two of the most distinguished botanists of France, and who ever after seem to have been his firm and honored friends. They reported very favorably upon the work, observing particularly upon the extent of his researches, and the exactness and precision of his descriptions. From this time he began to be well known, and from this, too, probably, dates his connection with Lamarck, with whom he was afterwards associated in editing the Flore Française. His connection with Lamarck and with the Flore Française, was of momentous consequences to him. It was the first edition of this work, as he himself declares,† which, by initiating him in his youth into the elements of botany, decided his taste and his fate for life.

It must have been about this period that he spent six years in traversing all the provinces of France.‡ In every one he herborized; every where he studied the vegetation, and every where made, or obtained from public or private collections, specimens and documents.

In 1804, he published in quarto his Essay upon the Medical Properties of Plants. It was his inaugural thesis on taking the degree of doctor in medicine in the Faculty of Paris.

In the same year he delivered his first course of lectures on physiology, the substance of which he introduced in the "Princi-

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impossible to make dried specimens. Each is accompanied by a beautiful colored figure by Redouté. If it were intended, as it seems to be, to give a pretty full history of plants of this character, a comparison of it with the account of the same genera in the Prodromus, will show how immensely the species increased in number in the interval which elapsed until the publication of the latter work.

* Astragologia was published in Paris in 1802, in one volume folio, by Garnery, from the press of Didot. It contains descriptions of a great number of species, many of them new, of Astragalus and the allied, often gum-bearing Leguminosæ. It is illustrated with fifty plates by Redouté.

† Preface to the sixth volume of Flore Française, p. 10.

‡ Flore Française, vi, preface, p. 7.

ples of Botany" prefixed to his edition of the Flore Française, which was published immediately after. In this edition he added the surprising number of two thousand to the species of plants (twenty seven hundred) previously described in the Flora,* and in the sixth volume of the edition of 1815, he makes an addition of thirteen hundred more, thus raising the number of species belonging to France, under the empire, when it comprehended the Italian and German provinces, to six thousand, about a fifth part of the total number of plants then known on the globe.

In preparing this last edition, he had called to his aid all the best botanists of France, increased to a large number by the publication of the former editions of this very work; and he makes express acknowledgment by name, to forty three for France proper, ten for the Italian provinces, and five for the German. These great additions were made with scrupulous care, for he introduces the description of no plant of which he had not an authentic specimen.

It is not easy to say how it has happened that the Flore Française has not attained a celebrity, *out of France*, more nearly proportioned to its preëminent excellence. It is, without question, the most complete Flora‡ that has ever been made; the Preliminary Discourse and the General Principles giving every thing that is necessary to an understanding of the work, and the "Analytical Method" presenting the only tolerable substitute since the time of Linnæus, for the artificial system of that great man, in solving the first question that always presents itself in examining a plant—what is its name? The very fact that a single editor could have enlarged, by more than one half, the flora of his native land, and that too the native land and the seat of the labors of Tournefort, the Jussieus and Lamarck, should have turned all eyes towards it. This side the ocean and the channel, indeed, as beyond, all eyes have been occupied with the treasures that have been flowing in from both Americas, New Holland, the Pacific islands, Farther India, and the coast of Africa; and the Browns, and Hookers, and Grevilles, and Lindleys of England, and the Nuttalls, Elliotts, Bigelows, Torreys and Grays of America,

* Flore Française, p. 1. † Ibid. p. 9.

‡ The English Flora of Sir J. E. Smith, is a mere flora, and takes it for granted that the reader has learnt the principles of the science from some other source. Besides which, it gives nothing of the natural orders.

have had enough to do to examine and describe the plants they have been gathering, or that have been sent home to them.

De Candolle did not wait to ask how his labors were received abroad. In 1808 he became an inhabitant of Montpelier,* and took charge of the botanic garden there, which he raised to the highest perfection. For ten years from this time, he must have been beyond measure diligent. He thoroughly explored the south of France, gave courses of lectures at the Faculty of Medecine in Montpelier, published, in conjunction with Lamarck, a synopsis of the plants of the French flora, gave a catalogue of the plants in the botanic garden of Montpelier, published figures and descriptions of the rarer plants of France, several articles on geographical and agricultural botany, in 1813 his Elementary Theory of Botany,† and, in 1816, a second edition in octavo, of his "Essay on the Medical Properties of Plants."

The object of this work,‡ is to ascertain the relations which subsist between the medical properties of plants, their external forms, and their natural classification. The dedication is curious:

"To the botanists who laid the foundation of the Theory of Natural Relations,—J. and G. Bauhin, Tournefort, Magnol, Ray, Morison, who had an anticipation of it; Bernard de Jussieu, who proved it; Adanson, who developed it; Antoine-Laurent de Jussieu, who subjected it to fixed laws; Desfontaines, who connected it with vegetable anatomy; Richard, who threw light upon it by the analysis of fruits; Robert Brown, who extended it by the examination of the plants of New Holland."

Considering the uniform justice and generosity of De Candolle, this dedication is remarkable for its injustice in omitting the name of Linnæus, to whom, as he confesses in this very work,§ is due the first perfectly distinct enunciation of the principle which it is the object of the "Essai" to prove—that plants of the same genus have the same properties; those of the same natural order, similar properties; and those of the same natural class, some analogy in their properties; and he admits that Jussieu *adopts*

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* Flore Française, vi, 7.

† Théorie Elémentaire de la Botanique. 1 vol. 8vo. A second edition was published in 1819.

‡ Essai sur les Propriétés Medicales des Plantes, comparées avec leurs formes exterieures et leur classification naturelle. Paris. Crochard, 1816.

§ Essai, Introduction, p. 4.

this opinion.* The omission is, moreover, inconsistent with the profound respect with which he always refers to the great systematist.

In the midst of and by means of this multiplicity of labor, De Candolle was commencing what he meant to be the great work of his life, and what, if he had lived to complete it as it was begun, would have been far the most remarkable work on botany ever executed—I mean his Natural System of the Vegetable Kingdom.† He seems to have entered upon it with a full sense of the greatness of the undertaking before him, and with a lofty and resolute, but ever modest purpose‡ of devoting his whole strength and time, with all his immense resources and all the accumulated ability of a life devoted to the preparation, to its accomplishment. One is reminded of the heroic perseverance with which Saussure, from the banks of that same beautiful lake of Geneva, had for so many years cherished the firm resolve to scale Mont Blanc, and make known the new and strange phenomena which its naked top should present; or of that more than heroic purpose, cherished and kept still at heart through a whole life of preparation, of the far greater Milton, to achieve something worthy to be remembered in future years, and to place his name with those of

"Blind Thamyris and blind Mæonides,
Tiresias and Phineas, prophets old."

De Candolle's plan was no less than to arrange and describe, in their natural orders, all known plants, giving to each order the fulness and completeness of a monograph. We who now look back upon his work, can see how far he soared above those whom he hoped to equal, Lamarck, Willdenow, Vahl, Persoon. Few works give us better executed examples of the Baconian method, of forming general conclusions from the careful observation of particulars, and thence going back and reëxamining the particulars. He first minutely examined all the species of a genus, and thence

* After quoting Amœn. Acad. v, p. 148, for this opinion of Linnæus, he adds, "M. de Jussieu adopte la même opinion." Introduction, p. 5.

† Regni Vegetabilis Systema Naturale, sive ordines, genera et species plantarum secundum methodi naturalis normas digestarum et descriptarum. Volumen Primum, Parisiis, sumptibus sociorum Treuttel et Wurtz, 1818.

‡ Hanc ipsam curam, hoc opus quod nemo apud nos, nemo apud veteres tentavit, timidus hodie aggredior. Prolegomena, p. 3.

drew his generic characters. From a similar full examination of all the genera of an order, he drew the ordinal characters. This done, he returned to the genera and species, and rejected from the generic what had been sufficiently expressed in the ordinal, and from the specific, what had been distinctly stated in the generic characters. Thus, applying the highest logic to his work, he gave a model both of analytical and synthetical investigation, which has done much to raise botany to the rank which it holds among the sciences, and set an example by which every succeeding botanist has profited.

Besides this general preparation, which involved many years of diligent and methodical labor in his study, he made special preparation which few, up to that time, had attempted. He visited and carefully examined all the herbaria, even at that time immense, of France and England. He noted their contents; and obtained the coöperation of nearly all the distinguished botanists then living. Nor was it with living botanists and with herbaria alone that he had to do. He studied with minute and patient care whatever had been previously written of plants. For evidence of the extent of his investigations, we have only to refer to his history of almost any plant he has described. For *Hepatica triloba*,* for example, he refers to volume and page, and accompanying figure, if any, of more than thirty descriptions before the Species Plantarum of Linnæus; to fifteen more under the name given in that work; to six additional ones, under other names; to five more for the American variety; and he had besides examined six authentic specimens! Thus we have reference to full sixty descriptions and six herbaria for a single plant.

The first volume of the Systema was finished in Geneva, to which place he had in this busy interval removed, interrupted, it is said, in the midst of his peaceful labors, by the demon of party spirit. It bears the date of October, 1816. It contains only five orders.† A second volume, containing six orders,‡ and finished in the same elaborate manner, appeared in 1821.§

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* Vide Reg. Veg. Vol. I, p. 216.

† Ranunculaceæ, Dilleniaceæ, Magnoliaceæ, Anonaceæ, and Menispermeæ.

‡ Berberideæ, Podophylleæ, Nymphæaceæ, Papaveraceæ, Fumariaceæ, and Cruciferæ.

§ A beautiful quarto volume of illustrations of the rarer and more curious plants described in the first volume of the Systema, especially of those in the herbarium

But De Candolle had undertaken a work perhaps beyond the strength of any man, whatever might be his capacity; and I believe no other volume has appeared.

In November, 1823, he finished, at Geneva, the first volume of a work of infinitely less pretensions, undertaken at the urgent request of his friends, which he offered and intended only as a rapid survey of plants, to precede his great work, the completion of which he still kept in view. He gave it the modest title of Prodromus.* The first volume, comprehending fifty four orders, was published in 1824.†

In the next year came the second volume, containing only ten orders, showing that his materials were rapidly accumulating under his hands, and that he had imperceptibly enlarged his plan. This was accompanied by a volume of Memoirs on the Leguminosæ,‡ with numerous plates. In 1828, '30, '36, '37 and '38, appeared successive volumes of the Prodromus, and within this period, ten memoirs on various subjects, with plates, now collected in one volume.§

During all this time, his lectures were going on at the Museum in Geneva; among others, a course on agricultural botany, of the substance of which we have some portion in the graceful dress in which it is presented by Mrs. Marcet in that admirable volume which she called "Conversations on Vegetable Physiology."||

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of De Lessert, was edited by B. De Lessert, with one hundred plates by Turpin, and published in Paris in 1820. A similar volume, still better executed, also under the direction of Turpin, and with one hundred of his engravings, and many beautiful dissections, was published by De Lessert in 1823, in illustration of the second volume of the Systema.

* Prodromus Systematis Naturalis Regni Vegetabilis. Parisiis: Treuttel et Wurtz. Pars Prima, 1824.

† In 1837, De Lessert published a third volume of Illustrations in the same style and of the same size of those just noticed, containing figures of some of the rarer plants in the first four volumes of the Prodromus, together with those of others not described in that work.

‡ Mémoires sur la Famille des Légumineuses. Paris: 70 planches, 4to. pp. 525.

§ Collection de dix Mémoires pour servir à l'Histoire du Règne Végétal. Paris: Treuttel et Wurtz, 1828—1838.

|| This has been published in this country under the title of "Blake's Botany" by some person who has thus claimed a property of authorship in the book, on no better ground than his having interspersed questions which give not the slightest intimation of an acquaintance with the subject, and leave one doubtful whether he knew enough of it to distinguish a sedge from a bulrush, or a moss from a lichen. Would that this shameless kind of piracy were confined to a solitary case.

In 1826 he had prepared for publication his work on the organs of plants,* another portion of his course of botanical lectures. Rich as they had become from his extensive reading, from observation, and from the constant suggestions of his vigorous and original mind, it was no longer just to withhold them from the public. In this work on Organography, following out the hint given by the German poet Goëthe,† taking advantage of the light afforded by those who were successfully engaged in exploring the animal kingdom, and gathering conclusions from the immense number of new facts presented by other botanists, and by himself in preparing the Prodromus, he exhibits a fuller and more philosophical view of vegetable structure, than had previously been given, in the language.

Five years after, in 1831, he completed his great work on Vegetable Physiology,‡ also taken from his lectures, a rich storehouse of facts, upon the properties and functions of the organs of plants and the forces external and internal which act upon them. The title of Physiology he admits to be not the most proper which could be devised; and he would have preferred that of Organodynamy—the forces of the organs, as more descriptive of the subject of his treatise.§

One of the most interesting portions of this work, at least for the young philosophical student of botany, is the Appendix; marking out, as it does, the limits of the science in its most important particulars, and indicating to the physiologist, the traveller, the cultivator, the chemist, and the natural philosopher, as well as to the botanist, to what points it is important that attention should be directed, to advance still farther the boundaries of our knowledge. How many inquirers have these questions already stimulated to action! Many of these questions he would

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* Organographie Végétale ou Description Raisonnée des Organes des Plantes. Deterville, Paris, 1827. 2 vols. 8vo.

† Org. Veg. p. 8.

‡ Physiologie Végétale, ou Exposition des Forces et des Fonctions vitales des Végétaux. Paris, 1832. 3 vols. 8vo.

§ According to the idea of De Candolle, vegetable physiology is but one department of general physiology. It cannot be fully comprehended by one who is ignorant of its principles in their other forms. Adequately to understand the nature of plants, he must study atmospherical influences, the action of light, electricity and heat, the laws of chemistry, the nature of soils; and whatever can be known of the laws of life.

himself have solved, but feeling that he had laid out more work than the longest life could suffice to execute, and anxious to complete the Prodromus, he frankly imparts his plans, his doubts, and his suspicions, hoping that younger and less busy laborers would clear up the one and complete the other.

He more than once intimates his intention of following the publication of the Physiology with other works which should cover the whole ground he had gone over in his lectures. In the preface to the Physiology, he gives the titles of those which he intended, if time and health and will should serve, to send forth, to fill up the great plan he had laid down. To complete the *fundamental* portions, in addition to the two works he had already published, he proposed to himself *methodology*, which should deduce from the study of the organs, the principles and methods of classification. For the principles on which this was to be executed he refers us to the "Elementary Theory;" for the conclusions, to the Prodromus.

Among the accessory branches of the science, he includes,

1. *Botanical Geography*, which, from the two preceding, infers the laws or general facts relative to the distribution of plants on the surface of the earth;*

2. *Oryctological Botany*, which would comprehend the history of fossil vegetables, considered in their relations both to the strata of the earth and to the forms of recent plants;

3. *Historical Botany*, exhibiting the steps by which botany has arrived at its present state.†

Among the *practical parts*, he reckons,

1. *Agricultural Botany*, the application of the principles of the preceding to the culture of vegetables, on which he had twice given a course of lectures;

2. *Medical Botany*, their application to medicine; on which subject he apparently meant to enlarge the work already mentioned, upon the medical properties of plants;

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* On this subject he had published, in 1809, the article "Botanical and Agricultural Botany," in the Dictionnaire d'Agriculture, and in 1820, the article "Botanical Geography," in the Dictionnaire des Sciences Naturelles, besides the introduction to the second volume of Floré Française, explaining the botanical map of France.

† The article *Phytography*, in the Dictionnaire Classique d'Histoire Naturelle, contains an outline of this portion, extracted from his lectures upon the subject.

3. *Economical Botany,* which was to comprehend the study of all the other modes of making plants subservient to the wants of man; a part of the subject which he looked upon as still to be written.*

Such are some of the works he contemplated, which he had long familiarly considered, and for which his whole course of study had been a preparation. In what words can we sufficiently lament the loss to science and to humanity of a man who had laid out so broad a plan of useful labor, and had given such examples of the manner in which he was hastening to complete it! It is to be hoped that the manuscript notes of the extensive courses of lectures to which he refers, may supply his son, or some other equally competent person, with the means of filling up the outline he has sketched.

Eight years of unremitted and obstinate labor had been consecrated to the study of the immense family of the Compositæ.† This intense devotion, the natural effect of his native and characteristic ardor, proved too much for his health, already affected by severe study, and undermined, it is said, by a constitutional malady. What constitution could have held up under labors so immense? We know not the particulars of his end; the burden was too great, and the body of the wise and strong man failed.

It is impossible to estimate the extent and magnitude of the influence of the writings and character of such a man as De Candolle. The science to which he devoted his life must always feel it; it cannot go back. His vast plan once laid down, noble spirits every where and in all future time will strive to realize it. His great idea of the science once spread before the world, no one can hereafter aspire to the worthy name of botanist, who is a mere collector and labeller of specimens, or a mere dissector of plants. He must aim to fill his mind with the extensive and various and exact knowledge of other sciences, and of all parts of his own, which this great man has shown to be essential to an accomplished botanist.

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* From an article on the geographical distribution of the plants used as food, in the "Bibliothèque Universelle de Genève," for April and May, 1836, we conceive hopes that M. Alphonse De Candolle is engaged in a work of this kind.

† See Mémoire Neuvième, in the volume of Mémoires. If the Compositæ had been given with the same fulness and minuteness of description and reference which characterize the Systema, they would have occupied twelve or fifteen volumes.

Gathering our materials only from his works, there is very much which we should delight to know, in regard to De Candolle, of which we are now almost entirely ignorant. We would gladly learn what was the discipline and what were the studies of his early years; whence he gained his beautiful and simple Latinity, whence the clearness and elegance of his style, and his severe and exact logic; by what wise arrangement of his hours he accomplished so much, and made such attainments in the knowledge, not only of living plants, but of herbaria, and books, and various sciences. We know him as a philosopher and a botanist, and we understand and feel the power of his mind and the force of his genius. We would gladly see him in the higher relations of friend, and father, and citizen—we would know him as a man. We hope that we shall not long remain without a life of him by some one capable of understanding his works and appreciating his character.

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Art. II.—*Geological Reports of the State of New York for* 1840, *communicated by the Governor to the Assembly, Feb.* 17, 1841. [Assembly, No. 150.]*

By these reports of the geological corps, the survey of the state is nearly completed, and after a partial continuance of the work for this season, the final report is to be made. The desired work on the geology of this great state may be anticipated in the beginning of the next year. It is generally understood that the final report will be made by the corps in the manner already done. For the mineralogy, zoology, botany, and palæontology of the state, this is the proper course. It is to be hoped, however, that the geology will not be divided into four great districts, but that the maps, and sections, and descriptions, will present before the public one general view. This is the more important, as the four districts assigned to four principal geologists have no natural geological lines of separation, but are connected in the most intimate manner. The importance of a chief geologist, or of the most complete harmony of views, becomes obvious, extending, as do several of the strata or groups, through more than

* Communicated for this Journal by the author.

one of the districts, the *designations* of the rocks, their *position*, *connection*, and *organic remains*, demand the language of one mind. Hoping for a harmonious and splendid work, let us take a brief review of the progress of the survey for the last year.

As the general groups had already been announced, and are considered correct, the additions have been made chiefly from the filling up of the less observed parts of the state.

1. Facts in respect to the *salines* at Onondaga lake. By boring at Syracuse to the depth of two hundred and sixty five feet, one hundred feet deeper than any previous boring, brine of much greater strength was obtained. Taking saturation at 100°, the old well yielded brine of the strength of 56°, on the scale; while the new well gives the strength of 78°, a difference of nearly forty per cent. The average number of bushels produced in the two preceding years, was 2,700,000; and this amount may now be greatly increased. The importance of the salines to the state and to the country, needs no remark, and the means of making them more valuable are ably considered by Dr. Beck, pp. 18–23, and by Prof. Vanuxem, pp. 141–5.

2. The amount of hydraulic limestone in the western part of the state, and of nearly the same excellent quality. It lies at the base of the terrace of limestone, which is so prominent in Erie County, and may be traced from Niagara River to Cayuga Lake. It is attended every where "by numerous and copious sulphur springs," or springs yielding sulphuretted hydrogen gas. From Black Rock eastward, it occurs in many places; abounds at Williamsville, where it is burned and ground for cement by thousands of barrels. It occurs at Rochester also. The difference in the quality of the hydraulic lime is attributed more to the *burning* than to the stone itself. Many of the strata appear to grow thinner in the western district, and some to disappear. See Report, pp. 150–8, Hall. This terrace bounds on the south all the beds of gypsum. p. 156.

3. Discovery of abundance of primary limestone on the north and the west shores of Lake Janet, is of great importance to that part of the state.—*Report*, p. 126, Emmons.

The "steel ore" of the Duane bed is wrought at once into cutting instruments of fine quality. Prof. Emmons does not state that the ore is *steel*, or that it is made into steel, but the fact that good edge tools are formed of it. p. 134, 135.

4. The Trenton limestone is an important rock for its marble, in Schenectady County, and particularly in Saratoga County. It is a fine grained and durable stone. On one of the strata of it at Glen's Falls on the Hudson, the upper surface contains marks "like those produced in soft mud by drops of rain."—*Report*, p. 97, Mather. *Ripple* marks are shown on "brown sandstone on the road from Cattskill to the Mountain House, one mile above the tollgate." p. 85. The *chloritic* and talcose rocks of the western part of the valley of the Hudson, are considered by Prof. Mather, as "*metamorphic* with intrusive rocks interstratified:" and he extends the metamorphic rocks into the western part of New England. pp. 93 and 96. In this opinion he is opposed by some of our distinguished geologists, and cannot be followed without far more and much stronger proof than has yet been offered. Indeed it seems obvious that the metamorphic theory is an easy method of breaking down the usual distinctions of the rocks. A fine section of the rocks "from the summit of the Cattskill Mountain, south of the Mountain House, to Cattskill Creek," is given on pages 78–81, *Mather*.

5. The report of the paleontologist contains very important matter, and some interesting corrections.

Mr. Conrad distinguishes our rocks of the Silurian system, "for the sake of convenience," into three subdivisions, the *Lower*, *Middle, and Upper, Silurian series;* it seems also to be quite a natural arrangement. The danger is that the classification has been made too early, and that adequate examination has not settled the entire distinctness of all the series. A great proportion of them however are satisfactorily ascertained. There is some doubt about the termination upwards of the *Lower* series. It is limited by the *Pentamerus oblongus limestone* in the report, and the lowest stratum in the *Middle* is made Rochester shale. If we understand it, this *Pentamerus limestone* at Rochester is towards the lower part of the shale, and at Lockport is found entirely above the Rochester shale, which is much thicker there than at Rochester; there would be no diffculty in the natural arrangement in making the Red or Medina Sandstone the upper stratum in the *Lower* Silurian. But the *Pentamerus limestone* must go with it, in whatever series it is placed.

On p. 31 is a tabular view of the whole series, with the corresponding rocks of Murchison, and the characteristic genera of organic remains. The Rochester and gypseous shales are given as the equivalent of the *Wenlock Shale* of Murchison. The fossils placed against Nos. 7, 8 and 9, belong to the lower rocks, as Triarthrus and Isotelus to the Trenton limestones. Against No. 9 should stand the shell *Pentamerus oblongus*, or if a trilobite must be introduced, it can be neither of those mentioned, but *Asaphus longicaudatus*. Where is the statement that the remains against Nos. 5–9 have been found even as high as the Rochester shale?

The limestone of Tully, or Tully limestone, is considered as identified with the *Aymestry limestone* of Murchison by two species of shells, *Avicula reticulata* and *Atrypa didyma*. p. 31.

The fronds of Fucoides are often very prominent, but the structure like that of the rock in which they exist; of other plants, scarely more than impressions remain. The petrifying material of the corals is commonly *siliceous* earth; but of the Crinoidea, is *limestone*, whether they lie in calcareous or siliceous rock. p. 40.

Several new genera and many new species are described, and many yet remain for the final report. pp. 48–57.

Several important corrections are announced.

The *Calymene Blumenbachii*, as the trilobite in the Trenton limestone was called, Mr. Conrad considers a new and undescribed species; it is named by him *Calymene senaria*, from its place in so old a rock. It no longer is an instance of an animal that "escaped into remote seas," and lived in a much later era than its period of destruction here. "*Calymene platys* of Green" is stated to be *C. Blumenbachii*, and to agree with it in *place* also; so that this fossil is found where it *ought to be*, and no longer throws uncertainty over the age of our rocks.

The evidence is now thought conclusive by Mr. Conrad *against the existence* of any fresh-water shells in the strata below the carboniferous, "in which Uniones occur in Pennsylvania." The supposed Unio in the sandstone at Medina turns out to be something else, the Planorbis "probably a Bellerophon," and another to belong to an allied genus. This correction is the more necessary as these shells "are associated with two marine genera, Lingula and Orthocera." Probably the existence of fresh-water fossils in that sandstone had been a matter of high surprise to most geologists; the evidence decides the case. p. 41.

In former reports, Mr. Conrad has spoken of the *Cambrian* system below the *Silurian*, as being developed along the eastern part of the state, but in this report he speaks of the Silurian system as "composed of the oldest fossiliferous rocks yet discovered in North America." p. 26. No reason is given for this change; whether Mr. C. now refers these rocks to the Silurian system itself, or considers them as *metamorphic* rocks of this formation. He states "the oldest fossiliferous rock hitherto known" in our country to be the "calciferous sandstone" of Eaton, which contains "two species of Lingula, a small *univalve*, and something resembling *fucoidal* remains." p. 28. Prof. Eaton speaks of organic remains in a rock below this, and others have judged the same. The final report will doubtless clear up this matter, which seems rather obscure. It does not follow because some remains have been found, that much more extensive and particular examination will not discover others in the same or associated rocks, till we pass beyond the region of petrifactions.

"The mixture of species" sometimes occurs "at the junction of two formations," (groups.) This fact shows the necessity of great care in the division into groups, and renders the "exact line of demarcation" between them somewhat uncertain. It is not necessarily opposed, however, to the notion that "sudden convulsions of the earth's surface" have caused the destruction of most of the existing forms of life, nor does certainly prove that the temperature of the ocean has suddenly or gradually changed, because it is easy to see that many individuals *might for a time withstand* sudden or gradual changes or convulsions, unless it can be shown, as it cannot, that the convulsions were so great that the then existing forms of life must be destroyed by them. The continuance of some species through several successive groups or formations, is a fact of similar consequence, and admits the same easy solution; it certainly is no obstacle to the stratigraphical arrangement, because such species have no *characteristic* value, they designate or *characterize* no particular group,—they belong to no particular rock, and need no minute observation to give them their due estimation. p. 26.

There is a correction also of a former statement opposed to the notion of the impression of birds' feet in sandstone. The terminations of the Fucoids "sometimes rudely resemble a human hand, whilst others are not unlike the foot-marks of birds." p. 33.

Though these are maintained to be *fucoidal* remains in our sandstone; it is conceded, that the "curious foot-marks," the *Ornithichnites* described by Prof. Hitchcock in the new red sandstone, "peculiarly characterize that system." p. 43. This harmony of opinion is an indication of the firm foundation of this part of the science.

The shells formerly referred to the genus *Terebratula*, are said to belong to other and extinct genera. The mistake has not been made by our own geologists alone, if mistake it is. The shell remains, and a name so distinguished as that of Sowerby, sustains it. True it may be, that what is now defined to be a *Terebratula*, may not exist in our rocks; but to mention no more, *Delthyris* (*Terebratula*, Sow.) *tripartita* seems to be a common and widely spread species. p. 35.

A conclusion drawn from the state of the organic remains, has great interest, viz. that the depositions took place "in the bed of an ocean, undisturbed by violent currents or greatly agitated waters." This is derived from the finely preserved parts of even fragile shells, only one stratum being known in the state as an exception, "where the shells are in a fragmentary condition." p. 26, 7. This is true also, as we know from a previous report, of only a small portion of the Pentamerus in the limestone at Rochester, the rock referred to. As in many others the "valves of bivalves are found apart," so are they in this; often changed so that the hinge is fitted to the mouth; often the valves lie crosswise; more often piled above each other and petrified in masses, the convex matched into the concave side of another valve; often entire shells with their valves unmoved; and, often the surface of the stratum and sometimes the interior, with fragments of valves connected in any way. The indication of a disturbing power is here considerable. Is not the evidence far greater in the case of the *encrinal* limestone of Lockport, and the thin stratum of it at Rochester, where the fragments of the stems of encrinites are promiscuously jumbled together, and the surface made up of portions of shells, porites, encrinites, &c.? Beautiful specimens of the polished encrinal limestone have been spread abroad from Lockport.

The corrections already made are not more numerous or important, than were to be expected from the state of geological knowledge when the survey had been in considerable part made.

Murchison's work on the Silurian system had not appeared, and the field was new and to a great extent unexplored. After all that had been accomplished by Prof. Eaton in his survey of the strata along the Great Western Canal, and by others, the exploration, as connected with general geology, could scarcely be said to have been begun. Probably others yet remain to be accomplished. Too many groups may have been formed. While *Cryptolithus tesselatus* retains its place with some others in the Llandeilo flags and in the lower part of the Trenton limestone, and in that of the Mohawk at Fonda and in other places, that rock of Wales may yet find its equivalent in our series. The greater number and variety of our groups may not involve all those described by Murchison, but only the fullest examination should be satisfactory.

Finally. The *discoveries* which have been made by the paleontologist. These are many, and of great interest. Omitting all the organic remains which have been identified with the European, and the many new genera and species, there are several general facts of great value.

First: The identifying of the sandstone of Blossburg, Penn. with the old red sandstone of Europe, a part of the Devonian system. The geological positions of the two rocks are very nearly or quite the same; and the remains of the fish, *Holoptychus nobilissimus*, found before only in the old red sandstone, seem to settle the point conclusively. The stumbling block of our geology is thus removed. The Blossburg sandstone is the upper part of the Devonian system. The Chemung group, as it is called in the geological reports, forms the lower part of the Devonian, and is characterized by the same shells. pp. 42 and 43.

Second: The carboniferous system in Pennsylvania and Ohio, contains many species of shells found in the same system in Europe. Even "at Engineer Cantonment, Missouri River," the shells of the carboniferous system are found, as well as at Pittsburgh and on the Alleghany Mountains. Eleven species are named as common to the carboniferous strata in our country and Europe. p. 43.

Third: "Well characterized and undoubted oolite, in the state of Ohio," is *for the first time* announced in this report. p. 44. "Two European species of *Trigonia*, both of which are restricted to the oolitic system," are presented as the proof. It has long been known that the oolite of Saratoga County could not belong to the oolitic series of Europe.

Fourth: Eleven species of organic remains are given to identify the lower cretaceous series of New Jersey, Delaware, and the Atlantic states further south, with that of Europe. p. 45. Mr. Conrad discovered the middle division of this series at Wilmington, N. C. The upper division is stated to exist in South Carolina and Georgia, and to abound "in the southern counties of Alabama and in Florida." p. 45.

Fifth: The "lower tertiary" was *first noticed* by Mr. Conrad, and shown to be the same with the "Eocene formation." "In Georgia, and more rarely, in Alabama, a portion of the formation assumes the character of burr stone," containing beautiful shells finely "silicified," which we admired years ago, and were compelled to separate the rock from the Paris burr-stone, which is destitute of shells. On the Potomac, at Fort Washington, is the same lower tertiary, and at Claiborne, Alabama, Mr. C. found in it "about two hundred species of shells and corallines, many of which are identical with the Eocene species of Europe." p. 46.

Sixth: The rocks of the older Silurian system, terminating upwards with the *Pentamerus oblongus limestone* in this report, seem to be bounded on the south by the Mohawk River and the Erie Canal nearly, and which are covered by the mountain ridge at Lockport and Niagara River, &c., *reappear* "at Bedford Springs, and in the vicinity of Cincinnati, Ohio," according to the discovered fossils. p. 32. Indeed, the organic remains at the west seem likely to identify more of the rocks. What an uplifting of the strata in Ohio, must have taken place, or a mighty wearing away of the incumbent series which extend westward under the waters of Lake Erie, or a cutting off of the Silurian of this State from that of Ohio by the ridge through which the Niagara River passes.

In conclusion, reference might be made to the unnamed fucoids of the Niagara sandstone, which are abundant below the lower falls of Genessee, and the numerous shells and fucoids above this sandstone, which remain to be identified or to increase the number of the species. Standing as we do on these remains, the coming and final report is expected to reveal a world of mysteries and settle a host of difficulties.

At Lockport, is found a coralline, probably a *Porites*, which for distinction's sake, I will call *P. gypsea.* It occurs alone, or with laminated gypsum, often clear and fine selenite, diffused through it; or rather, the petrifaction of carbonate of lime has been converted into the sulphate, and crystallized where it was formed. Sometimes this *Porites* is divided, *as if by a saw*, into separate portions, straight; and the sections at various inclinations to each other. The cuttings are narrow, sometimes a fourth of an inch wide. The gypsum still lies in many of these apparent straight cuttings or saw-cuts; in others the gypsum has been dissolved, and the cuts are empty. Some of the specimens have great beauty. It is evident that the petrifaction has undergone this operation. How should it be divided by these straight cuts? Could the sulphuric acid be generated in that place, and for any reason follow a course which appears to have been drawn by a rule?

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Art. III.—*On the Manipulations of the Dipping Compass;* by John Locke, M. D., Prof. of Chem. in the Med. Coll. of Ohio, and Lecturer on Nat. Philos. in the Ohio Mechanics' Institute.

*Messrs. Silliman*—Every practical magnetician is aware of the great difficulty in obtaining consistent results, with even the most improved dipping apparatus. In my late communications to your Journal, it appears that I have succeeded, with an apparatus made by Robinson of London, so far that the discrepancies between the results of the two needles used, seldom amount to one minute of a degree. In the same communications I alluded to some peculiar manipulations which I adopted first at Davenport in Iowa, in September of 1839, and to which I attributed the superior consistency of my subsequent results. Having been honored with a verbal request by several distinguished collaborators, that I would communicate my views on this subject, I am induced to lay before your readers the following remarks.

In the instrument used by me, the dipping needle moves on small pivots supported by straight polished agate edges, on which they roll like a wheel upon a rail. As such a motion is not only rotary but progressive, the centre of the needle is carried out of the centre of the graduated circle, by the same rotation which brings it to the true dip. To restore the pivots to their place, two Vs and two inclined planes* raised by a lever engage them at their sides and at their ends, adjust them laterally and longitudinally, raise them just clear of the agate edges, and, by a reverse motion, lower and deposit them, and with them the needle in their proper places. Now the most objectionable anomaly has been, that when the same needle has been once adjusted by the Vs, read, and again simply raised by the Vs, and lowered *apparently in the same place*, and read again, there would be a discordance in the readings, often amounting to five minutes of a degree. I felt the full weight of these anomalies in my first attempts to determine the dip, and found to my mortification, that the mean results of the usual eight reversals and sixteen readings, with two different needles, would sometimes differ as much as six minutes of a degree.

I finally reflected that if the pivots could always be made to re-sit on *exactly the same* points, the readings must always agree, and that the apparent anomalies must arise from slight imperfections of form, and slight and imperceptible, but really essential, changes of position of the points of support to the pivots. With this view I endeavored by all possible means, so to use the apparatus as to bring the bearings at the same points, and especially that the pivots should perform their rotations on the same transverse section; or, in other words, that the same ring or circle of their circumference, should always rest on the agate edges. To accomplish this, the following points received attention.

1. The Vs and inclined planes, which raise and fix the needle to its place, were so adjusted as to allow of no shake or lateral motion of their own.†

2. The distance between each agate edge and the inclined plane, opposed to the end of the pivot operating as an end check, was made as nearly equal as possible.

3. Although the pivots had some "end chase" or longitudinal freedom between the end checks yet in use, each pivot was always slid over against one particular end check by means of a

* These inclined planes slope up opposite the ends of the pivots, and are really two parts of a V widely separated.

† I have lately examined one of Gambey's instruments, which was decidedly faulty in this particular.

slight pressure with the pencil against the side of the needle; say, when the face of the needle is westward the pivot is shoved over till it is checked on the west side, and when the face of the needle is eastward it is drawn over until checked on the eastern side.

4. When the needle has been placed in the compass and its reading noted, it should not be immediately taken out and reversed, but be suffered to remain exactly on its bearings, and the compass be *carefully* reversed in azimuth, and with it, the needle, when the second reading should be made, after which the needle itself may be taken out and reversed. The reversals and readings will then have the following order:

1. Face of the compass east, and face of the needle east.
2. Face of the compass west, and face of the needle west.
3. Face of the compass west, and face of the needle east.
4. Face of the compass east, and face of the needle west.

In the above, it will be seen that although the needle in relation to the face of the instrument and to the "points of compass" assumes four positions, yet to attain them it is removed from its place in the Vs but once, and that is between the second and third reading.

I am aware that it may be objected to all of this, that although I may obtain consistent results, still they may not indicate the true dip, for if the pivots of each needle be alike, although not perfectly cylindrical, and alike placed with reference to the axis of the needle, the mean results would agree to the same error. To this objection we observe first, that it is by no means probable that two pivots intended to be cylindrical should both assume another form, and both be exactly alike, and that these forms, even supposing them to be alike, should be alike placed in reference to the needle's axis; and secondly, we would remark that although we may involve an error by our consistent mode of observation, it would be a constant one, both in quantity and kind, might be ascertained by a great number of comparisons with the results of other instruments, or by other obvious means, and be corrected by a constant equation.

As an example of the order of reversals observed by me, I give below the result of my observations at Baltimore, April 28, 1841.

*At the first square northeast of the Washington Monument, called Howard's Woods. 6h. 37m. to 7h. 47m. A. M.*

| Needle No. 1. | A North. | | Needle No. 2. | A North. | |
|---|---|---|---|---|---|
| E. | E. | 70°38′.5 | E. | E. | 71°37′.5 |
| W. | W. | 73 03.5 | W. | W. | 71 16 |
| W. | E. | 70 35.5 | W. | E. | 71 30.5 |
| E. | W. | 73 05.0 | E. | W. | 71 08 |
| | B North. | | | B North. | |
| E. | E. | 72 52 | E. | E. | 71 55 |
| W. | W. | 69 53 | W. | W. | 71 35 |
| W. | E. | 72 36 | W. | E. | 71 52 |
| E. | W. | 69 56 | E. | W. | 71 34.5 |
| | | 8)572 39.5 | | | 8)572 29.5 |
| | | Mean=71 34.94 | | | Mean=71 33.7 |
| | | | | | Mean of No. 1=71 34.94 |
| | | | | | 2)143 08.64 |
| | | | | | Mean total=71 34.32 |

*At the Botanical Garden of St. Mary's College, Baltimore, April 28, 1841. 12h. 50m. to 1h. 10m. P. M.*

| Needle No. 1. | A North. | | Needle No. 2. | A North. | |
|---|---|---|---|---|---|
| E. | E. | 70°35′.5 | E. | E. | 71°53′.5 |
| W. | W. | 73 00 | W. | W. | 71 44.5 |
| W. | E. | 70 35.5 | W. | E. | 71 48.5 |
| E. | W. | 73 07 | E. | W. | 71 45.5 |
| | B North. | | | B North. | |
| E. | E. | 72 46 | E. | E. | 71 37 |
| W. | W. | 70 20 | W. | W. | 71 32.5 |
| W. | E. | 72 38.5 | W. | E. | 71 32.5 |
| E. | W. | 70 14 | E. | W. | 71 16.5 |
| | | 8)573 16.5 | | | 8)573 10.5 |
| | | Mean=71 39.56 | | | Mean=71 38.81 |
| | | | | | Mean of No. 1=71 39.56 |
| | | | | | 2)143 18.37 |
| | | | | | Mean total=71 39.18 |

At both localities Mr. Nicollet made observations on the same day and nearly at the same hours with a similar apparatus, manipulating at my request in the same manner as I have just described. The results were remarkably coincident, as have been others at the same localities.

| At Howard's Woods. | | At St. Mary's College. | |
|---|---|---|---|
| By Prof. Bache, Aug. 28, 1840, | 71°34′.4 | Prof. Bache did not observe at this locality. | |
| By Prof. Locke, April 23, 1841, | 71 34.3 | By Prof. Locke, April 23, 1841, | 71°39′.2 |
| By Mr. Nicollet, April 28, 1841, | 71 34.9 | By Mr. Nicollet, April 23, 1841, | 71 33.6 |
| By Maj. Graham, June 10, 1841, | 71 31.9 | By Maj. Graham, June 11, 1841, | 71 33.8 |

ART. IV.—*The Involution of Polynomials;* by WM. J. LEWIS, Civil Engineer, Germantown, Penn.

IF any binomial $a+b$ be raised by actual multiplication to the 2d, 3d, 4th, 5th, and $n$th powers, we find that the first and second terms of the powers are $a^2+2ab$, $a^3+3a^2b$, $a^4+4a^3b$, $a^5+5a^4b$, and $a^n+na^{n-1}b$ respectively.

Let it be required to raise to the 5th power any expression $a+b+c+d+e$, consisting of at least five terms.

Then considering $b+c+d+e$ first as one term, then as made up of $b+\overline{c+d+e}$, and subsequently regarding $\overline{d+e}$ as one term; and retaining only the second term of the first involution, and the first and second of the others, we have

$$\overline{a+b+c+d+e}^5$$
$$=5\overline{a+b+c+d}^4e+\&c. \qquad (\qquad =5a^4e+\&c.)$$
$$=5.4\overline{a+b+c}^3de+\&c. \qquad (\qquad =5\cdot4a^3de+\&c.)$$
$$=5\cdot4\cdot3\overline{a+b}^3cde+\&c. \qquad (\quad =5\cdot4\cdot3a^2cde+\&c.)$$
$$=5\cdot4\cdot3\cdot2abcde+\&c. \qquad (=5\cdot4\cdot3\cdot2abcde+\&c.)$$

Hence, if P=coefficient of *abcde*, then will $\frac{P}{2}$= coefficient of $a^2bcd$, $\frac{P}{2\cdot3}$=coeff. of $a^3bc$, $\frac{P}{2\cdot3\cdot4}$=coeff. of $a^4b$, and $\frac{P}{2\cdot3\cdot4\cdot5}$ = coeff. of $a^5$.

If our root had consisted of more than five terms, P would have represented the coefficient of the product of any five terms, $\frac{P}{2}$ the coeff. of the product of $a^2$, and three other terms, $\frac{P}{2\cdot3}$ the coeff. of $a^3$ multiplied by any two other terms, &c.

The coefficient of $a^2bcd$ is also the coefficient of $ab^2cd$, $abc^2d$, $abcd^2$, &c.; the coefficient of $a^3bc$ is the coefficient of $ab^3c$, $abc^3$, $abd^3$, &c.; and generally, any term can be substituted for $a$ in the above expressions. For either of the terms $b$, $c$, $d$, $e$, can be placed first in the root, when it will be subject to the same operations as have been performed on $a$, and will consequently be substituted for it. Our remarks, therefore, in relation to the powers and coefficients of $a$ are equally applicable to the powers and coefficients of all the other terms.

We see that when the powers of $a$ are connected with the product of other terms, $a$ is changed into $a^2$ by dividing the coefficient of $a$ by 2, $a^2$ into $a^3$ by dividing its coefficient by 3, &c. That is, *the power of any term may be increased one by dividing its coefficient by the index of the power to which it is to be raised.*

And conversely, *the power of any term may be depressed one by multiplying its coefficient by the index of its power.*

We have not yet ascertained whether the law may be extended to those terms in which the powers of two or more terms of the root are combined, as $a^2c^2de$, $a^2c^3$, &c.

Let N be the coefficient of $a^2c^2d$, and put $c=m+n$, then $Na^2c^2d=Na^2d\,\overline{m+n}^2=2Na^2dmn+$&c. Hence, N$=\frac{1}{2}$ coeff. of $a^2dmn=\frac{1}{2}$ coeff. of $a^2cde$. Therefore, coeff. of $a^2c^2d=\frac{1}{2}$ coeff. of $a^2cde$.

Again, let $m$ be the coefficient of $a^2c^3$, and putting $c=m+n$, we have $Ma^2c^3=Ma^2\overline{m+n}^3=3Ma^2m^2n+$&c. Hence, M$=\frac{1}{3}$ coeff. of $a^2m^2n=\frac{1}{3}$ coeff. of $a^2c^2d$.

Therefore the coeff. of $a^2c^3=\frac{1}{3}$ coeff. of $a^2c^2d=\frac{1}{2.3}$ coeff. of $a^2cde=\frac{1}{2\cdot2\cdot3}$ coeff. of $abcde=\frac{P}{2\cdot2\cdot3}$. A similar process applied to any combination of the powers of the terms of the root, will evidently show, that the coefficients are governed by the law which has been given. We remark then:

1. That P, the coefficient of the product of as many terms of the root as there are units in $n$ (the index of the power) $=n\,\overline{n-1}\,\overline{n-2}\,\text{-----}\,3\cdot2\cdot1$.

2. That the coefficients of terms involving the powers of one letter and the product of others are obtained by dividing P by 2, this quotient by 3, this again by 4, &c., the last divisor being $n-1$, and the final quotient $n$.

3. That the coefficients of terms combining powers of two or more terms are obtained by dividing these results by 2, 3, 4 ---- $n-2$ successively.

4. That the coefficient of any term $a^mb^rcd=$

$$\frac{P}{\overline{1,\,2,\,3\,\text{-----}\,m}\times\overline{1,\,2,\,3\,\text{-----}\,r}}=\frac{n\,\overline{n-1}\,\overline{n-2}\,\text{----}\,\overline{m+1}}{1,\,2,\,3\,\text{-----}\,r},$$ and

that the coefficient of $a^mbcd=n\,\overline{n-1}\,\overline{n-2}\,\text{-----}\,\overline{m+1}$. If the root contains only $a$ and $b$, or $c$, $d$, $e$, &c. are each $=0$, then all the terms containing these letters disappear from the equation, and we have $\overline{a+b}^n = a^n + na^{n-1}b + n\,\frac{n-1}{2}a^{n-2}b^2 + n\,\frac{n-1}{2}\,\frac{n-2}{3}\,a^{n-3}b^3$ +&c. in which $n$, $n-1$, $n-2$, &c. arise from the decrease of the powers of $a$, and the denominators from the increase of the powers of $b$. This is the well known Binomial Theorem.

Put $\overline{a+b}^n = a^n + na^{n-1}b + \mathrm{A}a^{n-2}b^2 + \mathrm{B}a^{n-3}b^3 + \mathrm{C}a^{n-4}b^4$ +&c.

If a third term $c$ is introduced, we shall have the following additional terms:

$$2\mathrm{A}a^{n-2}bc + 3\mathrm{B}a^{n-3}b^2c + 4\mathrm{C}a^{n-4}b^3c + 5\mathrm{D}a^{n-5}b^4c + \&c.$$

If a fourth term $d$ is now introduced, we shall have again as additional terms:

$$2{\cdot}3\mathrm{B}a^{n-3}bcd + 3{\cdot}4\mathrm{C}a^{n-4}b^2cd + 4{\cdot}5\mathrm{D}a^{n-5}b^3cd + \&c.$$

If a fifth term $e$, we must again add,

$$2{\cdot}3{\cdot}4\mathrm{C}a^{n-4}bcde + 3{\cdot}4{\cdot}5\mathrm{D}a^{n-5}b^2cde + \&c.$$

We must not forget that there are several terms in the expression for the power, involving like powers of different letters, (as $a^4b^2cd$, $a^2b^4cd$, $ab^2c^4d$, and $abc^2d^4$,) and having like coefficients; but only one of each of these terms has been given; this being sufficient to indicate the magnitude of all the coefficients.

When $n$ is large and the number of terms in the root is small, it is most convenient to find the coefficients of a binomial, and afterwards obtain from these the additional coefficients for the other terms, as shown in the last process. In many cases, however, it is better to find the higher coefficients first.

*Example* 1. Find the coefficients of $\overline{a+b+c}^3$. Here we have $\mathrm{P}=3\times2=6$, $\frac{\mathrm{P}}{2}=3$, and the form of the power is $\overline{a+b+c}^3 = a^3 + 3a^2bc + 6abc$ +&c.

*Ex.* 2. Find the coefficients of $\overline{a+b+c+d}^4$.

| | | |
|---|---|---|
| Here $\mathrm{P}=4\times3\times2=$ - - | 24 | $abcd$ |
| $\frac{\mathrm{P}}{2}=$ - - - - - - - | 12 | $a^2bc$ |
| $\frac{\mathrm{P}}{2\cdot2}=$ - - - - - | 6 | $a^2b^2$ |
| $\frac{\mathrm{P}}{2\cdot3}=$ - - - - - | 4 | $a^3b$ |
| $\frac{\mathrm{P}}{2\cdot3\cdot4}=$ - - - - - | 1 | $a^4$ |

Hence $\overline{a+b+c+d}^4 = a^4 + 4a^3b + 6a^2b^2 + 12a^2bc + 24abcd$ +&c.

*Ex.* 3. Find the coefficients of $\overline{a+b+c+d+e}^5$.

| | | |
|---|---|---|
| Here $P=5\times4\times3\times2\times1=$ | 120 | $abcde$ |
| $\frac{P}{2}=$ - - - | 60 | $a^2bcd$ |
| $\frac{P}{2\cdot2}=$ - - - | 30 | $a^2b^2c$ |
| $\frac{P}{2\cdot3}=$ - - - | 20 | $a^3bc$ |
| $\frac{P}{2\cdot3\cdot2}=$ - - - | 10 | $a^3b^2$ |
| $\frac{P}{2\cdot3\cdot4}=$ - - - | 5 | $a^4b$ |
| $\frac{P}{2\cdot3\cdot4\cdot5}=$ - - | 1 | $a^5$ |

Hence $\overline{a+b+c+d+e}^5=a^5+5a^4b+10a^3b^2+20a^3bc+30a^2b^2c+60a^2bcd+120abcde+$&c.

If the number of terms in the root is greater than the index of the power, the excess produces no change in the coefficients, as no more than $n$ letters can enter any term of the power.

*Ex.* 4. Find the coefficients of $\overline{a+b+c+d}^6$.

The binomial coefficients are 1, 6, 15, 20. The introduction of the third term $c$, gives us $2A=30$, $3B=60$. And the fourth term $d$, gives $2\cdot3B=120$, $3\cdot4C=180$.

Hence $\overline{a+b+c+d}^6=a^6+6a^5b+15a^4b^2+20a^3b^3+30a^4bc+60a^3b^2c+120a^3bcd+180a^2b^2cd+$&c.

Or we might have found P as before, observing that as two terms are deficient in the root, P must have at least two divisions before the consequent coefficient can enter into the expression of the power.

| | | |
|---|---|---|
| $P=6\times5\times4\times3\times2=$ | 720 | $abcdef$ |
| $\frac{P}{2}=$ - - - | 360 | $a^2bcde$ |
| $\frac{P}{2\cdot2}=$ - - - | 180 | $a^2b^2cd$ |
| $\frac{P}{2\cdot3}=$ - - - | 120 | $a^3bcd$ |
| $\frac{P}{2\cdot2\cdot3}=$ - - | 60 | $a^3b^2c$ |

| | | |
|---|---|---|
| $\frac{P}{2\cdot3\cdot4}=$ - - | 30 | $a^4bc$ |
| $\frac{P}{2\cdot3\cdot4\cdot2}=$ - - | 15 | $a^4b^2$ |
| $\frac{P}{2\cdot3\cdot4\cdot5}=$ - - | 6 | $a^5b$ |

But $e=0$, and $f=0$. Hence, $\overline{a+b+c+d}^6 = a^6 + 6a^5b + 15a^4b^2+30a^4bc+60a^3b^2c+120a^3bcd+180a^2b^2cd+$&c.

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## Art. V.—*Notice of a Hurricane that passed over New England in September*, 1815; by Noyes Darling, Esq.

1. Some circumstances attending this remarkable storm, induced me at the time, to make a collection and abstract of all the newspaper accounts of it which I could find. I was enabled from my situation, then in New York, to make the collection sufficiently ample to present a pretty full view of the storm in the greater part of its extent. Believing that the fruit of my labors may interest and perhaps be useful to those who are engaged in the investigation of "Atlantic hurricanes," I am induced to offer it for publication.

### 1. *Accounts of the Storm at Sea.*

2. Lat. 17° 54′ N., lon. 63° 10′ W., Sept. 18. *Schr. Phœnix, St. Barts.* Violent gale at that island on the 18th, which lasted thirty hours, from N. W.—W. and S. Forty vessels driven ashore.

3. Lat. 21° 18′, lon. 71° 5′, Sept. 20. *Ship William, Turks Island.* Violent hurricane at that island on the 20th from N. E. to S. W.; unroofed and blew down houses, &c. Lasted from morning to 4 P. M.

4. Lat. 32°, lon. 74° 50′, Sept. 22. *Schr. Return,* experienced a tremendous gale from S. E., which compelled us to cut away foremast. About 4 P. M., very heavy sea struck her and carried away bowsprit, bulwarks, &c. If the gale had not abated, she must have gone down. Another account.—On Friday, 22d, Schr. was in lat. 33°, lon. 74° 55′. At 6 A. M., a gale commenced at S. E., which continued with great violence till 7 in the evening. At 3 P. M. cut away foremast.

5. Lat. 32° 25′, lon. 70° 10′, Sept. 22. *Sloop Experiment,* on the morning of the 22d was upset, in a heavy gale from N. W.

which lasted eight hours, and remained on beam ends twenty two hours and then righted. Captain and mate taken off the wreck by Schr. Nelson, on the 24th, in lat. 38° 2′, lon. 75° 15′.

6. Lat. 33°, lon. 74°, Sept. 22. *Schr. Rover,* in a terrible gale on the 22d, lost main-mast and most of the canvass.

7. Lat. 33° 10′, Sept. 23. *Brig Sarah,* from St. Pierre's to New London; a very heavy gale and tremendous sea from S. E. to S. S. W.

8. Lat. 34° 20′, lon. 70° 50′, Sept. 23. *Schr. Indian Queen,* experienced a tremendous hurricane about 12 at night from E., and knocked on her beam ends. Gale lasted about four hours. Another account says five hours.

9. Lat. 34° 21′, lon. 71° 37′, Sept. 23. *Brig George,* experienced a tremendous gale from S. E., which lasted twelve hours.

10. Off Cape Hatteras, Sept. 22d, *Ship Minerva,* in fifteen fathoms water, encountered a tremendous gale from S. E. to N. W., main topmast carried away. At 3 A. M. wind shifted to northward, and became more moderate.—Sept. 22d, *Ship Phœnix,* experienced a most violent gale, which commenced at S. E. and ended in four hours at E. S. E. Lost topmasts, yards, &c.—*Schr. Ruby,* capsized on 22d.

11. Lat. 36° 30′, lon. 74°, Sept. 22. *Brig Morgiana,* experienced a heavy gale, which swept the decks.

12. Lat. 36° 44′, lon. 73° 17′, Sept. 22. *Schr. Thetis,* experienced a heavy gale from N. N. E. Lost fore and main topmast, &c. 23d, night; *Schr. Spartan,* from Marseilles to Baltimore. Sept. 2d, was in lat. 35° 58′, lon. 38°. On the 24th, was in lat. 37° 32′, lon. 72° 14′. On the 23d in the night experienced a very heavy gale from S. E. and S.

13. Lat. 37° 30′, lon. 72°, Sept. 23. *Brig Statira,* in the Gulf Stream, experienced a violent gale which carried away mainmast, yards, sails, &c. On her beam ends a considerable time after the gale. Another account.—On the 23d commenced with strong gales from S. E., close reefed topsails, &c.; at 3 P. M., took in fore topsails; at 4, took in main topsail, gale increasing hove to; at A. M. brought her more head to the wind; at 1 A. M., balance reefed the topsail; at 2, deck load shifting, cut away mainmast and she fell before the wind; at 3 sea swept the deck; at 10 gale abated, sea continued very high and irregular, being in Gulf Stream. Wind now shifted to W. S. W. as judged, for the com-

pass would not stand at any point during the gale. *Schr. Merino,* from Port au Prince to Boston, was in lat. 37° 18′, lon. 74°, on the 24th; experienced a heavy gale, carried away deck load and bowsprit.

14. Off the Capes, Sept. 23. *Schr. Traverse the Ocean,* for Baltimore, took the gale of the 23d, and was driven a long way S.; split her sails, &c.

15. Lat. 37°, lon. 76°, Sept. 23. *Schr. Sally,* experienced a heavy gale from E. N. E. to W., which lasted seven hours.

16. Off the Capes of Delaware, Sept. 23, night. *Brig Polly,* nearly on soundings, experienced a severe gale from S. W., cut away foremast, lost sails, &c.

17. Off Barnegat. *Schr. Alexander.* A severe gale commenced from E. N. E., which continued till 7 A. M., when it calmed and directly afterwards came from W. N. W. with great violence; stove in bulwarks. Never experienced a more violent gale. *Schr. Fair American,* for Alexandria, on the 22d was in lat. 39° 36′, lon. 70° 40′. Next day experienced a tremendous hurricane.

18. Lat. 39° 45′, lon. 72° 17′, Sept. 23. *Brig Connecticut,* experienced a gale in which she lost her bowsprit, &c. *Brig Amigo,* for New York, was in lat. 39°, lon. 71° 30′ on the 24th. Had a violent gale for four hours on the 23d.

19. Lat. 40°, Sept. 23. *Brig Othello,* for New York, in forty fathoms water; gale beginning from E. S. E. and veering round to W. S. W., blowing a storm from 4 A. M. to noon. Coming into New York the 26th. *Brig Morgiana,* Sandy Hook, W. N. W. twenty leagues; upset about half past eight in a violent hurricane.

20. Lat. 40°, lon. 72° 50′, Sept. 23. *Brig Henrico,* experienced the gale most violently. *Ship Balloon,* from Amsterdam to Philadelphia, was in lat. 40°, lon. 72° 3′, on the 24th. Experienced a severe hurricane from S. E. to S. W. on the 23d; lost main and fore topmasts. Another account.—Sept. 21, lat. 41°, lon. 64°. Sept. 24, lat. 39°, lon. 72°: severe hurricane on the 23d, from S. E. to S. W.

21. Lat. 40° 10′, lon. 70°, Sept. 22. *Schr. Rising States,* experienced a heavy gale from E. N. E. to W. S. W.; heavy cross sea running. *Brig Abaellino,* fifteen leagues westward of south shoals of Nantucket. Severe gale—carried away bulwarks.

22. Lat. 41° 41′, lon. 60°, Sept. 22d. *Two vessels* spoke, but no mention of the gale.

23. Lat. 41° 51′, lon. 63° 45′, Sept. 22. *Ship Mandarin*, on the 22d, experienced a heavy rolling sea, but little wind; then about one hundred and fifty miles S. E. of Boston.

24. Lat. 42° 28′, lon. 66°, Sept. 23. *Ship Thomas*, wind from N. W. to E. and S.; part of the day moderate, and part fresh breezes.

25. Off Cape Ann, Sept. 23. *Schr. Two Sisters*, sixteen leagues off Cape Ann—felt nothing of the gale.

26. East of Cape Ann, Sept. 23. *Schr. Leopard*, when five leagues E. of Cape Ann; experienced the gale very severely—thrown on beam ends. *Brig Caroline*, two hundred miles N. E. of Boston, a fresh breeze from N. E. to S.

27. Sept. 23. *Ship Prudence*, twenty leagues S. E. from St. George's shoals, had a tremendous swell from S. W. and lay to under reefed mizzen stay-sail, expecting a gale, but had nothing more than a balanced reef breeze; at midnight, set balanced reefs again, with strong westerly winds.

28. Sept. 24. *Brig Fredonia*, on 23d in lat. 36° 51′, lon. 73° 20′, and on 25th, Cape Henlopen, W. N. W. fifty miles; on 24th, a tremendous gale commenced at E. N. E. but shifted to N. W. *Schr. Gov. Shelby*, from Bordeaux to New York, arrived October 5th. Sept. 18th, was in lat. 39° 40′, lon. 43° 30′; experienced the gale within two days' sail of port, but received no injury. Since then, there has not been at sea a one knot breeze. *Schr. Comet*, from St. Barts to Baltimore: in the edge of soundings experienced a heavy gale; lay to ten hours—25th, took a pilot; 26th, came into bay.

2. *Accounts of the Storm on Land.*

29. *Philadelphia.* Great part of Friday night (22d) wind, a gale from N. E. with heavy rain. Early Saturday (23d) veered to N. W., and continued a gale, with torrents of rain, for several hours. Between 8 and 9 o'clock wind slackened, rain ceased, and clouds broke away in W. and S. W. About noon weather clear and mild, with a gentle westerly breeze. During the afternoon the sun greater part of the time obscured with flying clouds from W. and N. W.

30. *New York.* Thursday night? (21st) violent storm of wind and rain set in from N. E. and continued till about 2 o'clock at night, when it suddenly shifted to N. and N. W., and blew with

increased violence. Friday (22d) gale all day from N. E. and E., with heavy and incessant rain. Gale increased in the evening, continued till 4 o'clock, Saturday. At 2 o'clock in the morning backed round to N., and by 9 o'clock was at N. N. W., when it was most violent. In the course of the forenoon gradually backed round to S. W.

31. *Bridgeport, Ct.* Account is lost, but I find in a table which is subjoined, the following :—Wind N. E. at 6, 7, 8, 9, 10, $\frac{3}{4}$ past 10, and N. W. at 11 o'clock, of 23d.

32. *New Haven, Ct.* Friday night and Saturday morning (22d and 23d) severe storm of wind and rain. Did damage to roads and bridges, wharf inundated; six and a half inches of rain fell during storm; streams much swelled. Wind N. E. from morning of 22d to morning of 23d; noon of 23d W., evening S. W.

33. *Martha's Vineyard, Mass.* Gale very severe.

34. *Lyme, Ct.* Account lost, the following is from the table :—Wind N. E. at 6 and 7 o'clock, S. E. at 8 and 9 o'clock of 23d.

35. *New London, Ct.* Storm commenced on Friday (22d.) During that day and night a heavy fall of rain, wind N. E. Next morning (23d) wind increased, at 7 o'clock very violent, soon after almost a hurricane. The tide which commenced flood about 6 o'clock, covered the wharves before 9, and at 10 o'clock had risen three or four feet higher than was ever known. The rise had been so rapid, that the buildings in Beech street were deluged before the inhabitants felt their danger, and in thirty minutes after danger was apprehended waves rose four to six feet in the streets. Now stores were falling, buildings unroofed, trees falling; this destructive scene was short. Soon after 11 o'clock the wind shifted to the westward and abated, when the sea returned with the velocity it came in, though it should have run flood till 12; and the storm ceased. The destruction of trees in all towns in the neighborhood was immense. Intelligent farmers estimate half the best fruit and forest trees fallen. The showers which fell over this city and neighborhood were of salt water. The leaves of tender fruit trees and shrubs and of many forest trees, without frost, shrunk in a few hours after the gale as though they had been scorched. During the strength of the wind, in the eddies, the air was extremely hot and suffocating.—Another account. For two or three days wind blew from N. E., not very hard; about 8 o'clock it shifted to E., when its severity commenced.

Between 9 and 10 o'clock veered to S. E., when it blew most violent.—October 4th. The brooks which run through this place continue brackish. Some wells in the country have become brackish.

36. *Stonington, Ct.* Storm raged with great violence. Every vessel went ashore. Thirty buildings were destroyed or injured. The following is from the table:—Wind N. E. at 6, 7, 8, and 9 o'clock, and S. E. at 10 o'clock.

37. *Newport, R. I.* Commenced about 9 o'clock, wind S. E. by S., and continued unabated two hours and a half, when it subsided.

38. *Norwich, Ct.* Wind during most of the week blew moderately from the east with pleasant weather until Thursday, (21st,) when it became cloudy and uncommonly raw and cold. Friday morning (22d) it began to rain and continued the whole day. At night blew fresh from N. E., gradually increasing till about 8 o'clock, Saturday morning (23d) when it veered to E. S. E., and blew with tremendous fury from that point to W. S. W., till near 12 o'clock, when it abated. Many trees were levelled.

39. *Fair Haven, Mass.* Morning, wind blew from S. E., very hard. About 9 o'clock shifted to S. and remained two hours a tremendous gale. About 12 o'clock was S. W. and continued so the rest of the day, blowing hard with heavy rain most of the time. Windows covered with salt water; trees turned black.

40. *New Bedford, Mass.* Account lost; the following is from the table:—Wind S. E. at 6 o'clock and continued there till 12.

41. *East Greenwich, R. I.* Gale commenced about 7 o'clock and continued till 12. Tide rose seven feet higher than was ever known. Meeting-house unroofed.

42. *Warren, R. I.* Tide rose about seven feet above common spring tide. Trees, buildings, &c. demolished.

43. *Providence, R. I.* At 7 o'clock, wind shifted from N. E. to S. E., at which point it seemed to be settled in the course of half an hour. At 8 o'clock, from being cold, the air became suddenly very warm; so much so, that standing by a window looking eastward, sensations were felt not unlike standing before an oven moderately heated. At 9 o'clock, scuds run very low; the sky when visible looked very glassy, something like brass. The atmosphere seemed very much impregnated with saline particles, quite perceptible to the taste. At 9½ o'clock it blew a gale, and

continued to increase in violence till 11, when the wind shifted to S.; the tornado then began to abate. At 12 o'clock, wind veered to S. W. by S., when storm ceased. Another account:—A storm of rain from N. E. commenced on Friday, (22d,) and continued with little intermission till Saturday morning, (23d,) when wind was from E. Between 8 and 9 o'clock wind shifted S. E., and continued to blow, increasing in violence, till 11½, when it changed to W., and damage stayed.

44. *Poughkeepsie, N. Y.* Gale, but little or no damage done.

45. *Worcester, Mass.* Thursday [Friday?] evening (21st) [22d?] heavy storm (rain) commenced, with strong N. E. wind, which had been blowing twenty four hours before from that quarter. Early Saturday morning (23d) the wind increased, and rain descended in torrents, and continued with but short intermissions until about 10½ o'clock, when the rain abated and the wind suddenly shifted to S. E. and blew a hurricane, blowing down trees and chimneys. We have traced a column of near sixty miles in width, with nearly the same devastation. No parallel in this country. Period of destruction about one hour. Wind came in gusts with increasing violence until its utmost height, when it gradually subsided to a gentle breeze. A suffocating current of air, as from a hot bath, accompanied the middle stage of the tempest. The destruction of forest trees incalculable. Grapes in a garden had a taste of salt on their surface. Flocks of gulls were seen after the storm on Saturday, in a meadow near Worcester, and others about the same time in Grafton. Toward evening they flew toward the sea. Water which fell in Uxbridge, Grafton, Worcester and Sterling, salt.

46. *Boston, Mass.* Storm of rain from N. E. commenced on Friday, (22d); through the day moderate; at night rain increased, and wind somewhat violent. During the night it abated. Saturday morning storm renewed its violence. Wind with accumulating severity from E. till near 11 o'clock. At this time shifted to S. E. but increased in violence until 12 o'clock, when it began to abate, and between 1 and 2 o'clock shifted to S. W. At 2 o'clock danger from wind over, and at the close of the afternoon it had entirely subsided. About 12 o'clock, two hours before high water, when the gale from the S. E. was at its height, the tide rose very high. After change of wind it did not continue to rise; the wind compelled a fall earlier than natural. Glass-house

blew down about 11 o'clock; trees were thrown down. Every substance exposed to rain incrusted with salt; windows lost their transparency from the salt; leaves have the appearance of frost. Same observed some miles interior. Another account:—Storm commenced at 4 o'clock from E., with heavy showers. At 9 o'clock fresh gale from E. with slight rain; at ¼ before 11 shifted to S. E. without rain, and by 12 o'clock a violent hurricane. At 2 o'clock gale had abated; and at 6 o'clock moderate weather.

47. *Salem, Mass.* Saturday, (23d,) violent gale began about 9 o'clock, greatest fury about 11½ o'clock. Began at S. E. and filled the air with rain as briny as the ocean. At the time of greatest violence changed to S. W., and then did greatest damage; it afterwards changed to S. S. W., and before 3 o'clock the sun appeared. Not suffered as much as our neighbors. Loss of barns, out-houses, orchards and fences severely felt. Few vessels injured. Another account:—Morning, wind at E., about 11 shifted to S. E.; between 1 and 2 o'clock got S. W., and soon subsided; pleasant before night.

48. *Northampton, Mass.* Storm very severe only on Saturday (23d).

49. *Amherst, Mass.* All the country within this place, Brookfield, Tolland, New London, New Bedford, tempest raged about equally. Great destruction of trees. The following is from the table:—wind at 11½ o'clock S. E.; at 1½ o'clock subsided.

50. *Provincetown,* and *Wellfleet, Cape Cod.* The gale was but slightly felt.

51. *Troy, N. Y.* Great rain, sudden and unusual rise in Hudson River. Sunday, (24th,) most of the wharves covered several feet deep.

52. *Portsmouth, N. H.* Buildings considerably injured.

53. *Counties of Bristol, Barnstable, Plymouth, Norfolk, Worcester, Middlesex, Essex* and *Hampshire, Mass.* Reports that would fill columns. Damages pretty equally felt in injury of meeting-houses, dwellings, chimneys, barns, and trees. All fruit shaken off. In all places to leeward of salt water, pastures ruined by the salt spray, and the whole of trees and vegetables so blighted and changed as to exhibit the appearance of destruction by fire and smoke.

### 3. *Accounts showing the force of the wind in several parts of Massachusetts.*

54. *Abingdon.* Church destroyed.—*South Reading.* Steeple blown down.—*Wareham.* Steeple blown down.—*Cambridgeport.* Three dwellings demolished.—*Dorchester.* Seventeen houses unroofed, sixty chimneys blown over, and five thousand trees prostrated.—*Cape Towns.* No accounts of severe damage except at *Sandwich.*—*Chelsea.* Elm tree seventeen feet in girth, blown down.—*Marblehead.* Fourteen vessels on shore.—*Gloucester.* Vessels ashore, and buildings blown down.—*Danvers.* Storm violent, not greatly destructive. Pear tree imported and transplanted by Gov. Endicott in 1680 stripped of half its branches. Oaks that braved the tempest one hundred years thrown down.—*Andover.* Spray of salt water reached it, giving every thing it descended upon a saltish taste, and blighting every fibre of vegetation.—*Newburyport.* Ornamental trees suffered much; buildings injured.—*Ipswich.* Less damage done to vessels than other parts of our shore.—*Lynn.* Buildings suffered.—*Wenham.* Steeple blown down.—*Saugus.* Severe, trees blown down, barns, &c.—*Wells.* One man killed by falling of a tree.

55. I subjoin the table which I constructed, at the time of collecting the accounts, for the purpose of presenting a view of the storm simultaneously in different places, during the forenoon of the 23d September, 1815.

*View of the Hurricane in the forenoon of Saturday, Sept. 23d*, 1815.

| TIME. | Amherst. | Salem. | Boston. | Worcester. | Providence. | NewBedford. | Fair Haven. | Newport. | Stonington. | Lyme. | New London. | Bridgeport. | New York. | Philadelphia. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. 6 o'clock, | | E. | E. | N. E. | N. E. | S. E. | S. E. | | N. E. | N. E. | N. E. | N. E. | N. | N.W. |
| " 7 " | | E. | E. | N. E. | N. E. | S. E. | S. E. | | N. E. | N. E. | N. E | N. E. | N. | N.W. |
| " 8 " | | E. | E. | N. E. | S. E. | S. E. | S. E. | | N. E. | S. E | E. | N. E. | N. | N.W. |
| " 9 " | | E. | E. | N. E. | S. E. | S. E. | S. | S.E. by S. | N. E. | S. E. | E. | N. E. | N.N.W. | |
| " 9½ " | | | | | | | | | | | S. E. | | | |
| " 10 " | | E. | E. | N. E. | S. E. | S. E. | S. | S.E. by S. | S. E. | | S. E. | N. E. | S. W. | |
| " 10½ " | | | | S. E. | | | | | | | | | | |
| " 10¾ " | | E. | S. E. | S. E. | S. E. | S. E. | S. | S.E. by S. | | | S. E. | N. E. | | |
| " 11 " | | S. E. | S. E. | | S. E. | S. E. | S. | S.E. by S. | | | S. E. | N.W. | | |
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| M. 12 " | | S. E. | S. E. | | S. E. | S. E. | S. W. | | | | | | | |
| P.M. 1 " | | S. E. | S. E. | | | | S. W. | | | | | | | |
| " 1½ " | | S. W. | S. W. | | | | S. W. | | | | | | | |
| " 2 " | | | | | | | S. W. | | | | | | | |

56. The following facts appear to me to be established by the foregoing accounts.

1st. The hurricane commenced in the West Indies, and moved northward at the rate of twelve or fifteen miles an hour.

2d. Its course from St. Barts was about W. N. W. to Turks Island, and thence to Boston (nearly on the same meridian) it was a curve convex to the west. (See account of *Schr. Sally*, lat. 37°, lon. 76°, for the most western point of the curve.)

3d. Previous to the arrival of the hurricane in New England, a N. E. storm had prevailed along the Atlantic coast for more than twenty four hours. (See accounts, New York, New London, Norwich, Worcester, and Boston.)

4th. For some hours previous to the hurricane, there was a great and rapid condensation of vapor, producing a heavy fall of rain in the line of the N. E. storm. (See accounts, Philadelphia, New York, New London, Norwich, Worcester, Boston and Troy.)

5th. The hurricane (that is, the violent blow) was mostly from the S. E., blowing into and at right angles to the N. E. storm, at its southern termination.

6th. As the S. E. wind approached the line of the N. E. storm, it was deflected into an E. wind. (See table, Salem, Boston, and New London.)*

7th. The general form of the hurricane in and about New England was that of an eccentric ellipse, with its longest diameter N. E. and S. W.; wind blowing N. E. on the N. W. side; N. N. W. and W. N. W. at its south end; S. E. on its S. E. side,† curving into an E. wind at its junction with the N. E. current; wind blowing from S. at the easternmost part of the hurricane. The whole body of the hurricane, in this form, moved to the north nearly on the meridian.

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* May we not rather suppose that the more violent S. E. storm pursued its own course of rotation in this direction by E. and N. E. without regard to the previous N. E. wind which it had superseded?—Eds.

† Did not this S. E. wind pertain more nearly to the centre of the path of the hurricane? For we find that the ship Prudence, twenty leagues from St. George's Shoals, had a tremendous swell from S. W., which would appear to have been produced on the S. E. margin of the gale.—Eds.

ART. VI.—*A New Method of determining the quantity of Nitrogen in Organic Compounds;* by Drs. VARRENTRAPP and WILL. Translated from the original in the Annalen der Chemie und Pharmacie, by J. LAWRENCE SMITH, M. D. of Charleston, S. C.

*Messrs. Editors*—In this letter I send you a translation of such parts of the original article of Drs. V. and W. as may enable one to thoroughly understand this valuable addition to what is already known upon the subject of organic analyses; neither the first nor the latter parts are here taken notice of, as the one is merely a detached account of the various processes that have been previously employed to estimate the quantity of nitrogen in organic compounds, and the other, the mention of some analyses made with the view of comparison.

"This method has for its basis the peculiar action of the hydrated fixed alkalies, upon organic substances containing nitrogen, when subjected to a high temperature. It consists in the separation of nitrogen in the form of ammonia, and estimating the latter, either under the form of the muriate of platinum and ammonia, or from metallic platinum."

"If one melts an organic substance free from nitrogen, together with the hydrate of potash, the water of the potash becomes decomposed, (as Gay Lussac has shown,) its oxygen combines with the carbon and hydrogen of the organic matter, and its hydrogen passes off in the form of gas."

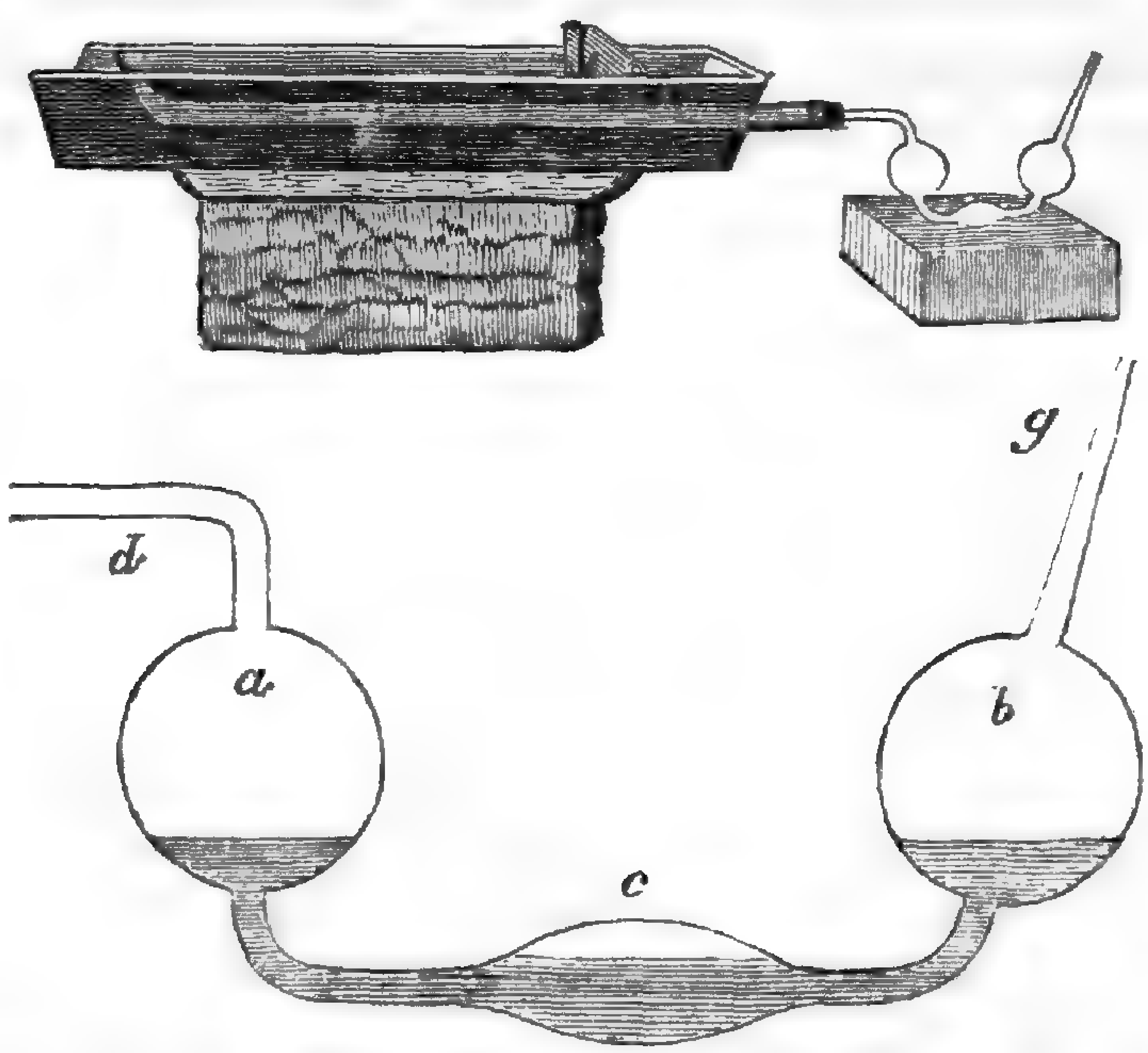
For a perfect result of the above nature a high temperature is required, as well as a considerable excess of potash.

"When on the contrary, the organic substance contains nitrogen, the free hydrogen combines with it and forms ammonia. Since the observation of this fact, the only use that it has been put to, has been that of ascertaining the presence of nitrogen in an organic compound."

The first and chief difficulty that presented itself to Drs. V. and W. in making use of this method to estimate the quantity of nitrogen, was that when a substance was very rich in that element, the whole of it would not be converted into ammonia, but that a portion by combining with the carbon formed cyanogen, which would pass off or be converted into hydrocyanic acid, and the latter unite itself to the potash. But upon experiment these gentlemen found, by employing a sufficient excess of hydrated alkali and a temperature not too low, that every cyanide and all other substances that contained nitrogen not under the form of nitric acid, would become decomposed by this means, and all the nitrogen be converted into ammonia.

"Our method, which is based upon the peculiar property already stated of all substances containing nitrogen, in which this element does not exist in combination, under the form of nitric acid, consists in the complete interception of the ammonia, by means of hydrochloric acid, and subsequently weighing it in a solid form as chloride of platinum and ammonia."

The apparatus used by Drs. V. and W. is such as is represented in the annexed figures. It consists of a furnace, such as is ordinarily used in organic analyses, with a tube of hard glass drawn out at its closed extremity. The length of this tube should be




from twelve to fifteen inches, and its inner diameter about three lines. To the open end of this tube is attached an apparatus, somewhat similar to Liebig's alkali bulbs, but differently constructed to facilitate the pouring out of the liquid, which is placed within it. It is composed of three bulbs *a, b, c*, the two first being about one and a quarter inches in diameter, and the latter about five lines. The tube connecting these bulbs is about a line in diameter, and drawn out at its extremity *g* by means of a spirit lamp. The bulbs are filled to about the height represented in the figure, with *pure* hydrochloric acid of the ordinary strength, and this part of the operation is done by applying the mouth to the extremity *d*, and drawing the acid through the extremity *g*.

"As means of decomposing the organic substance containing nitrogen, that is to say, of oxydizing its carbon and hydrogen, we make use of the hydrate of potash, or soda mixed with caustic lime, in such proportions, that the mixture when exposed to a strong heat will not melt, but only slightly run together. This mixture has the advantage of being easily pulverized, and of not attracting moisture very rapidly, and generally it is managed with the same facility as the bioxide of copper or the chromate of lead. We have preferred latterly the mixture containing soda, in preference to that with potash; because the hydrate of soda, on account of its smaller atomic weight, contains more water, and consequently more oxydizing material than the same weight of the hydrate of potash. Also the mixture of the hydrate of soda and lime attracts moisture less readily than that of potash and lime; and moreover, the hydrate of soda requires but twice its weight of anhydrous lime to form a mixture that will not melt at a red heat. For one part of potash three of lime are necessary. The easiest method of preparing it, is to slake the lime in a solution of known concentration, of either of the above alkalies; heat the mixture to redness in a crucible, and rub it to a fine powder. Or we may rub up quickly one of the alkalies (first melted and then cooled) in a warm mortar, and then mix intimately with it anhydrous lime in the proper proportion. In this latter case, the lime must be first slaked and then heated to redness as a fine powder before being used. The mixture prepared in either of the above ways is once more heated to redness to drive away all mixture and then preserved in a well stopped phial."

In performing an analysis, the process is as follows:

"The burning tube, clean and dry, is half filled with the alkaline mixture, and that is the measured quantity to be mixed with the substance about to be analyzed, which is first dried and weighed in the ordinary method. The quantity of the substance employed should vary according as it contains more or less nitrogen. When rich in this element about three grains, but when its quantity is quite small about six grains should be used."

"The mixture of the weighed substance with the measured quantity of the alkaline powder, is done in a porcelain mortar with a flat bottom, (which has been previously slightly warmed,) and with a very gentle movement of the pestle. If these precautions are strictly observed, no loss of material will result by its sticking to the sides of the mortar, or bottom of the pestle. If the mixture be pressed too hard, or if it be rubbed too fine, or if the mortar be not perfectly dry, a portion of the substance will adhere to its sides. After introducing the mixture into the burning tube in the ordinary way, the mortar is rinsed with the alkaline powder, with which we fill the tube to within an inch of its mouth, in which is placed a loose stopper of asbestus that has been heated to redness and cooled."

The use of the asbestus is to prevent the gas that is generated, from projecting any of the powdered alkali into the apparatus containing the hydrochloric acid, which accident would of course cause a serious error in the result.

"With a tight cork we unite the tube containing the mixture to the acid apparatus, and by warming slightly the bulb *a*, by bringing an ignited coal beneath it, we are able to ascertain whether the apparatus is tight, for if so, the liquid will be chased from the bulb *a*. The tube is now heated as in the case of ordinary organic analysis, by placing ignited coals at the front part of the furnace, that contains none of the organic substance. The cork must be kept as warm as possible, so that it may contain no moisture, which by absorbing ammonia, may cause a loss of nitrogen. So soon as the first part of the tube is red hot, we carry the fire slowly back upon that part containing the substance."

"Carbonic acid is formed, the oxygen in the water of the hydrated alkali combining with the carbon of the substance, the free hydrogen combines with its nitrogen, and ammonia is formed, which is absorbed by the hydrochloric acid. Hydrogen or carburetted hydrogen (according as the substance contains more or less carbon) is evolved, and this passing through the acid without being absorbed, enables us to see the progress of the burning."

"It may be well to remark, that a continued current of gas is evolved, but there need be no apprehension of the escape of the ammonia, for its absorption is so complete and goes on with such rapidity, that one has rather to apprehend a recoil of the fluid; if the current of gas is only stopped for a moment, the fluid rises in the bulb *a*, and if the fire be carelessly attended to, it will enter the tube *d*, and thence the burning tube, rendering the experiment useless."

Drs. V. and W. state that when the body contains a large portion of nitrogen, this accident is more to be apprehended, and they recommend the mixing of an equal weight of some substance free from nitrogen, as for instance, sugar, with the body containing nitrogen, and with the alkali lime, which by forming gases not absorbable by the acid, will cause no error, and prevent any accident.

"After the whole length of the tube is red hot and gas no longer generated, when all the carbon of the substance is burnt, and the mixture in the tube appears white, the small end of the burning tube is broken, and a quantity of air drawn through the burning tube, and absorption apparatus, in order to bring all the ammonia in the tube in contact with the hydrochloric acid; the air is drawn through by means of the extremity *g*, a small tube containing potash being placed between it and the mouth, to prevent one from inhaling the acid vapors."

"We proceed to analyze fluids exactly as in the burning with the binoxide of copper. A little of the alkali lime is first introduced into the burning tube, and upon that is dropped the little bulb, containing the known quantity of the fluid to be analyzed, with its capillary extremity broken off, and then fill the tube as before with the alkali lime. The operation goes on more regularly, if we commence by heating the first third of the tube to redness, and then warming that part of the tube containing the bulb, from which the fluid is expelled, which disseminates itself over the middle part of the tube, without being decomposed; if we now carry the fire from before backwards, a gentle and constant current of gas will be evolved."

"After the burning is complete, and the air passed through the apparatus, the contents of the absorption apparatus are emptied into a small porcelain capsule. With a dropping tube we introduce first into the apparatus, a mixture of alcohol and ether, which must be shaken backwards and forwards, and then added to the first fluid. The bulbs are now washed with water, until it affords no acid reaction, and all the washings added to the hydrochloric acid containing the hydrochlorate of ammonia. The washing with alcohol and ether has for its object the dissolving of any carburetted hydrogen which may be formed during the burning, and by collecting in the bulbs would prevent the water from coming perfectly in contact with the sides, and thereby rendering a complete washing difficult. Seldom is more than an ounce to an ounce and a half of fluid needed for the removal of all the hydrochlorate of ammonia."

"To this fluid, now containing hydrochlorate of ammonia, an excess of a pure solution of the chloride of platinum is added, and it is then evaporated to dryness, either first by the aid of a spirit and then by a water bath, or entirely by the latter means. From a well conducted burning, the chloride of platinum and ammonia that is obtained, is always beautifully yellow; but if the material contained a great deal of carbon, or was burnt with difficulty, then the chloride of platinum and ammonia is of a darker color. This color though, has little or no effect upon the accuracy of the result, supposing the washing to have been carefully done."

"Upon the residue in the porcelain capsule, after it has cooled, a mixture of two parts of absolute alcohol and one of ether is poured. This dissolves the excess of the chloride of platinum, and no part of the chloride of platinum and ammonia. It is immediately known, whether there has been an excess of the chloride of platinum, by the fluid assuming a yellow color; if it is colorless, then there has been a deficiency."

"The washing of the residue is performed easiest by holding the capsule, after the fluid has been poured upon a weighed filter, perpendicularly over the same, and washing the precipitate in, with the solution of alcohol and ether. The filter must be washed by the same mixture until it passes without color or acid reaction. The precipitate and filter are dried on a covered capsule or weighed tube at 212° Fah. and weighed. It is well, in order to continue the result, to decompose the chloride of platinum and ammonia by heat, and out of the residue obtained, calculate again the quantity of nitrogen, and if the chloride of platinum was pure, the quantity of nitrogen calculated by this latter method will not differ from the double chloride."

In decomposing the chloride of platinum and ammonia, it must be done by heating it, enveloped in its filter, gradually to redness; for if it be done too hastily, the vapor of the muriate of ammonia and chlorine will remove mechanically some of the platinum. The chloride of platinum used in this process, must be perfectly pure, and Drs. V. and W. state, that it is difficult to obtain spongy platinum without a trace of muriate of ammonia, by simply decomposing the chloride of platinum and ammonia by heat. They therefore recommend that the spongy platinum used to form the chloride, should be well washed with hot distilled water, before being dissolved in the nitro-hydrochloric acid.

"If we weigh the nitrogen as the chloride of platinum and ammonia, we have one hundred and seventy seven parts of it for every two thousand seven hundred and eighty eight of the double chloride, but if as metallic platinum, one hundred and seventy seven parts for every twelve hundred and thirty three of the metal."

"The weight of the chloride of platinum and ammonia remains constant under a long continued drying at 212° Fah., as well as that of the filter, after it has been completely washed. If there be a trace of acid remaining on the filter it becomes dark and friable."

I believe that now all the important steps in this operation have been fully detailed, and I shall conclude with a translation of a letter of Prof. Liebig's, that was attached to the original publication, in order that it may be seen, how highly this new method of estimating the quantity of nitrogen in organic bodies is esteemed by that distinguished chemist.

"I have had the pleasure of being constantly present at the development of the experiments by which Drs. V. and W. by degrees have arrived at the method, which they have here described. I regard this new method of estimating nitrogen as one of the most important improvements in organic analysis, because it determines the quantity of nitrogen with a certainty and precision which until now were wanting. The whole opreation is completed in a few hours, and with all the accuracy of the determination of the carbonic acid. I doubt not that this apparatus will very soon replace the ordinary method, to the contentment of all analytical chemists.—J. L."

The little experience and observation I have had of it, verify the opinion of Prof. Liebig, and in simplicity it is every thing that can be desired.

Geissen, November, 1841.

Art. VII.—*A Letter to William Whewell, Professor of Moral Philosophy in the University of Cambridge, England, in reply to certain allegations and arguments advanced in a pamphlet entitled a Demonstration that all Matter is Heavy*;* by Robert Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

1. *Dear Sir*—I thank you for your kind attention in sending me a copy of your pamphlet entitled a "*Demonstration that all Matter is Heavy*," comprising a communication made to the Cambridge Philosophical Society.

2. I conceive that to demonstrate that all matter is heavy, is, in other words, to prove that all matter is endowed with attraction of gravitation, or that general property which, when it causes bodies to tend towards the centre of the earth, is called weight. Hence to assert that all matter is heavy, is no more than to say, that attraction of gravitation exists between all or any masses of matter.†

3. You say, "it may be urged that we have no difficulty in conceiving of matter which is not heavy." I have no hesitation in asserting, that there should be no difficulty in entertaining such a conception; since I cannot understand why any two masses may not be as readily conceived to *repel* as to *attract* each other, or *neither to attract nor to repel*. Is it not easier to imagine two remote masses indifferent to each other, than that they act upon each other? Is any thing more difficult to understand than that a body can act where it is not?

4. It is also mentioned by you, that it may be urged "*that inertia and weight are two separate properties of matter.*" Now I will not only urge, but also, with all due deference, will undertake to show, that the existence of inertia may as well be proven, and its quantity estimated, by means of repulsion as by means of attraction.

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* Transactions of the Cambridge Philosophical Society.

† We have thought that Dr. Hare's letter would be better understood by our readers, if we republished the "Demonstration" of Prof. Whewell, as it has probably been seen by few persons in America. It will accordingly be found in full at the end of Dr. Hare's letter.—Eds.

5. Suppose two bodies, A and B, to be endowed with reciprocal attraction; or, in other words, to gravitate towards each other. Being placed at a distance, and then allowed to approach, if, after any given time, it were found that they had moved severally any ascertained distances, evidently their relative inertias would be considered as inversely as those distances.

6. In the next place, let us suppose two bodies, X and Y, endowed with the opposite force of reciprocal repulsion, to be placed in proximity, and then allowed to fly apart. The distances run through by them severally, being, at any given time, determined, might not their respective inertias be taken to be inversely as those distances; so that the question would be as well ascertained in this case, as in that above stated in which gravitation should be resorted to as the test?

7. It seems to me that this question is sufficiently answered, in the affirmative, in your second paragraph, page 7, (p. 269,) in which you allege, that "*one body has twice as much inertia as another, if when the same force acts upon it for the same time, it acquires but half the velocity. This is the fundamental conception of inertia.*"

8. In the third paragraph, fourth page, (p. 261,) you say, "*that the quantity of matter is measured by those sensible properties of matter which undergo quantitative addition, subtraction and division, as the matter is added, subtracted or divided, the quantity of matter cannot be known in any other way; but this mode of measuring the quantity of matter in order to be true at all, must be true universally.*"

9. Also your fourth paragraph, fifth page, (p. 268,) concludes with this allegation, "*and thus we have proved, that if there be any kind of matter which is not heavy, the weight can no longer avail us, in any case to any extent, as the measure of the quantity of matter.*"

10. In reply to these allegations let me inquire, cannot a matter exist of which the sensible properties do not admit of being measured by human means? Because some kinds of matter can be measured by "those sensible qualities which undergo quantitative addition, subtraction and division," does it follow that there may not be matter which is incapable of being thus measured? And wherefore would the method of obtaining phi-

losophical truth be "futile" in the one case, because inapplicable in the other? Because the inertias of A and B have been discovered, by means of their gravitation, does it follow that the inertias of X and Y cannot be discovered by their self-repellent power? Why should the inapplicability of gravitation in the one case render its employment futile in the other?

11. It is self-evident, that matter without weight cannot be estimated by weighing, but I deny that on that account such weightless matter may not be otherwise estimated. The inertias of A and B cannot be better measured by gravitation than those of X and Y by repulsion, as already shown.

12. You seem to infer, in paragraph second, page sixth, (p. 268,) that we should be equally destitute of the means of measuring matter accurately, "*were any kind of matter heavy indeed, but not so heavy, in proportion to its quantity of matter, as other kinds.*"

13. If in the case of all matter weight be admitted to be the only measure of quantity, it were inconsistent to suppose any given quantity of matter, of any one kind, to have less weight than an equal quantity of another kind; but upon what other than a conventional basis is it to be assumed, that there is more matter in a cubic inch of platinum than in a cubic inch of tin; in a cubic inch of mercury than in a cubic inch of iron? Judging by the chemical efficacy of the masses, although the weight of mercury is to that of iron as 13.6 is to 8, there are more equivalents of the latter than the former in any given bulk, since by weight twenty-eight parts of iron are equivalent to two hundred and two parts of mercury.

14. Weight is one of the properties of certain kinds of matter, and has been advantageously resorted to, in preference to any other property, in estimating the quantity of the matter to which it appertains. Nevertheless, measurement by bulk is found expedient or necessary in many cases. But may we not appeal to any general property which admits of being measured or estimated? Faraday has inferred that the quantity of electricity, is as the quantity of gas which it evolves. Light has been considered as proportional in quantity to the surface which it illuminates with a given intensity at a certain distance. The quantity of caloric has been held to be directly as the weight of water which it will render aëriform; and has also been estima-

ted by the degree of its expansive or thermometric influence. What scale-beam is more delicate than the thermoscope of Melloni?

15. In the last paragraph but one, seventh page, (p. 270,) you suggest, that "*perhaps some persons might conceive that the identity of weight and inertia is obvious at once, for both are merely resistance to motion; inertia, resistance to all motion, or change of motion; weight, resistance to motion upwards.*"

16. I am surprised that you should think the opinion of any person worthy of attention, who should entertain so narrow a view of weight, as antagonist of momentum, as that above quoted, "*that it is a resistance to motion upwards.*" Agreeably to the definition, given at the commencement of the letter, weight, in its usual practical sense, is only one case of the general force which causes all ponderable masses of matter to gravitate towards each other, and which is of course liable to resist any conflicting motion, whatever may be the direction. When in the form of solar attraction, it overcomes that inertia of the planets which would otherwise cause them to leave their orbits, does gravitation "*resist motion upwards?*"

17. In the next paragraph you allege, that "*there is a difference in these two kinds of resistance to motion. Inertia is instantaneous, weight is continuous resistance.*"

18. It is to this allegation I object, that as you have defined inertia to be "*resistance to motion, or to change of motion,*" it follows that it can be instantaneous only where the impulse which it resists is instantaneous. It cannot be less continuous than the force by which it is overcome.

19. Gravity has been considered as acting upon falling bodies by an infinity of impulses, each producing an adequate acceleration; but to every such accelerating impulse, producing of course a "*change of motion,*" will there not be a commensurate resistance from inertia? and the impulses and resistances being both infinite, will not one be as continuous as the other?

20. I have already adverted to inertia as the continuous antagonist of solar attraction in the case of revolving planets.

21. Agreeably to Mossotti, the creation consists of two kinds of matter, of which the homogeneous particles are mutually repellent, the heterogeneous mutually attractive. Consistently with

this hypothesis, *per se*, any matter must be imponderable; being endowed with a property the very opposite of attraction of gravitation. This last mentioned property exists between masses consisting of both kinds of particles, so far as the attraction between the heterogeneous atoms predominates over the repulsion between those which are homogeneous. It would follow from these premises, that all matter is ponderable or otherwise, accordingly as it may be situated.

22. Can the ether by which, according to the undulatory theory, light is transmitted, consist of ponderable matter? Were it so, would it not be attracted about the planets with forces proportioned to their weight, respectively? and becoming of unequal density, would not the diversity in its density, thus arising, affect its undulations, as the transmission of sound is influenced by any variations in the density of the aëriform fluid by which it is propagated?

With esteem,

I am yours truly,

ROBERT HARE.

*Demonstration that all Matter is Heavy. By the Rev.* WILLIAM WHEWELL, B. D., *Fellow of Trinity College and Professor of Moral Philosophy.* [Read February 22d, 1841.]

"The discussion of the nature of the grounds and proofs of the most general propositions which the physical sciences include, belongs rather to metaphysics than to that course of experimental and mathematical investigation by which the sciences are formed. But such discussions seem by no means unfitted to occupy the attention of the cultivators of physical science. The ideal, as well as the experimental side of our knowledge, must be carefully studied and scrutinized, in order that its true import may be seen; and this province of human speculation has been perhaps of late unjustly depreciated and neglected by men of science. Yet it can be prosecuted in the most advantageous manner by them only: for no one can speculate securely and rightly respecting the nature and proofs of the truths of science without a steady possession of some large and solid portions of such truths. A man must be a mathematician, a mechanical philosopher, a natural historian, in order that he may philosophize well concerning mathematics, and mechanics, and natural history; and the mere metaphysician who without such preparation and fitness sets himself to determine the grounds of mathematical or mechanical truths, or the principles of classification, will be liable to be led into error at every step. He must speculate by means of general terms, which he will not be able to use as instruments of discovering and conveying philosophical truth, because he cannot, in his own mind, habitually and familiarly, embody their import in special examples.

"Acting upon such views, I have already laid before the Philosophical Society of Cambridge essays on such subjects as I here refer to; especially a memoir "On the Nature of the Truth of the Laws of Motion," which was printed by the Society in its Transactions. This memoir appears to have excited in other places, notice of such a kind as to shew that the minds of many speculative persons are ready for and inclined towards the discussion of such questions. I am therefore the more willing to bring under consideration another subject of a kind closely related to the one just mentioned.

"The general questions which all such discussions suggest, are (in the existing phase of English philosophy) whether certain proposed scientific truths, (as the laws of motion,) be *necessary* truths; and if they are necessary, (which I have attempted to shew that in a certain sense they are,) *on what ground* their necessity rests. These questions may be discussed in a general form, as I have elsewhere attempted to shew. But it may be instructive also to follow the general arguments into the form which they assume in special cases; and to exhibit, in a distinct shape, the incongruities into which the opposite false doctrine leads us, when applied to particular examples. This accordingly is what I propose to do in the present memoir, with regard to the proposition stated at the head of this paper, namely, that *all matter is heavy.*

"At first sight it may appear a doctrine altogether untenable to assert that this proposition is a necessary truth: for it may be urged, we have no difficulty in conceiving matter which is not heavy; so that matter without weight is a conception not inconsistent with itself; which it must be if the reverse were a necessary truth. It may be added, that the possibility of conceiving matter without weight was shewn in the controversy which ended in the downfall of the phlogiston theory of chemical composition; for some of the reasoners on this subject asserted phlogiston to be a body with positive levity instead of gravity, which hypothesis, however false, shews that such a supposition is possible. Again, it may be said that *weight* and *inertia* are two separate properties of matter; that mathematicians measure the quantity of matter by the inertia, and that we learn by experiment only that the weight is proportional to the inertia; Newton's experiments with pendulums of different materials having been made with this very object.

"I proceed to reply to these arguments. And first, as to the possibility of conceiving matter without weight, and the argument thence deduced, that the universal gravity of matter is not a necessary truth, I remark, that it is indeed just to say that we cannot even distinctly conceive the contrary of a necessary truth to be true; but that this impossibility can be asserted only of those perfectly distinct conceptions which result from a complete developement of the fundamental idea and its consequences. Till we reach this stage of developement, the obscurity and indistinctness may prevent our perceiving absolute contradictions, though they exist. We have abundant store of examples of this even in geometry and arithmetic; where the truths are universally allowed to be necessary, and where the relations which are impossible, are also inconceivable, that is, not conceivable distinctly. Such relations, though not distinctly conceivable, still often appear conceivable and possible, owing to the indistinctness of our ideas. Who, at the first outset of his geometrical studies, sees any impossibility in supposing the side and the diagonal of a square to have a common measure? Yet they can be rigorously proved to be incommensurable, and therefore the attempt distinctly to conceive a common measure of them must fail. The attempts at the geometrical duplication of the cube, and the supposed solutions, (as that of Hobbes) have involved absolute contradictions; yet this has not prevented their being long and obstinately entertained by men, even of minds acute and clear in other respects. And the same might be shewn to be the case in arithmetic. It is plain, therefore, that we cannot, from the supposed possibility of conceiving matter without weight, infer that the contrary may not be a necessary truth.

"Our power of judging, from the compatibility or incompatibility of our conceptions, whether certain propositions respecting the relations of ideas are true or not, must depend entirely, as I have said, upon the degree of developement which such ideas have undergone in our minds. Some of the relations of our conceptions on any subject are evident upon the first steady contemplation of the fundamental idea by a sound mind: these are the *axioms* of the subject. Other propositions may be deduced from the axioms by strict logical reasoning. These propositions are no less *necessary* than the axioms, though to common minds their *evidence* is very different. Yet as we become familiar with the steps by which these ulterior truths are deduced from the axioms, *their* truth also becomes evident, and the contrary becomes inconceivable. When a person has familiarized himself with the first twenty-six propositions of Euclid, and not till then, it becomes evident to him, that parallelograms on the same base and between the same parallels are equal; and he cannot even conceive the contrary. When he has a little further cultivated his geometrical powers, the equality of the square on the hypothenuse of a right-angled triangle to the squares on the sides, becomes also evident; the steps by which it is demonstrated being so familiar to the mind as to be apprehended without a conscious act. And thus, the contrary of a necessary truth cannot be distinctly conceived; but the incapacity of forming such a conception is a condition which depends upon cultivation, being intimately connected with the power of rapidly and clearly perceiving the connection of the necessary truth under consideration with the elementary principles on which it depends. And thus, again, it may be that there is an absolute impossibility of conceiving matter without weight; but then, this impossibility may not be apparent, till we have traced our fundamental conceptions of matter into some of their consequences.

"The question then occurs, whether we can, by any steps of reasoning, point out an inconsistency in the conception of matter without weight. This I conceive we may do, and this I shall attempt to shew.

"The general mode of stating the argument is this:—the quantity of matter is measured by those sensible properties of matter which undergo quantitative addition, subtraction and division, as the matter is added, subtracted and divided. The quantity of matter cannot be known in any other way. But this mode of measuring the quantity of matter, in order to be true at all, must be universally true. If it were only partially true, the limits within which it is to be applied would be arbitrary; and therefore the whole procedure would be arbitrary, and, as a method of obtaining philosophical truth, altogether futile.

"We may unfold this argument further. Let the contrary be supposed, of that which we assert to be true: namely, let it be supposed that while all other kinds of matter are heavy, (and of course heavy in proportion to the quantity of matter,) there is one kind of matter which is absolutely destitute of weight; as, for instance, phlogiston, or any other element. Then where this *weightless* element (as we may term it) is mixed with *weighty* elements, we shall have a compound, in which the weight is no longer proportional to the quantity of matter. If, for example, 2 measures of heavy matter unite with 1 measure of phlogiston, the weight is as 2, and the quantity of matter as 3. In all such cases, therefore, the weight ceases to be the measure of the quantity of matter. And as the proportion of the weighty and the weightless matter may vary in innumerable degrees in such compounds, the weight affords no criterion at all of the quantity of matter in them.

And the smallest admixture of the weightless element is sufficient to prevent the weight from being taken as the measure of the quantity of matter.

"But on this hypothesis, how are we to distinguish such compounds from bodies consisting purely of heavy matter? How are we to satisfy ourselves that there is not, in every body, some admixture, small or great, of the weightless element? If we call this element *phlogiston*, how shall we know that the bodies with which we have to do are, any of them, absolutely free from phlogiston?

"We cannot refer to the weight for any such assurance; for by supposition the presence and absence of phlogiston makes no difference in the weight. Nor can any other properties secure us at least from a very small admixture; for to assert that a mixture of 1 in 100 or 1 in 10 of phlogiston would always manifest itself in the properties of the body, must be an arbitrary procedure, till we have proved this assertion by experiment; and we cannot do this till we have learnt some mode of measuring the quantities of matter in bodies and parts of bodies; which is exactly what we question the possibility of, in the present hypothesis.

"Thus, if we assume the existence of an element, *phlogiston*, devoid of weight, we cannot be sure that every body does not contain some portion of this element; while we see that if there be an admixture of such an element, the weight is no longer any criterion of the quantity of matter. And thus we have proved, that if there be any kind of matter which is not heavy, the weight can no longer avail us, *in any case or to any extent*, as a measure of the quantity of matter.

"I may remark, that the same conclusion is easily extended to the case in which phlogiston is supposed to have absolute levity; for in that case, a certain mixture of phlogiston and of heavy matter would have no weight, and might be substituted for phlogiston in the preceding reasoning.

"I may remark also, that the same conclusion would follow by the same reasoning, if any kind of matter, instead of being void of weight, were heavy indeed, but not *so* heavy, in proportion to its quantity of matter, as other kinds.

"On all these hypotheses there would be no possibility of measuring quantity of matter by weight at all, in any case, or to any extent.

"But it may be urged, that we have not yet reduced the hypothesis of matter without weight to a contradiction; for that mathematicians measure quantity of matter, not by weight, but by the other property, of which we have spoken, inertia.

"To this I reply, that, practically speaking, quantity of matter is always measured by weight, both by mechanicians and chemists: and as we have proved that this procedure is utterly insecure in all cases, on the hypothesis of weightless matter, the practice rests upon a conviction that the hypothesis is false. And yet the practice is universal. Every experimenter measures quantity of matter by the balance. No one has ever thought of measuring quantity of matter by its inertia practically; no one has constructed a measure of quantity of matter in which the matter produces its indications of quantity by its motion. When we have to take into account the inertia of a body, we inquire what its weight is, and assume this as the measure of the inertia; but we never take the contrary course, and ascertain the inertia first in order to determine by that means the weight.

"But it may be asked, Is it not then true, and an important scientific truth, that the *quantity of matter* is measured by the *inertia?* Is it not true, and proved by experiment, that the *weight* is *proportional* to the *inertia?* If this be not the result of Newton's experiments mentioned above, what, it may be demanded, do they prove?

"To these questions I reply: It is true that quantity of matter is measured by the inertia, for it is true that inertia is as the quantity of matter. This truth is indeed one of the laws of motion. That weight is proportional to inertia is proved by experiment, as far as the laws of motion are so proved: and Newton's experiments prove one of the laws of motion, so far as any experiments can prove them, or are needed to prove them.

"That inertia is proportional to weight, is a law equivalent to that law which asserts, that when pressure produces motion in a given body, the velocity produced in a given time is as the pressure. For if the velocity be as the pressure, when the body is given, the velocity will be constant if the inertia also be as the pressure. For the inertia is understood to be that property of bodies to which, *ceteris paribus*, the velocity impressed is *inversely* proportional. One body has twice as much inertia as another, if, when the same force acts upon it for the same time, it acquires but half the velocity. This is the fundamental conception of *inertia.*

"In Newton's pendulum experiments, the pressure producing motion was a certain resolved part of the weight, and was proportional to the weight. It appeared by the experiments, that whatever were the material of which the pendulum was formed, the rate of oscillation was the same; that is, the velocity acquired was the same. Hence the inertia of the different bodies must have been in each case as the weight: and thus this assertion is true of all different kinds of bodies.

"Thus it appears that the assertion, that inertia is universally proportional to weight, is equivalent to the law of motion, that the velocity is as the pressure. The conception of inertia (of which, as we have said, the fundamental conception is, that the velocity impressed is inversely proportional to the inertia,) connects the two propositions so as to make them identical.

"Hence our argument with regard to the universal gravity of matter brings us to the above law of motion, and is proved by Newton's experiments in the same sense in which that law of motion is so proved.

"Perhaps some persons might conceive that the identity of weight and inertia is obvious at once; for both are merely resistance to motion;—inertia, resistance to all motion (or change of motion)—weight, resistance to motion upwards.

"But there is a difference in these two kinds of resistance to motion. Inertia is instantaneous, weight is continuous resistance. Any momentary impulse which acts upon a free body overcomes its inertia, for it changes its motion: and this change once effected, the inertia opposes any return to the former condition, as well as any additional change. The inertia is thus overcome by a momentary force. But the weight can only be overcome by a continuous force like itself. If an impulse act in opposition to the weight, it may for a moment neutralize or overcome the weight; but if it be not continued, the weight resumes its effect, and restores the condition which existed before the impulse acted.

"But weight not only produces rest, when it is resisted, but motion, when it is not resisted. Weight is measured by the reaction which would balance it; but when unbalanced, it produces motion, and the velocity of this motion increases constantly. Now what determines the velocity thus produced in a given time, or its rate of increase? What determines it to have one magnitude rather than another? To this we must evidently reply, *the inertia*. When weight produces motion, the inertia is the reaction which makes the motion determinate. The accumulated motion produced by the action of unbalanced weight is as determinate a condition as the equilibrium produced by balanced weight. In both cases the condition of the body acted on is determined by the opposition of the action and reaction.

"Hence inertia is the reaction which opposes the weight, when unbalanced. But by the conception of action and reaction, (as mutually determining and determined,) they are measured by each other: and hence the inertia is necessarily proportional to the weight.

"But when we have reached this conclusion, the original objection may be again urged against it. It may be said, that there must be some fallacy in this reasoning, for it proves a state of things to be necessary when we can so easily conceive a contrary state of things. Is it denied, the opponent may ask, that we can readily imagine a state of things in which bodies have no weight? Is not the uniform tendency of all bodies in the same direction not only not necessary, but not even true? For they do in reality tend, not with equal forces in parallel lines, but to a centre with unequal forces, according to their position: and we can conceive these differences of intensity and direction in the force to be greater than they really are; and can with equal ease suppose the force to disappear altogether.

"To this I reply, that certainly we may conceive the weight of bodies to vary in intensity and direction, and by an additional effort of imagination may conceive the weight to vanish: but that in all these suppositions, even in the extreme one, we must suppose the rule to be universal. If *any* bodies have weight, *all* bodies must have weight. If the direction of weight be different in different points, this direction must still vary according to the *law of continuity;* and the same is true of the intensity of the weight. For if this were not so, the rest and motion, the velocity and direction, the permanence and change of bodies, as to their mechanical condition, would be arbitrary and incoherent: they would not be subject to mechanical ideas; that is, not to ideas at all; and hence these conditions of objects would in fact be inconceivable. In order that the universe may be possible, that is, may fall under the conditions of intelligible conceptions, we must be able to conceive a body at rest. But the rest of bodies (except in the absolute negation of all force) implies the equilibrium of opposite forces. And one of these opposite forces must be a *general* force, as weight, in order that the universe may be governed by general conditions. And this general force, by the conception of force, may produce motion, as well as equilibrium; and this motion again must be determined, and determined by general conditions; which cannot be, except the communication of motion be regulated by an inertia proportional to the weight.

"But it will be asked, Is it then pretended that Newton's experiment, by which it was intended to prove inertia proportional to weight, does really prove nothing but what may be demonstrated *à priori?* Could we know, without experiment, that all bodies,—gold, iron, wood, cork,—have inertia proportional to their weight? And to this we reply, that experiment holds the same place in the establishment of this, as of the other fundamental doctrines of mechanics. Intercourse with the external world is requisite for developing our ideas; measurement of phenomena is needed to fix our conceptions and to render them precise; but the result of our experimental studies is, that we reach a position in which our convictions do not rest upon experiment. We learn by observation truths of which we afterwards see the necessity. This is the case with the laws of motion, as I have repeatedly endeavored to shew. The same will appear to be the case with the proposition, that bodies of different kinds have their inertia proportional to their weight.

"For bodies *of the same kind* have their inertia proportional to their weight, both quantities being proportional to the quantity of matter. And if we compress the same quantity of matter into half the space, neither the weight nor the inertia is altered, because these depend on the quantity of matter alone. But in this way we obtain a body of *twice the density;* and in the same manner we obtain a body of any other density. Therefore whatever be the density, the inertia is proportional to the quantity of matter. But the mechanical relations of bodies cannot depend upon any difference of *kind*, *except* a difference of density. For if we suppose any fundamental difference of mechanical nature in the particles or component elements of bodies, we are led to the same conclusion, of arbitrary, and therefore, impossible, results, which we deduced from this supposition with regard to weight. Therefore all bodies of different density, and hence, all bodies whatever, must have their inertia proportional to their weight.

"Hence we see, that the propositions, that all bodies are heavy, and that inertia is proportional to weight, necessarily follow from those fundamental ideas which we unavoidably employ in all attempts to reason concerning the mechanical relations of bodies. This conclusion may perhaps appear the more startling to many, because they have been accustomed to expect that fundamental ideas and their relations should be self-evident at our first contemplation of them. This, however, is far from being the case, as I have already shewn. It is not the *first*, but the most complete and developed condition of our conceptions which enables us to see what are axiomatic truths in each province of human speculation. Our fundamental ideas are necessary conditions of knowledge, universal forms of intuition, inherent types of mental development; they may even be termed, if any one chooses, results of connate intellectual tendencies; but we cannot term them *innate* ideas, without calling up a large array of false opinions. For innate ideas were considered as capable of composition, but by no means of simplification; as most perfect in their original condition; as to be found, if any where, in the most uneducated and most uncultivated minds; as the same in all ages, nations, and stages of intellectual culture; as capable of being referred to at once, and made the basis of our reasonings, without any special acuteness or effort: in all which circumstances the fundamental ideas of which we have spoken, are opposed to innate ideas so understood.

"I shall not, however, here prosecute this subject. I will only remark, that fundamental ideas, as we view them, are not only not innate, in any usual or useful sense, but they are not necessarily *ultimate* elements of our knowledge. They are the results of our analysis so far as we have yet prosecuted it; but they may themselves subsequently be analyzed. It may hereafter appear, that what we have treated as different fundamental ideas have, in fact, a connexion, at some point below the structure which we erect upon them. For instance, we treat of the mechanical ideas of force, matter, and the like, as distinct from the idea of substance. Yet the principle of measuring the quantity of matter by its weight, which we have deduced from mechanical ideas, is applied to determine the substances which enter into the composition of bodies. The idea of substance supplies the axiom, that the whole quantity of matter of a compound body is equal to the sum of the quantities of matter of its elements. The mechanical ideas of force and matter lead us to infer that the quantity both of the whole and its parts must be measured by their weights. *Substance* may, for some purposes, be described as that to which properties belong; *matter* in like manner may be described as that which resists force. The former involves the idea of permanent being; the latter the idea of causation. There may be some elevated point of view from which these ideas may be seen to run together. But even if this be so, it will by no means affect the validity of reasonings founded upon these notions, when duly determined and developed. If we once adopt a view of the nature of knowledge which makes necessary truth possible at all, we need be little embarrassed by finding how closely connected different necessary truths are; and how often, in exploring towards their roots, different branches appear to spring from the same stem. W. Whewell."

Grange, August 31, 1840.

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## Art. VIII.—*Integration of a particular kind of Differential Equations of the second order;* by Prof. Theodore Strong.

The equations which we propose to integrate, are $\frac{d^2y}{du^2}+\frac{2pq-q+1}{u}\frac{dy}{du}+q^2a^2b^2u^{2q-2}y=0$, (1), and $\frac{d^2y}{du^2}+\frac{2pq-q+1}{u}\frac{dy}{du}-q^2a^2b^2u^{2q-2}y=0$, (2), in which $y$ and $u$ are the only variable quantities, $u$ being considered as the independent variable, whose differential (denoted by $du$) is supposed to be constant or invariable, and $y$ is supposed to be a function of $u$.

(1) is taken from Vol. III, p. 537, second edition, of the Traité du Calcul Differentiel et du Calcul Integral, par S. F. Lacroix; and (2) is deduced from (1) by changing the sign of the last term, or which comes to the same thing, by changing $b^2$ in (1) into $-b^2$, that is, using $b\sqrt{-1}$ for $b$. We shall put $2pq-q+1=c$, $(a)$, and shall use the characteristic, $\int_n^m$, when prefixed to any differential expression, to signify that its integral is to be taken with reference to the variable, from its value $n$, to the value $m$; or $n$ and $m$ are two values of the variable, and the integral is supposed to be taken from the first limit $n$, to the second $m$.

Lacroix remarks that $y=\int_0^a dx(a^2-x^2)^{p-1}\cos. bu^q x$, is a particular value of $y$, which satisfies (1); in which $u^q$ is to be regarded as constant in taking the integral, $x$ and its functions being the only variables, and the integral is supposed to be taken from $x=0$ to $x=a$, which are the first and second limits of $x$.

We have also found by integrating (1) (by the method of sesies) that it is satisfied by the particular value of $y$, which is denoted by $y=u^{1-c}\int_0^a dv(a^2-v^2)^{-p}\cos. bu^q v$, when $p$ is positive, and such that $1-p$ is positive, and not an indefinitely small quantity, and it is to be noted that $v$ and its functions are considered as the only variables in taking the integral, $u^q$ being regarded as constant. Hence if we use A and B to denote two arbitrary constants, we shall have (by the well known theory of integrals) for the complete value of $y$, the expression $y=A\int_0^a dx(a^2-x^2)^{p-1}\cos. bu^q x+Bu^{1-c}\int_0^a dv(a^2-v^2)^{-p}\cos. bu^q v$, $(b)$, in which $p$ must not be considered as an indefinitely small quantity, and $1-p$ is positive and finite; since the limits of $x$ and $v$ are the same in $(b)$, we may change $v$ into $x$, and then the value of $y$ may be put under the form $y=\int_0^a dx(a^2-x^2)^{p-1}\cos. bu^q x\left(A+Bu^{1-c}(a^2-x^2)^{1-2p}\right)$, $(c)$. If we put $1-c=e$, $1-2p=f$, or $c=1-e$, $2p=1-f$, $(d)$, we get $u^{1-c}(a^2-x^2)^{1-2p}=u^e(a^2-x^2)^f$, and if we substitute the values of $c$ and $2p$ from $(d)$ in $(a)$, we get by a slight reduction $f=\frac{e}{q}$, $\therefore u^e(a^2-x^2)^f=\left(u(a^2-x^2)^{\frac{1}{q}}\right)^e$, hence, when $e$ is very small, using hyperbolic logarithms and rejecting the terms which involve $e^2$, $e^3$, &c. we get (by the exponential theorem,) $u^{1-c}(a^2-x^2)^{1-2p}=1+e\log.u(a^2-x^2)^{\frac{1}{q}}$, which when substituted in ($c$) gives $y=\int_0^a dx(a^2-x^2)^{p-1}\cos.bu^q x\left(A+B+Be\log.u(a^2-x^2)^{\frac{1}{q}}\right)$, in which (although $e$ is supposed to be indefinitely small,) we may suppose that A+B is yet represented by A′, and $e$B by B′, A′, B′ being arbitrary finite quantities; ∴ $y=\int_0^a dx(a^2-x^2)^{p-1}\cos.bu^q x\left(A'+B'\log.u(a^2-x^2)^{\frac{1}{q}}\right)$; now when $e$ is very small, ($q$ being finite,) $f$ is also very small, and ($d$) gives $2p=1-f$, or $p=\frac{1}{2}$ by rejecting $\frac{f}{2}$ in comparison with $\frac{1}{2}$; hence when $p=\frac{1}{2}$ (and $q$ not indefinitely small) we get for the integral of (1), (observing that $p=\frac{1}{2}$ gives $c=1$,) $y=\int_0^a dx(a^2-x^2)^{-\frac{1}{2}}\cos.bu^q x\left(A'+B'\log.u(a^2-x^2)^{\frac{1}{q}}\right)$, ($e$), A′, B′ being the two arbitrary constants which (1), an equation of the second order of differentials, requires that the complete value of $y$ should have.

We may observe that Lacroix's integral will always satisfy (1) when $p$ is positive and not indefinitely small, but it will not satisfy (1) when $p$ is negative; also our integral will always satisfy (1) when $p$ is negative, (whether it is indefinitely small or not;) but when $p$ is positive and greater than unity it fails to satisfy it. Again, if we put $c=0$, we get by ($a$) $p=\frac{q-1}{2q}$, and $\frac{1-q}{2q}=-p$, and the particular value of $y$ which we have found, becomes $y=u\int_0^a dv(a^2-v^2)^{\frac{1-q}{2q}}\cos.bu^q v$, and if we put $b=\frac{1}{q}$ it will become $y=u\int_0^a dv(a^2-v^2)^{\frac{1-q}{2q}}\cos.\frac{1}{q}u^q v$, or if we put $\frac{1-q}{2q}=i$, we get $1-q=2iq$ ∴ $q=\frac{1}{2i+1}$, and $2q-2=-\frac{4i}{2i+1}$, and $y=u\int_0^a dv(a^2-v^2)^i\cos.(2i+1)u^{\frac{1}{2i+1}}v$, and (1) becomes $\frac{d^2y}{du^2}+a^2yu^{\frac{-4i}{2i+1}}=0$, the value of $y$ being a particular solution of it; it would now be easy after the manner of Lacroix to deduce (from what has here been done) the second class of the cases of integrability of the equation of Riccati; but as it is sufficiently obvious, we shall not stop to give it, but shall refer for the process to the same volume and page of Lacroix's work that we have done at the commencement of this paper.

We will now show how to find the integral of (2). If we change $b$ into $b\sqrt{-1}$, in ($b$), we shall have the complete value of $y$ in the general case when $p$ is positive and less than unity; and if $p=\frac{1}{2}$, $c=1$, by making the same change in ($e$) we shall have the complete value of $y$ in this case of the general integral.

If $p$ is positive and greater than unity, we must change $b$ into $b\sqrt{-1}$ in Lacroix's integral, and change $-v^2$ in ours into $+v^2$, then using A and B to denote two arbitrary constants, we get $y=A\int_0^u dx(a^2-x^2)^{p-1}\cos. bu^q x\sqrt{-1}+B\int_0^{\text{infin.}} u^{1-c}dv(a^2+v^2)^{-p}$ $\cos.\ bu^q v$, ($f$), for the complete value of $y$. If $p$ is negative and finite, we must change $-x^2$ into $+x^2$ in Lacroix's integral, and $b$ into $b\sqrt{-1}$ in ours, then using A and B for the arbitrary constants we shall have $y=A\int_0^{\text{inf.}} dx(a^2+x^2)^{p-1}\cos. bu^q x+Bu^{1-c}$ $\int_0^u dv(a^2-v^2)^{-p}\cos. bu^q v\sqrt{-1}$, ($g$), for the complete value of $y$. We will now give some applications of what has been done to differential equations which can be reduced to the form of (2).

Suppose that we would integrate the equations $\frac{d^2y}{dx^2}+\frac{A}{x}\frac{dy}{dx}-B^2x^n y=0$, ($h$), and $\frac{d^2y}{dx^2}+A\frac{dy}{dx}-B^2e^{nx}y=0$, ($i$), in which $x$ and $y$ are the only variables, $y$ being considered as a function of $x$, $x$ being considered as the independent variable whose differential $dx$ is supposed to be constant, and $e$ is supposed to be the base of hyperbolic logarithms; if we change the independent variable from $x$ to $u$, we must not consider $dx$ to be constant, but we may suppose $du$ to be constant; also in ($h$) and ($i$) we must suppose that $\frac{d^2y}{dx^2}$ is changed to $\frac{d\left(\frac{dy}{dx}\right)}{dx}$. We shall now put $u=x^{n+2}$, $n+2=m$, and $du=$ constant in ($h$), then since $y$ is regarded as a function of $u$, and $u$ of $x$, we get by well known formulæ of differentiation $\frac{dy}{dx}=\frac{dy}{du}\frac{du}{dx}=m\frac{dy}{du}x^{m-1}$, and hence $\frac{d\left(\frac{dy}{dx}\right)}{dx}=m$

$(m-1)x^{m-2}\frac{dy}{du}+m^2\frac{d^2y}{du^2}x^{2m-2}$, or since $u=x^m$, we get $\frac{dy}{dx}=\frac{mu}{x}\frac{dy}{du}$, and $\frac{d\left(\frac{dy}{dx}\right)}{dx}=m(m-1)\frac{u}{x^2}\frac{dy}{du}+\frac{m^2u^2}{x^2}\frac{d^2y}{du^2}$; by substituting these values of $\frac{dy}{dx}$, $\frac{d\left(\frac{dy}{dx}\right)}{dx}$, and $x^n=\frac{u}{x^2}$ in $(h)$ we get by a slight reduction $\frac{d^2y}{du^2}+\left(1+\frac{\text{A}-1}{m}\right)\frac{dy}{udu}-\frac{\text{B}^2}{m^2}\frac{y}{u}=0$, $(k)$, which is reduced to the form of (2) by putting $1+\frac{\text{A}-1}{m}=2pq-q+1=c$, $b^2=\frac{\text{B}^2}{m^2}$, $2q-2=-1$, or $q=\frac{1}{2}$; $\therefore p=\frac{1}{2}+\frac{\text{A}-1}{m}$, also $a^2=1$: hence the integral of $(k)$ is found the same way as that of (2) given above; hence we have $y$ expressed by a known function of $u$, then putting for $u$ its value $x^m$, we have $y$ expressed by a known function of $x$ as required. Again, if we put $u=e^{nx}$, we get $\frac{dy}{dx}=\frac{dy}{du}\frac{du}{dx}=n\frac{dy}{du}e^{nx}=nu\frac{dy}{du}$, and $\frac{d\left(\frac{dy}{dx}\right)}{dx}=n^2u^2\frac{d^2y}{du^2}+n^2u\frac{dy}{du}$, substituting these values and $u=e^{nx}$ in $(i)$, we have by a small reduction $\frac{d^2y}{du^2}+\left(1+\frac{\text{A}}{n}\right)\frac{dy}{udu}-\frac{\text{B}^2}{n^2}\frac{y}{u}=0$, $(l)$; hence if we put $2pq-q+1=1+\frac{\text{A}}{n}$, $a^2=1$, $b^2=\frac{\text{B}^2}{n^2}$, $2q-2=-1$ or $q=\frac{1}{2}$, we shall have $p=\frac{1}{2}+\frac{\text{A}}{n}$; then the value of $y$ is found in terms of $u$, as in integrating (2), and by putting for $u$ its value $e^{nx}$, $y$ becomes known in terms of $x$ as required. The equations $(h)$ and $(i)$ were proposed in the Mathematical Miscellany by Prof. Peirce, at p. 399, first volume; we gave an answer to them in No. 8 of that work, which was incorrect in several particulars, which we shall not stop to notice any further than to observe, that $u$, the independent variable, when integrating with reference to $x$ in Lacroix's integral, and $v$ of our own, was involved in one of the limits of the integrals, so as to be a function of $x$ or $v$, which ought not to have been so, but the error was not noticed by us in time sufficient for correction before the solution was published.

We will now reduce the equation $u\frac{d^2z}{du^2}+\frac{dz}{du}-2a'uz-\frac{2u}{b'}$, $(m)$, to the form of (2); $(m)$ is easily changed to $\frac{d^2z}{du^2}+\frac{dz}{udu}-2a'\left(z+\frac{1}{a'b'}\right)=0$, and if we put $y=z+\frac{1}{a'b'}$ we have $\frac{d^2y}{du^2}+\frac{dy}{udu}-2a'y=0$, $(n)$. If we put $2q-2=0$ or $q=1$, $a^2=1$, $b^2=2a'$, $c=1$ or $2qp-q+1=2p=1$, we get $p=\frac{1}{2}$, and (2) will become the same as $(n)$. Hence if in $(e)$ we put $q=1$, $a^2=1$, $b=\sqrt{-2a'}$, we have $y=A'\int_0^1 dx(1-x^2)^{-\frac{1}{2}}\cos.ux\sqrt{-2a'}+B'\int_0^1 dx(1-x^2)^{-\frac{1}{2}}\log.[u(1-x^2)]\cos.ux\sqrt{-2a'}$, $(o)$, for the complete value of $y$, which is the integral of $(n)$. If we use $e$ for the hyperbolic base, we get by known formulæ $\cos.ux\sqrt{-2a'}=\frac{e^{-ux\sqrt{2a'}}+e^{ux\sqrt{2a'}}}{2}$, and if we put $x=\cos.\varphi$ we get $dx(1-x^2)^{-\frac{1}{2}}=-d\varphi$, $1-x^2=\sin.^2\varphi$, $\cos.ux\sqrt{-2a'}=\frac{e^{-u\sqrt{2a'}.\cos.\varphi}+e^{u\sqrt{2a'}.\cos.\varphi}}{2}$; by substituting these values in $(o)$ we have $y=-\int_0^1 d\varphi\left(e^{-u\sqrt{2a'}.\cos.\varphi}+e^{u\sqrt{2a'}.\cos.\varphi}\right).\left(\frac{A'}{2}+\frac{B'}{2}\log.u\sin.^2\varphi\right)$, the integral being taken from $\cos.\varphi=0$ to $\cos.\varphi=1$; or if we denote $\frac{A'}{2}$ and $\frac{B'}{2}$, by A and B, we have by interchanging the limits of the integral and changing its sign, (which makes no alteration in its value,) $y=\int_1^0 d\varphi\left(e^{-u\sqrt{2a'}.\cos.\varphi}+e^{u\sqrt{2a'}.\cos.\varphi}\right).\left(A+B\log.u\sin.^2\varphi\right)$, the integral being taken from $\cos.\varphi=1$ to $\cos.\varphi=0$, or if we put $\pi=3.14159$, &c. (= the semi-circumference of a circle whose radius $=1$,) we get $y=\int_0^{\frac{\pi}{2}} d\varphi\left(e^{-u\sqrt{2a'}.\cos.\varphi}+e^{u\sqrt{2a'}.\cos.\varphi}\right).\left(A+B\log.u\sin.^2\varphi\right)$, 0 and $\frac{\pi}{2}$ denoting the limits of $\varphi$; or (since $\cos.\varphi$ becomes negative in the second quadrant) we shall obtain the same value of $y$ by putting $y=\int_0^{\pi} d\varphi e^{u\sqrt{2a'}.\cos.\varphi}\left(A+B\log.u\sin.^2\varphi\right)$, $(m')$, the integral being taken from $\varphi=0$, to $\varphi=\pi$, $(m')$ will be found on trial to satisfy $(n)$, and since it involves the two independent arbitrary constants, $y$ is the complete integral of $(n)$ as required.

Since $z+\frac{1}{a'b'}=y$, we get $z=y-\frac{1}{a'b'}=\int_0^\pi d\varphi\left(Ae^{u\sqrt{2a'}.\cos.\varphi}-\frac{1}{a'b'\pi}\right)$ $+B\int_0^\pi d\varphi e^{u\sqrt{2a'}.\cos.\varphi}\left(\log.u+2\log.\sin.\varphi\right)$, or if we still denote $Aa'b'\pi$ (for brevity) by A, $z=\frac{1}{a'b'\pi}\int_0^\pi d\varphi\left(Ae^{u\sqrt{2a'}.\cos.\varphi}-1\right)+B$ $\int_0^\pi d\varphi\left(\log.u+2\log.\sin.\varphi\right).e^{u\sqrt{2a'}.\cos.\varphi}$, $(p)$. If we put $B=0$, $A=1$, we get $z=\frac{1}{a'b'\pi}\int_0^\pi d\varphi\left(e^{u\sqrt{2a'}.\cos.\varphi}-1\right)$, which is a particular value of $z$ that satisfies $(m)$, and agrees with the value used by Laplace in the supplement to the 10th book of the Mécanique Céleste, Vol. IV, p. 60, (of the supplement,) and he expresses it as his opinion that the complete value of $z$ cannot be found by any of the known methods; we will add that the same particular value is to be found in the profound commentary by Dr. Bowditch, at p. 973, Vol. IV.

Again, if $p=0$, (or is indefinitely small,) (2) becomes $\frac{d^2y}{du^2}+\frac{1-q}{u}\frac{dy}{du}-q^2a^2b^2u^{2q-2}y=0$, $(q)$, which is not satisfied by Lacroix's integral, but our integral $u^{1-c}\int_0^u dv\,(a^2-v^2)^{-p}\cos.bu^qv\sqrt{-1}$, which (since $1-c=q$, $(a^2-v^2)^{-p}=1$, rejecting indefinitely small quantities,) becomes $\int_0^u u^q dv\cos.bu^qv\sqrt{-1}=\frac{\sin.abu^q\sqrt{-1}}{b\sqrt{-1}}=\frac{e^{-abu^q}-e^{abu^q}}{-2b}=\frac{e^{abu^q}}{2b}-\frac{e^{-abu^q}}{2b}$, (where $e=$ the hyperbolic base,) will satisfy it; it is also evident that $(q)$ ought to be satisfied by each of the values $y=e^{abu^q}$, $y=e^{-abu^q}$, which on trial will each be found to satisfy $(q)$, hence if A and B denote two arbitrary constants, the complete value of $y$ that satisfies $(q)$ is $y=Ae^{abu^q}+Be^{-abu^q}$.

Also, if $p=1$, (or if $1-p$ is indefinitely small,) (2) becomes $\frac{d^2y}{du^2}+\frac{1+q}{u}\frac{dy}{du}-q^2a^2b^2u^{2q-2}y=0$, $(r)$, which is not satisfied by our integral, but Lacroix's integral will satisfy it, that is, (since $(a^2-x^2)^{p-1}=1$,) $y=\int_0^u dx\cos.bu^qx\sqrt{-1}=\frac{e^{abu^q}}{2u^qb}-\frac{e^{-abu^q}}{2u^qb}$, will satisfy it; $\therefore$ the values $y=u^{-q}e^{abu^q}$, $y=u^{-q}e^{-abu^q}$, will each satisfy ($r$), and if A and B denote two arbitrary constants, $y=\left(Ae^{abu^q}+Be^{-abu^q}\right)\times u^{-q}$ is the complete value of $y$ that satisfies ($r$). Thus far $q$ has been supposed to be different from zero; but if $q=0$, (2) becomes $\frac{d^2y}{du^2}+\frac{dy}{udu}=0$ or $ud^2y+dydu=0$, $\therefore$ $udy=Adu$, or $dy=\frac{Adu}{u}$, or $y=Ah.l.u+B$, where A and B are the two arbitrary constants which the integral requires. Thus we believe we have integrated (2) completely in all the cases which can occur.

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ART. IX.—*Notice of the Zoological Writings of the late C. S. Rafinesque;* by S. S. HALDEMAN.*

CONSTANTINE SAMUEL RAFINESQUE, was born "at Galata, a suburb of Constantinople," October 22d, 1783, and died in Philadelphia on the 18th of September, 1840, of cancer of the stomach and liver. While yet an infant, his parents removed to Marseilles, where he remained some years, previous to being removed to Leghorn. It is apparent throughout his works, that he considers himself a great traveller; thus the motto to his "Life of Travels" is

"Un voyageur dès le berceau,
Je le serais jusqu'au tombeau."

He states that his parents took him to Asia while he was an infant, that he *saw* the coast of Africa, and names the places he *would have seen*, if he had been allowed to accompany his father to Canton! According to his own account, he commenced the study of natural history at an early age, which is certainly the fact, as his "description of four new species of birds from Java," (seen in the Philadelphia museum,) was published in the Bul. des Sciences in 1803, when he was but nineteen years old; and his Florula Columbica and Delawarica, were presented to Dr. Barton, for insertion in his Med. and Phys. Journal, the year following.

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* A notice of the Botanical Writings of Rafinesque, appeared in this Journal, Vol. XL, p. 221, April, 1841.

Rafinesque was a most industrious man, and passed a great deal of work through his hands, relating to almost every subject. His life was made up of a series of vicissitudes, and his efforts were retarded by poverty, and the consequent necessity of making a living. His greatest fault as a naturalist was not so much, perhaps, the shortness and resulting obscurity of his characters, as his passion for 'new species,' and the recklessness with which he proposed them, without sufficiently examining the works of his predecessors. The author who pursues such a course, treats his fellow-laborers with disrespect, and prevents his works from being as much consulted as they may deserve; for there is nothing to compel other authors to wade through unsatisfactory descriptions, which must, in many instances, be referred to established species. Rafinesque was very credulous, which led him to believe the exaggerated accounts of the vulgar; and to write essays and found 'species,' upon grounds which should be beneath the notice of any naturalist.

In giving a list of his zoological works, it is more with a view to point them out for the use of those who follow him in the various branches upon which he touched, than to write a critique upon the whole, as this would be impossible; and nothing would be gained by it, as each department must eventually be consulted by those interested. We notice them as nearly as we are able, in chronological order, and believe the omissions will be but few.

1810. *Caratteri di alcuni nuovi generi e nuove specie di anamali, &c.*, 8vo. pp. 105. This work is principally devoted to fish, illustrated by many rude figures, upon seventeen quarto copperplates. It is a good work. Thirty pages, and three plates, are devoted to botany.

*Indice D'Ittiologia, &c.*, 8vo. pp. 70, and two plates. This work contains about three hundred and ninety species of Sicilian fishes, (one hundred and ninety of which are marked as new,) and twenty eight new genera. It is noticed at length by Swainson, in *Fishes*, &c. Vol. I, pp. 60–3 of the Cabinet Cyclopedia. Mr. S., who spent several years in Sicily, states that Rafinesque anticipated many of the genera of Cuvier, and thinks most of his species will yet be brought to light, he having identified many of them himself.

1811. *Description of two new genera of Crustacea, and a new species of Atlantic fish.* Sent to the Lin. Soc.

*Zoologie Sicilienne, &c.* Containing about three hundred and sixty new species, independent of those already published. Unpublished?

1814. *Précis des découvertes, &c.* This pamphlet contains many descriptions of new animals, commencing with two new genera of bats, the first of which he calls Cephalotes, which contains a new species; and the Vespertilio cephalotes of Pallas, or C. Pallasi, Raf. Geoffroy had previously formed a genus Cephalotes and called this species C. Pallasii. The characters of Geoffroy's genus require *incisors* $\frac{4}{6}$; and Rafinesque's $\frac{2}{0}$, the number in C. Pallasii; which is referred improperly, to his genus. Still Rafinesque's genus is not new, it having been previously characterized as a new genus of Illiger, under the name Harpya, which name (under the Greek form) has been subsequently applied to a genus of birds by Cuvier. Genus ii, Atalapha, Raf. has $\frac{0}{0}$ incisors, and besides a new Sicilian species, he cites the Vespertilio Noveboracensis as A. Americana. He says of his species, Nos. 3 and 4, "j'ai changé le nom trop court et équivoque de *Mus* en *Musculus!*" This change is very unexpected from an author who has done so much in abbreviating names. Genus iii, a Mediterranean cetacean, not noticed by subsequent writers, is considered doubtful. Oxypterus, Raf., was by many considered an imaginary genus, until a second species was discovered by Quoy and Gaimard. Sp. 6 and 7, Gerbillus soricinus and Talpa cupreata, observed in North America. Of five new species of American fish, Centropomus albus, is perhaps the Labrax mucronatus; C. luteus, Perca flavescens; and Sparus mocasinus, Pomotis vulgaris, Cuv.; a Linnean species.* Rafinesque remarks of the *Crustacea*, that "after the fishes, it is in this class that I have made the most numerous discoveries in Sicily; of about one hundred and eighty species that I have observed here, nearly the half are new; they will be all figured and described in my Sicilian Plaxology;" and of the insects, "my discoveries in this class are less numerous; I have about twenty new species." Besides a new genus, the species described are four of Lepisma, two Acari, a Formica, and two Aphides. We cite these to fortify our opinion that Rafinesque had little or no knowledge of Entomolo-

* Among the Sicilian fish is one named Esox reticulatus, a name subsequently applied by Lesueur to a well known American species.

gy; as a great part of his American new species belong to these genera, and to Julus; genera with which every one is familiar. The remainder of the "*Précis*" is taken up (except the botanical portion) with new species of Cephalopoda, worms, and zoophytes.

*Principes fondamentaux de Somiologie, ou les Lois de la Nomenclateur, etc.* "The *Laws* are necessarily familiar to all professed naturalists; but we have never before met with so welcome a digest of them. Somiology is designed to express the science of organized bodies in one word, and seems derived from *sōma*, a body, and *logos*, a discourse; and, without it, two must be used, as Zoology, and Phytology or Botany."* French is recommended as the language of Natural History, instead of Latin. Another rule should have been added, viz. when a new species is characterized, which has nothing to enable one to recognize the description as belonging to a distinct species, it becomes necessary to state wherein it *differs* from an allied and well known species.

*Specchio delle Scienze, &c.*, 2 v. 8vo., Palermo, 1814. This work was published monthly for one year, when it was discontinued, for the want of sufficient support; a fate which has befallen all the periodical works of this author. He even states that the last number was detained by the printer, although indebted to him, but he must afterwards have succeeded in getting it, as we possess it. There are a number of zoological articles in it, among which are descriptions of two new genera of fish, Leptopus and Nemochirus. *Osservazioni microscopiche,*† are principally devoted to new species of Infusoria. An article on the Sicilian Phocidæ, gives five species under four genera, retaining the Linnean name for "P. vitulina," under which name several species have been

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* Loudon's Mag. V, 76. These laws are *not* well known, or we would not have so many barbarous names imposed upon the science from day to day. Our author was particularly happy in his nomenclature, for which he deserves the gratitude of all naturalists. Barbarous names, he says, should be expunged; such as *Messerschmidia, Hoffmansegga, Kraschenimikofia, etc.* We protest, however, against the injustice of crediting a genus to an author who has merely varied a name from its original form; as Lepidosteus, *Agass.*, instead of *Lacépède*, who named this genus Lepisosteus. If Agassiz is to have the *genus*, the *species* follow of course; and a rule which leads to such a result, must be false.

† *Arthrodia*, a new genus of Conferva, seems to be identical with Oscillatoria. We do not pretend to determine the right of priority, between Rafinesque and other authors, in the instances cited in this article.

confounded. Aglophema, Raf. has precedence of F. Cuvier's Arctocephalus; Aglophema pusilla (Phoca pusilla, Lin.) being the type of both; Rafinesque, however, calls it A. phoca, changing the specific name without cause. Authors are not agreed upon the habitat of this species, but its range may be extensive, or distinct species may be confounded under the same name.

The "*Prodromus of Sicilian Herpetology,*" suggests such 'improvements' as Batrachus, for Bufo; Ranaria, for Rana; and Hylaria, for Hyla! and contains notes of a considerable number of new species.

*Thirty six new genera of Marine animals of Sicily.* Of five mollusks, Oxynoe is said to differ from Sigaretus, by having an external shell;* and of three Limaces, one (Tylodina) appears to be identical with Testacellus. Artedia differs from Planaria by having two little tentacles. As we will have occasion to refer to his section of Porostomes, we give its characters here—POROSTOMI-*Animali senza bocca apparente, e nutrendosi con pori superficiali; quasi sempre gelatinosi e natanti.* Vol 2, p. 165.

1815. *Description of Balæna gastrytis,* a new Mediterranean species. In the Palermo Port Folio.

*Analyse de la Nature, &c.*, pp. 224, 8vo., with a portrait. Among his manuscripts, I find a sketch of his life written as by another person, wherein it is stated that he esteemed this work more than any other of which he is the author. We cite his orders of Mammalia, the three first of which form his sub-class Chiropodea. 1. Primatia, 2. Chiropteria; 3. Exogenea (Marsupials); 4. Stereoplia (Solipeda, Ruminantia); 5. Pachydermia; 6. Anodonea (Edentata); 7. Gliria; 8. Ferea; 9. Amphibia (Phoca, Manatus); 10. Cetacea.

1816. *Observations on the Sturgeons of N. America,* and description of a new species, Accipenser marginatus, for the Phil. Soc. of Philadelphia.

*Circular address on Botany and Zoology, &c.* This is a general invitation to all to forward the author specimens, &c. for exchange, as "rare pamphlets, and publications not in my possession..... I shall receive thankfully any kind of information or news relating to natural sciences, such as discoveries, publications, proceedings of individuals and learned societies, &c. I particu-

* See the note to Pl. 49 of Deshayes' edition of the Règne Animal.

larly beg for complete sets of the natural orders and families of orchideous, ombelliferous, liliaceous, grasses, mosses, lichens, marine plants, labiated, leguminous, &c., and for specimens, or the characters of all the new genera.....I beg the coöperation of all my friends and correspondents; inviting them to communicate every particular, even of the most trifling nature, or obsolete, relating to the properties, qualities, uses, employments, &c., of all plants and animals; provided they are unpublished, else it will be sufficient to let me know (or send me if rare) in which works or pamphlets they are already published."

These extracts show that our author was preparing to get as many materials from every quarter as possible, evidently with the intention of getting new genera, species, and observations, from the labors of others. That he had an especial interest in getting assistance from all parts, is evident from the avidity with which he attacked every subject.*

There are two prizes offered on the cover of the Atlantic Journal, which place the intention of these requests in a still stronger light. They are, "*Fifty dollars* in books for the best memoir on the effects on the earth and mankind of the geological flood or floods, all over the globe as far as known; including *all accounts without exception*, preserved by history or traditions, among all *the nations* of the earth. *Twenty five dollars* in botanical books and herbariums, to the author of the best synopsis of *all* native *phenogamous plants* of the U. S. as far as known; provided that not a single one already described or published in America or Europe be omitted!!"

The absurdity of these *prizes* is sufficient to make one doubt the sanity of the man; for who could be induced to write a synopsis of American plants for *such* a reward! Judging from the appearance of the specimens, his method of preserving plants was more simple than any recommended in books, as it consisted in placing

* Thus among his MSS. lost by shipwreck are the following, most of which he intended to re-write! A greater piece of presumption than this list indicates, cannot be cited, when we consider the talents and the means of the man. His industrious habits would never have compensated for his extreme carelessness and want of method, and his poverty prevented him from obtaining the requisite works, his library containing scarcely any thing modern.—*Critiques des genres, &c.* An investigation of all generic names of plants and animals.—*Amenities.* Nearly one hundred tracts on Zoology and Botany.—*Fauna Sicula,* with nearly four thousand species.—*Genera of Birds,* with many new genera.—*Synopsis* of all known species of quadrupeds and fishes.

the newly gathered examples between paper (without pressure) where they were left without being disturbed, until required.*

The circular contains a prospectus of a Flora and Fauna of N. America, in which he proposes to figure every animal and plant on wood, and that every one may have such a portion as he may require, partial sets are indicated as a fauna and flora ornata, economica, dietetica, Virginica, &c. &c., amounting to no less than one hundred and fifteen varieties of flora, and nearly as many of fauna.

1817–18. *American Monthly Magazine.* This periodical contains many descriptions of bats, reptiles, fish, crustacea, &c. and Notrema, a curious genus of shell from the Ohio, which resembles Fissurella. The name is changed to Tremesia in the Monograph of Ohio shells. This animal is said to have been discovered by Audubon, and communicated to Rafinesque, who described and figured, without having seen it. It certainly cannot be admitted into the systems of malacology without further investigation. His Mazama (Ovis montana, Ord.) is identical with Aplocerus of Smith, and was probably first published.† If this is the case, Smith's genus Mazama is left without a name. Many new species of Aphis, (and two new genera,) are described in this periodical; and, in the extended article "on water snakes, several species of Sea-serpent are named, principally from newspaper paragraphs. See a list of these papers, appended to the Florula Ludoviciana.

1819. *Seventy new genera of animals* in the Journal de Physique, Vol. 88. This paper is too long for analysis. Two Cheiroptera are noticed, and some "genera" of Helix proposed. The fishes described are reproduced in his Ohio fishes; and many of the genera, especially among the zoophytes, are fossil.

Several genera and species of fish are described in the Jour. Acad. Nat. Sci. Vol. I, and in the first volume of the American

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* The greater part of his fossils resembled his plants, as any stone which was marked with the slightest ridge or furrow, or bore any vestige of organic remain, was carefully preserved, together with strange looking pebbles and waterworn fragments. *Bushels* of such trash were sold at the sale of his effects, for trifling sums, but the specimens were absolutely worthless; the localities even being unknown. There were many bad specimens of Unio, mostly odd valves, among them.

† It includes Smith's genus Subulo! one species being called Mazama pita, and another M. bira. These names are taken from Azara. See Hunter's trans. vol. 1, p. 141 and 145.

Journal of Science.* Of these we are acquainted with Exoglossum alone, which is founded upon natural characters, and is a good genus.

Without knowing their precise date, we will here notice a series of articles from vols. 5, 6, and 7 of the An. Gen. des Sci. Phys., published at Brussels. Ours is a detached set, and we may therefore have omitted other articles from the same work.

*Prodrome d'une Monographie des Turbinolies du Kentuky*, par C. S. Rafinesque et J. D. Clifford. Five sub-genera and sixteen species are described.

*Monographie des coquilles bivalves et fluviatiles de la rivière Ohio*, (with figures.) As Rafinesque was the first to make known the greater part of the western Unios, it is but fair that those who study this genus, should exert themselves to identify his species. They are surrounded by fewer difficulties than those of Linnæus, yet there is little doubt respecting the latter, and as Rafinesque sold examples of his species to any one disposed to purchase, he certainly must be credited with the disposition to afford every assistance. The most complete collection of authentic specimens now existing, is that of Mr. Poulson† of Philadelphia, who also possesses many of Rafinesque's unpublished MSS. and drawings.‡ Most of these species are, in fact, so well established, that it is a mere affectation to assert that they cannot be identified. The greater part of Mr. Swainson's sub-genera of American Unios in the Cabinet Cyclopedia, were previously indicated by our author. The same paper contains a division of the genus Cyclas into sub-genera, but without any notice of Pisidium.

*Sur les animaux polistomes et porostomes.* The former are Zoophytes, the latter Infusoria, which with the older authors, he supposed to take their nourishment by means of pores, whence the name. As an example of the style, we transcribe a few of the introductory observations. "Des erreurs accréditées pas des savans illustres, admises tacitement comme des vérités démontrées par la foule des copistes et des esprits superficiels qui se contentent de croire sur parole, sont bien difficiles à détruire ; néam-

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* Several reptiles are described here, also.

† Our cabinet contains three shells not in Mr. Conrad's list, viz. Unio pallens, metaplatos and bicolor ; the last is a variety of U. dilatatus, Raf. Mr. P. is so liberal that he gives every facility to those who wish to consult his fine collection and library.

‡ We have a considerable number of these.

moins il est du devoir de ceux qui ont verifié et constaté les faits réels qui les détruisent, de chercher à les divulger et à éclairer la domaine des sciences..... Il est plus facile de copies des erreurs, que de rechercher la vérité, et quand elle est découverte, elle a souvent bien de la peine à percer les nuages de l'ignorance ou des préjugés scientifiques."

*Remarques sur trois erreurs ichthyologiques.* "The first is the absurd division of fishes into osseous and cartilaginous;" the second, that authors consider the Pleuronectes as thoracic instead of jugular; and the third, that the prepared fish roe called botargo, does not belong to the Mugil, but to the Tunny.

*Sur quelques animaux hybrides.* This apocryphal account, (founded upon hearsay,) relates to such animals as Felis domestica, Didelphis Virginianus; and Procyon Vulpes.

*Sur le genre Manis, et description d'une nouvelle espèce.* Three species (two of which are Linnean) are described under two subgenera, which, with changing specific names, has enabled our author to append his name to them all!

*Western Review.* Several articles are inserted here, but we can only mention the *Canis leucurus*, a white tailed fox of Kentucky.

1819. *Twenty four lectures on the natural history of the Universe, the earth and mankind, animals and plants.* (MS.) These unpublished lectures are in our possession; they treat of astronomy, meteorology, geology, mineralogy, crystallography, &c. Nine of them constitute the zoological portion, and indicate but little talent. The introductories are good, and those devoted to American geology amusing, from the singularity of the views advanced.

1820. *Ichthyologia Ohiensis*, one vol. 8vo., pp. 90. One hundred and eleven species are described. It is a valuable contribution to this branch of science, and Prof. Kirtland's labors in the same field will render a particular notice unnecessary. He very properly separates the broad-mouthed, from the narrow-mouthed Lepidostei.

*Fishes of the Susquehanna.* (Unpublished MS.) The descriptions are too short to enable one to make out all the species; and, as usual with our author, species are multiplied on the strength of the locality. "Perca interrupta, Raf." is Labrax lineatus, Lin.; Esox chlorops = reticulatus, Les.; and Luxilus verrucosus, is probably Cyprinus cornutus, Mitch. Thirty seven species are described, and thirteen are certainly omitted, which gives fifty species to the Susquehanna. Among the omissions are all the cartilaginous fishes: viz. Sturio; Petromyzon Americanus, Les.; P. (Bdellostoma) nigricans, Les.; and Ammocætes bicolor, Les. Lepisosteus osseus, Lin. is omitted also.

*Annals of Nature.* This tract contains eighty one new species and a proportionate number of new genera of animals. The first twelve are "Mastosia or Sucklers," including three bats, a Mephitis, (probably the common species, which varies much,) a species of Spalax, two of Gerbillus, three of Lemmus, and a Sciurus. Of four birds, Milvus leucomelas appears to be Nauclerus furcatus, Lin. Hirundo phenicephala, (head scarlet,) is given on the authority of Mr. Audubon, who, however, does not describe it. The first reptile described is a species of *Necturus,* a genus proposed for the Salamandra Alleganiensis, afterward described under a new generic name by Dr. Harlan. Several species of *Triturus* follow, this name being applied to the reptile Triton, (there being a mollusc Triton,) because the two are inadmissible. The reptile has precedence in point of time, (at least, this is our impression,) and Laurenti* could not have been, under ordinary circumstances, deprived of his genus, merely because Lamarck thought proper to adopt the name for a different one. Many of the serpents named in this pamphlet, are evidently described from hearsay.

1831. *Enumeration and account of some remarkable natural objects, &c.* This tract is chiefly devoted to fossils, and is partly a catalogue of objects which he had for sale. His Mazama salinaria is minutely characterized from a horn. This 'unique specimen of great beauty and value,' is in our cabinet; but those who wish to possess so desirable an object, can be gratified, if they will take the trouble to break the prongs from the horns of a Cervus Canadensis, and deposit them where the inside porous portion may become filled with mineral matter.

1832–3. *Atlantic Journal.* This periodical is principally filled with the productions of the editor, although sometimes over fictitious signatures, which can never mislead any one acquainted with his style. Art. 13, on the Mexican Jaguars. He cites several instances in which these animals have penetrated into the Western States. Art. 14, Cougars of Oregon. He acknowledg-

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* According to Cuvier, Laurenti's name was applied to a larva; consequently it cannot be retained, and that of Rafinesque must stand. See Harlan's Researches, p. 165, note *.

es several *varieties*, but contrives to make species out of them thus: Var. Oregonensis, dark brown, &c..... Is it not a peculiar species? *Felis Oregonensis.*—I find in Leraye's travels,* that a smaller animal nearly similar in color, but not longer than a cat, is found, &c. Is it a new species? *Felis macrura*, Raf. Art. 10, Aquila dicronyx, Raf., appears to be identical with Holiaetus, Washingtoni, Aud. The old genus Condylura of Illiger, is reproduced under the name Astromycter. We have seen Rafinesque's Psephides, "a new tubular fresh-water shell of the Allegany mountains," and consider it the case of a larva. Whether the many species of fossil shells which Rafinesque has described, from the Alleganies of Pennsylvania, are new, will of course be determined by the geological survey of this State, (Pennsylvania,) which is drawing to a close.

1836. *A life of travels and researches, &c.* We close this article with a few extracts from this work.

"Mr. Gibbs, consul of the U. S., received me well; he was also a banker and merchant. I became his secretary and chancellor. I dwelt with him in a palace till 1808, when I took a house of my own and became a merchant, having made a small fortune in his employ within three years. Shortly after my arrival, political events made Sicily the residence of the court of Naples, and broke all our communications with Italy and France. The produces of the island fell to a low rate: it was by trading in them that I acquired my first personal fortune, as well as by discovering in the island several new drugs and sources of trade. Such were the squills, rosemary, wormwood, bay-leaves, &c. I established a manufacture of dry squills on a large scale: the Sicilians were wondering at me for this, as they made no use of them, and fancied they were a new tinctorial article, which I let them believe.... I wrote in Italian through prudence, rather than in French. Prudent considerations had already induced me to add the name of *Schmaltz*, my mother's name, to my own, and to pass for an American."

"Swainson went often with me in the mountains; he carried a butterfly-net to catch insects, and was taken for a crazy man or a wizard; as he hardly spoke Italian. I had once to save him from

* These travels cannot be received as zoological authority; the species, therefore, that Rafinesque has founded upon them, (Am. Monthly Mag. v. 1, p. 435,) are not worth looking after.

being stoned out of a field, where he was thought to seek for a treasure buried by the Greeks!....

"Such is then the picture of my life, my labors, and my travels. I give it to the public, or rather to the learned, as an uncommon instance of perseverance and industry. May this inspire youthful minds with a wish to do as well; and the friends of sciences with the wish to know me, or patronize the labors of my old age: permit me at last to produce under their shield, those works, fruits of my travels and researches, which I desire to leave as monuments of my life and exertions.

"If I have often gone beyond the actual state of knowledge in my views and opinions, or anticipated on future knowledge, it was with the noble aim of adding my mite to the mental improvement of mankind. If my discoveries and projects have not been speedily admitted, I leave them as a legacy to those superior minds who will be able to appreciate them, and bestow me the justice often denied in my days: to the friends of useful sciences, of virtue and peace, to the wise philanthropists, to the enlightened, liberal and impartial men of both hemispheres."

Near Marietta, Pa., April, 1842.

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## Art. X.—*M. Faraday's answer to Dr. Hare's second Letter.**

Royal Institution, Dec. 24, 1841.

*My Dear Sir*—On reading your second letter to me in Silliman's Journal, (published July, 1841,) I wrote a brief answer back, but find from Dr. Silliman, that it has been mislaid. I therefore send this brief note to say that I hope you will excuse any controversial reply. I do not find any reason to change my opinion as to the matters referred to in yours to me: and as far as I should have occasion to answer for my own part, I would rather refer the readers of the Journal to my papers and my former reply to your first letter. As to the new and important matter into which your last letter would lead me, I am not sufficiently clear in my mind, upon the evidence we as yet have, to wish to enter into it at present. Ever my dear Sir,

With the highest esteem, yours very truly,

M. Faraday.

Dr. Hare, &c. &c. &c.

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* Communicated from M. Faraday to this Journal.

Art. XI.—*Meteorological Observations, made at the Mines of San Fernando, situated in the Partido de la Manicaraqua, Island of Cuba,* Lat. 22° 20′ 14″ N., Lon. 73° 51′ 27″ W. of Cadiz, at an elevation 554 feet above the sea; by John H. Blake, of Boston, Mass.

| DATE, 1840. | Barometer. | Hygrometer. | Temp. F. in shade at 8 A. M. | Temp. F. in shade at noon. | Temp. F. in shade at 6 P. M. | Temp. F. in sun's rays at 8 A. M. | Temp. F. in sun's rays at noon. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| Janu'ry | | | ° | ° | ° | ° | ° | |
| 1 | | 10.6 | 67 | | | 82 | | A shower. |
| 2 | | 12.3 | | 68 | 63 | | | |
| 3 | | 13.5 | | 66 | 62 | | 74 | |
| 4 | | 13.5 | 61 | 67 | 60 | | | |
| 5 | 29.28 | 15.5 | 65 | 71 | 65 | 80 | 83 | |
| 6 | 29.26 | 19. | 68 | | | 81 | | Drizzling. |
| 7 | 29.21 | 19 5 | 71 | 76 | 67 | 84 | 84 | |
| 8 | 29.23 | 8.3 | 68 | 74 | 65 | 86 | 116 | |
| 9 | 29.23 | 21.5 | 65 | 72 | 65 | 74 | 99 | |
| 10 | 29.23 | 18. | 66 | | 63 | | | |
| 11 | 29.10 | 29. | 67 | 71 | 67 | 86 | 111 | |
| 12 | 29.15 | 28. | 69 | 73 | 68 | 93 | 115 | |
| 13 | 29.21 | 27. | 68 | 73 | 68 | 89 | 106 | |
| 14 | 29.22 | 25. | 68 | 71 | 70 | 88 | 123 | |
| 15 | 29.25 | 23. | 67 | 72 | 65 | 90 | 113 | |
| 16 | 29.20 | 21. | 60 | 71 | 67 | | 109 | |
| 17 | 29.15 | 21. | 68 | 71 | 64 | | 107 | Hazy. |
| 18 | 29.20 | 21. | 67 | 71 | | 85 | 107 | |
| 19 | 29.20 | 21. | | 70 | 61 | | 85 | |
| 20 | 29.20 | 21. | 67 | 68 | 62 | 71 | 81 | |
| 21 | 29.25 | 21. | 64 | 70 | 69 | 81 | 84 | |
| 22 | 29.22 | 19. | 68 | 74 | 71 | 81 | 106 | |
| 23 | 29.25 | 21. | 71 | 78 | 72 | 91 | 98 | |
| 24 | 29.15 | 18.2 | 69 | 76 | 72 | | 97 | |
| 25 | 29.26 | 16.5 | 73 | 77 | 73 | 84 | | |
| 26 | 29.19 | 23.5 | 73 | 76 | 72 | | | Thunder storm. |
| 27 | 29.20 | 23.5 | 72 | 74 | 68 | | 97 | Drizzling. |
| 28 | 29.23 | 17. | 71 | 75 | 70 | 74 | 108 | Thunder without rain. |
| 29 | 29.22 | 13.5 | 70 | 75 | 70 | | 110 | A shower. |
| 30 | 29.10 | 19. | 71 | 76 | 69 | 80 | 101 | A shower. |
| 31 | 29.28 | 11.5 | 74 | 75 | 72 | 97 | 111 | |

| | | |
|---|---|---|
| Barom. | Average for the month, | 29.208 |
| | Maximum altitude, | 29.28 |
| | Minimum altitude, | 29.10 |
| Hygrom. | Average for the month, | 19.1 |
| | Extreme dryness, | 29. |
| | Extreme moisture, | 8.3 |
| Temp. | Mean for the month, | 74.9° |
| | Maximum in shade, | 78. |
| | Minimum in shade, | 60. |
| | Mean in sun's rays, | 92.6 |
| | Maximum in sun's rays, | 123. |
| | Minimum in sun's rays, | 80. |

Rain, &c.

Total of water deposited during the month, 2.74 inches.

Greatest quantity that fell in one shower, 1.20 inches.

Number of showers, 4.

Showers with lightning, 1.

Prevailing wind during the month, easterly.

Prevailing clouds, cumulus.

| DATE, 1840. | Barometer. | Hygrometer. | Temp. F. in shade at 8 A. M. | Temp. F. in shade at noon. | Temp. F. in shade at 6 P. M. | Temp. F. in sun's rays at 8 A. M. | Temp. F. in sun's rays at noon. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| Feb. | | | | | | | | |
| 1 | 29.19 | 18.5 | 73° | 77° | 73° | 79° | 106° | |
| 2 | 29.15 | 21. | 73 | 77 | 73 | 83 | 125 | |
| 3 | 29.12 | 18.2 | 71 | 76 | 71 | | 110 | Drizzling. |
| 4 | 29.19 | 12. | 67 | 67 | 64 | | | Drizzling. |
| 5 | 29.22 | 17.5 | 62 | 70 | 64 | 65 | 105 | |
| 6 | 29.22 | 17.5 | 71 | 75 | 66 | 95 | 95 | |
| 7 | 29.37 | 17. | 69 | 74 | 69 | 71 | 112 | |
| 8 | 29.27 | 11. | 70 | 74 | 68 | 80 | 80 | |
| 9 | 29.17 | 17.6 | 70 | 74 | 72 | 94 | 110 | |
| 10 | 29.08 | 17.5 | 68 | 75 | 70 | | 112 | |
| 11 | 29.18 | 20.3 | 71 | 71 | 60 | | 107 | |
| 12 | 29.23 | 16.5 | 66 | 68 | 64 | 70 | 75 | |
| 13 | 29.27 | 18. | 64 | 72 | 67 | | 98 | |
| 14 | 29.30 | 19.5 | 70 | 74 | 71 | 87 | 87 | |
| 15 | 29.22 | 16. | 65 | 72 | | | 82 | Drizzling. |
| 16 | 29.28 | 14. | | 71 | 67 | | 106 | |
| 17 | 29.22 | 17. | 70 | 72 | 66 | 84 | 114 | |
| 18 | 29.21 | 17.2 | 72 | 87 | 69 | 101 | | |
| 19 | 29.21 | 19. | 71 | 74 | | 83 | 102 | |
| 20 | 29.20 | 20.5 | 72 | 74 | 68 | 89 | 99 | |
| 21 | 29.26 | 18.4 | 70 | 76 | 67 | 74 | 122 | |
| 22 | 29.21 | 20.5 | 61 | 72 | 67 | 68 | 112 | |
| 23 | 29.23 | 13.2 | 69 | 74 | 74 | 102 | 116 | Drizzling. |
| 24 | 29.11 | 15. | 71 | 74 | 72 | 83 | 123 | |
| 25 | 29.12 | 20. | 71 | 77 | 72 | 72 | 125 | Drizzling. |
| 26 | 29.23 | 20. | 72 | 75 | 73 | 80 | 84 | Drizzling. |
| 27 | 29.20 | 11. | 73 | 76 | 74 | 80 | 96 | |
| 28 | 29.33 | 9.5 | 74 | 78 | 74 | 81 | 92 | Thunder storm. |
| 29 | 29.17 | 7.8 | 74 | 76 | 68 | | 85 | Shower. |

Barometer. Average for the month, . . . 29.213
Maximum altitude, . 29.37
Minimum altitude, . 29.11

Hygrometer. Average for the month, . . . 16.5
Extreme dryness, . 21.
Extreme moisture, . 7.8

Temperature. Mean for the month, . . . 70.5°
Maximum in shade, 87.
Minimum in shade, 60.
Mean in sun's rays, 92.2
Maximum in sun's rays, 125.
Minimum in sun's rays, 65.

RAIN, &c.

Total of water deposited during the month, .59 of an inch.

Greatest quantity that fell in one shower, .20 of an inch.

Number of showers, 2.

Showers with lightning, 1.

Prevailing wind during the month, easterly, but variable.

Prevailing clouds, cumulus.

| DATE, 1840. | Barometer. | Hygrometer. | Temp. F. in shade at 8 A. M. | Temp. F. in shade at noon. | Temp. F. in shade at 6 P. M. | Temp. F. in sun's rays at 8 A. M. | Temp. F. in sun's rays at noon. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| March | | | | | | | | |
| 1 | 29.28 | 9. | 74° | 74° | 71° | 80° | 96° | Drizzling. |
| 2 | 29.15 | 17.5 | 71 | 74 | 68 | 80 | 90 | Shower. |
| 3 | 29.24 | 9. | 70 | 75 | 68 | 92 | 99 | |
| 4 | 29.01 | 20.3 | 71 | 74 | 66 | 74 | 82 | Shower. |
| 5 | 29.07 | 21.5 | 69 | 74 | 65 | 92 | 122 | |
| 6 | 29.25 | 12. | 68 | 72 | 65 | 92 | 81 | |
| 7 | 29.20 | 15.5 | 69 | 73 | 71 | 86 | 84 | |
| 8 | 29.22 | 17. | 69 | 74 | 69 | 82 | 127 | |
| 9 | 29.11 | 21.5 | 69 | 72 | 71 | 98 | 124 | |
| 10 | 29.08 | 20. | 70 | 76 | 68 | 97 | 100 | High wind. |
| 11 | 29.10 | 22.8 | 71 | 74 | 74 | 96 | 111 | |
| 12 | 29.15 | 23. | 73 | 77 | 69 | 106 | 117 | Thunder storm. |
| 13 | 29.31 | 20.5 | 72 | 74 | 65 | 97 | 110 | |
| 14 | 29.41 | 10.5 | 70 | 76 | 67 | 80 | 107 | |
| 15 | 29.34 | 13.5 | 68 | 78 | 71 | 88 | 120 | |
| 16 | 29.17 | 24. | 73 | 79 | 72 | 92 | 106 | |
| 17 | 29.23 | 10.5 | 75 | 79 | 77 | 100 | 138 | Showers. |
| 18 | 29.26 | 10.8 | 76 | 79 | 72 | 93 | 83 | Shower. |
| 19 | 29.22 | 13. | 70 | 78 | 73 | | 86 | Shower. |
| 20 | 29.24 | 10.5 | | 77 | 72 | | 112 | |
| 21 | 29.23 | 9.5 | 75 | 78 | 70 | 91 | 95 | |
| 22 | 29.21 | 11. | 73 | | 72 | 84 | | |
| 23 | 29.19 | 10. | 73 | 78 | 76 | 82 | 115 | |
| 24 | 29.13 | 12.7 | 74 | 78 | 76 | 81 | 85 | Drizzling. |
| 25 | 28.98 | 10. | 75 | 78 | 74 | 82 | | Thunder storm. |
| 26 | 29.21 | 12. | 65 | | 69 | 76 | | |
| 27 | 29.20 | 20. | 65 | 70 | 72 | 86 | 106 | |
| 28 | 29.30 | 14. | 69 | 74 | | 82 | 84 | |
| 29 | 29.26 | 11. | 73 | 76 | 75 | 80 | 124 | |
| 30 | 29.24 | 10. | 71 | | 76 | 82 | | |
| 31 | 29.24 | 10.5 | 72 | 76 | 77 | 100 | 120 | |

Barometer. Average for the month, . . . . 29.20
Maximum altitude, . 29.41
Minimum altitude, . 28.98

Hygrometer. Average for the month, . . . . 14.6
Extreme dryness, . 24.
Extreme moisture, . 9.

Temperature. Mean for the month, . . . . 73.5°
Maximum in the shade, 79.
Minimum in the shade, 65.
Mean in sun's rays, . 96.
Maximum in sun's rays, 138.
Minimum in sun's rays, 74.

### Rain, &c.

Total of water deposited during the month, 2.49 inches.

Greatest quantity that fell in one shower, 1.13 inches.

Number of showers, 7.

Showers with lightning, 2.

Prevailing wind during the month, westerly, but very variable.

Prevailing clouds, cirrus.

| DATE, 1840. | Barometer. | Hygrometer. | Temp. F. in shade at 8 A. M. | Temp. F. in shade at noon. | Temp. F. in shade at 6 P. M. | Temp. F. in sun's rays at 8 A. M. | Temp. F. in sun's rays at noon. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| April | | | | | | | | |
| 1 | 29.30 | 10. | 73° | 77° | 77° | 87° | 98° | |
| 2 | 29.28 | 11.5 | 75 | 79 | 79 | 90 | 114 | |
| 3 | 29.30 | 11. | 77 | 81 | 80 | 101 | 111 | |
| 4 | 29.31 | 11. | 76 | 80 | 80 | 82 | 96 | |
| 5 | 29.39 | 12. | | 82 | 82 | | 105 | |
| 6 | 29.30 | 10.5 | 77 | 80 | 80 | 88 | 115 | |
| 7 | 29.28 | 10.5 | 76 | 79 | 82 | 90 | 128 | |
| 8 | 29.23 | 11.5 | 70 | 82 | 79 | 78 | 92 | Windy. |
| 9 | 29.23 | 10.2 | 76 | 79 | 79 | 103 | 116 | Rain. |
| 10 | 29.25 | 8.5 | 78 | 80 | 76 | 112 | 122 | Thunder, but no rain. |
| 11 | 29.23 | 8. | 72 | 78 | 77 | 88 | 105 | |
| 12 | 29.21 | 9. | 75 | 79 | 77 | 90 | | Rain. |
| 13 | 29.25 | 7.5 | 75 | 79 | 77 | 97 | 85 | |
| 14 | 29.21 | 7.5 | 75 | 81 | | 82 | 100 | |
| 15 | 29.25 | 7.5 | | | 79 | | | |
| 16 | 29.28 | 8. | | 80 | 79 | | 110 | |
| 17 | 29.23 | 8.5 | 76 | 80 | 79 | 93 | 135 | |
| 18 | 29.28 | 8.7 | 78 | 82 | 82 | 92 | 129 | |
| 19 | 29.33 | 9. | 77 | 82 | 82 | 92 | 111 | |
| 20 | 29.33 | 10.5 | 78 | 81 | 81 | 94 | 110 | |
| 21 | 29.32 | 12. | 77 | 81 | 80 | 82 | 117 | |
| 22 | 29.28 | 13.5 | 80 | | 79 | | 116 | |
| 23 | 29.27 | 14.5 | | 81 | 80 | | 106 | |
| 24 | 29.21 | 12. | | 81 | 79 | | 109 | |
| 25 | 29.19 | 11.5 | 71 | 81 | 79 | | 113 | Rain. |
| 26 | 29.18 | 11.5 | 76 | 81 | 79 | 95 | 108 | Rain. |
| 27 | 29.22 | 11.5 | 76 | 80 | 77 | 92 | | Thunder storms. |
| 28 | 29.27 | 11.5 | 77 | 82 | 80 | 88 | 113 | Thunder storm. |
| 29 | 29.34 | 12.3 | 80 | | 81 | | | Thunder storm. |
| 30 | 29.33 | 12.5 | | 81 | 82 | | 123 | |

Barometer. Average for the month, . . . 29.269
Maximum altitude, . 29.39
Minimum altitude, . 29.18
Hygrometer. Average for the month, . . . 10.5
Extreme dryness, . 14.5
Extreme moisture, . 7.5
Temperature. Mean for the month, . . . 78.1°
Maximum in the shade, 82.
Minimum in the shade, 70.
Mean in sun's rays, 101.1
Maximum in sun's rays, 135.
Minimum in sun's rays, 82.

RAIN, &c.

Total of water deposited during the month, 2.09 inches.

Greatest quantity that fell in one shower, 1.35.

Number of showers, 7.

Showers with lightning, 3.

Prevailing wind during the month, northerly.

Prevailing cloud, cirrus.

| DATE, 1840. | Barom. at 32 F. | Hygrometer. | Temp. F. in shade at 8 A. M. | Temp. F. in shade at noon. | Temp. F. in shade at 6 P. M. | Temp. F. in sun's rays at 8 A. M. | Temp. F. in sun's rays at noon. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| May | | | ° | ° | ° | ° | ° | |
| 1 | 29.28 | 12. | 77 | | 82 | 94 | | Shower. |
| 2 | 29.33 | 12.5 | | | 83 | | | Shower. |
| 3 | 29.22 | 12.3 | 79 | 82 | 80 | 102 | 95 | |
| 4 | 29 22 | 15. | 79 | 85 | 80 | 94 | 111 | Shower. |
| 5 | 29.18 | 11. | 73 | 80 | 79 | 88 | 83 | |
| 6 | 29.15 | 11. | 75 | 82 | 77 | 104 | 99 | Shower. |
| 7 | 29.13 | 10.5 | 79 | 84 | 82 | 88 | 87 | Drizzling. |
| 8 | 29.17 | 12.5 | 80 | 83 | 79 | 92 | 122 | |
| 9 | 29.15 | 12.5 | 79 | 84 | 82 | 103 | 99 | |
| 10 | 29.15 | 13. | 78 | 82 | 83 | 95 | 113 | |
| 11 | 29.18 | 13 5 | 77 | 62 | 81 | 98 | 101 | |
| 12 | 29.22 | 12.8 | 78 | 82 | 78 | 110 | 122 | Shower. |
| 13 | 29.20 | 11. | 76 | 80 | 77 | 92 | 121 | Shower. |
| 14 | 29.21 | 12.7 | 81 | 78 | 75 | 94 | 86 | Shower. |
| 15 | 29.14 | 12.2 | 74 | 77 | | 80 | 109 | Shower. |
| 16 | 29.08 | 11.5 | 73 | | | 85 | | Shower morn and eve. |
| 17 | 29.06 | 10. | | 75 | 74 | | 76 | Shower—a rainy day. |
| 18 | 29.08 | 10. | 74 | 76 | 73 | | | Shower—a rainy day. |
| 19 | 29.08 | 10.8 | 73 | 75 | | | | Shower—a rainy day. |
| 20 | 29.16 | 8.5 | 75 | 79 | 77 | 108 | 106 | Shower. |
| 21 | 29.13 | 10.5 | 75 | 79 | 79 | 105 | 106 | |
| 22 | 29.13 | 10. | 76 | 78 | 79 | 86 | 104 | Shower. |
| 23 | 29.22 | 10.2 | 76 | 79 | 77 | 83 | | Shower. |
| 24 | 29.21 | 9.5 | 76 | 79 | 77 | 118 | | Shower. |
| 25 | 29.16 | 10.2 | 76 | 79 | 79 | 109 | 86 | |
| 26 | 29.13 | 10.5 | 76 | 79 | 79 | 85 | 97 | Shower. |
| 27 | 29.08 | 11. | | 80 | 78 | 98 | | |
| 28 | 29.08 | 9.8 | 76 | 80 | 78 | | | Shower, and heavy rain at night. |
| 29 | 29.15 | 10. | 74 | 77 | 78 | | 94 | Shower, cloudy during the day, but little rain. |
| 30 | 29.13 | 10. | 76 | 80 | 79 | | 82 | Showers occasional, and at night heavy rain. |
| 31 | 29.14 | 9.3 | 74 | 76 | 76 | | | Shower—a rainy day and night. |

Barom. Average for month, 29.159
Maximum altitude, 29.33
Minimum altitude, 29.06
Hygr. Average for month, 11.1
Extreme dryness, 13.
Extreme moisture, 8.5
Temp. Mean for month, 78.°
Maximum in shade, 85.
Minimum in shade, 73.
Mean in sun's rays, 98.
Maximum in sun's rays, 122.
Minimum in sun's rays, 80.

Rain, &c.

Total of water deposited during the month, 20.28 inches.

Greatest quantity at one time, 7.3 inches.

Number of showery days, 21.

Showers with lightning, 15.

Prevailing wind, easterly, but very variable.

Prevailing clouds, cirrus, cumulo-stratus, and nimbus.

| DATE, 1840. | Barometer. | Hygrometer. | Temp. F. in shade at 8 A. M. | Temp. F. in shade at noon. | Temp. F. in shade at eve. | Temp. F. in sun's rays at morn. | Temp. F. in sun's rays at noon. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| June | | | ° | ° | ° | ° | ° | |
| 1 | 29.04 | 9. | 76 | 79 | 74 | 86 | | A rainy day. |
| 2 | 29.11 | 8.4 | 75 | 78 | 77 | 108 | | A rainy day. |
| 3 | 29.21 | 7. | 76 | 79 | 78 | 84 | 120 | |
| 4 | 29.23 | 7.5 | 76 | 80 | 80 | 86 | 98 | |
| 5 | 29.26 | 8.5 | 75 | 79 | 76 | | | |
| 6 | 29.26 | 9. | 73 | 80 | | 85 | 118 | Slight shower, P. M. |
| 7 | 29.22 | 6. | 76 | 76 | 72 | | | A shower, P. M. |
| 8 | 29.19 | 7. | 74 | 78 | 76 | 99 | | Showers. |
| 9 | 29.19 | 5. | 74 | 78 | 77 | 95 | | A shower, P. M. |
| 10 | 29.24 | 7.5 | 77 | 80 | 80 | 92 | 118 | |
| 11 | 29.21 | 10. | 77 | 80 | 77 | 81 | | A shower, P. M. |
| 12 | 29.15 | 8. | 76 | | 77 | 85 | | |
| 13 | 29.18 | 8.9 | 76 | 78 | 72 | 79 | 108 | A shower, P. M. |
| 14 | 29.24 | 8.8 | 76 | 79 | 73 | | | A shower, P. M. |
| 15 | 29.22 | 5.7 | 74 | 78 | 73 | 75 | | A shower, P. M. |
| 16 | 29 22 | 7.8 | 71 | 76 | 72 | 86 | | A shower, P. M. |
| 17 | 29.28 | 6.5 | 73 | 77 | 76 | 100 | 106 | |
| 18 | 29.32 | 6.8 | 77 | 82 | 78 | 86 | 95 | A shower, P. M. |
| 19 | 29.30 | 6.5 | 76 | 82 | 77 | 95 | | |
| 20 | 29.28 | 8.6 | 77 | | 84 | 97 | | |
| 21 | 29.26 | 9.2 | 78 | 91 | 84 | 98 | 92 | |
| 22 | 29.29 | 9.4 | 77 | 90 | 80 | 89 | 103 | |
| 23 | 29.35 | 9.2 | 76 | 90 | 78 | | 111 | |
| 24 | 29.34 | 10. | | 91.5 | 77 | | | A shower, P. M. |
| 25 | 29.28 | 5. | 74 | 90 | 72 | | 106 | A shower, P. M. |
| 26 | 29.24 | 10.5 | 86 | 87.5 | 78 | 110 | 108 | |
| 27 | 29.24 | 8. | 82 | 89 | | 90 | 102 | A shower, P. M. |
| 28 | 29.24 | 7. | 82.5 | 79.5 | 76.5 | 104 | | A shower, P. M. |
| 29 | 29 23 | 8.5 | 76 | 88 | 78 | 95 | 128 | A shower, P. M. |
| 30 | 29.22 | 8.5 | 77 | 89 | 76.5 | 83 | | |

Barometer. Average for the month, . . . 29.228
Maximum altitude, . 29.35
Minimum altitude, . 29.04
Hygrometer. Average for the month, . . . 7.3
Extreme dryness, . 10.5
Extreme moisture, . 5.
Temperature. Mean for the month, . . . 82.4°
Maximum in the shade, 91.5
Minimum in the shade, 71.
Mean in sun's rays, 99.9
Maximum in sun's rays, 128.
Minimum in sun's rays, 75.

Rain, &c.

Total of water deposited during the month, 14.56 inches.

Greatest fall of rain in one shower, 2.5 inches.

Number of showers, 17 days.

Showers with lightning, 17 days.

Prevailing wind, easterly.

Prevailing clouds, cumulo-stratus.

| MONTHS. | Temp. F. in shade at 8 A. M. | Temp. F. in shade at noon. | Temp. F. in shade at eve. | Temp. F. in sun's rays at 8 A. M. | Temp. F. in sun's rays at noon. | Maximum temp. in shade. | Minimum temp. in shade. | Maximum temp. in sun's rays. | San Fernando, Island of Cuba, Lat. 22° 20′ 14″ N., Lon. 73° 51′ 27″ W. of Cadiz. *Remarks*, 1839. |
|---|---|---|---|---|---|---|---|---|---|
| January. Mean 69.9° | 66.9° | 71.5° | 68.3° | 79.7° | 95.2° | 79° | 57° | 117° | 4 days showers, 1 of heavy rain. |
| February. Mean 71.4° | 68.9 | 73. | 69.8 | 87.1 | 98. | 78 | 57 | 117 | 6 days showers. |
| March. Mean 73.2° | 73.2 | 76.6 | 69.9 | 90.9 | 105.8 | 82 | 62 | 135 | 9 days showers. |
| April. Mean 74.6° | 73.8 | 78.7 | 70.6 | 99. | 110.9 | 83 | 64 | 130 | 6 days showers, 2 of them with lightning. |
| May. Mean 77.9° | 77. | 80.6 | 75.3 | 101.4 | 102.1 | 85 | 71 | 119 | 24 days showers, 15 of them with lightn'g. |
| June. Mean 78.9° | 78.5 | 82.2 | 75.7 | 100.4 | 111.3 | 85 | 72 | 129 | 21 days showers, all with lightning. |
| July. Mean 80.5° | 78.5 | 83.1 | 78. | 101. | 106.5 | 86 | 71 | 131 | 22 days showers, 21 of them with lightn'g. |
| August. Mean 79.6° | 79.7 | 83.2 | 76.1 | 99.6 | 100. | 87 | 71 | 120 | 20 days showers, 15 of them with lightn'g. |
| September. Mean 78.6° | 78.2 | 82.7 | 74.6 | 93.7 | 96.8 | 86 | 68 | 121 | 16 days showers, 11 of them with lightn'g. |
| October. Mean 75.9° | 74.9 | 78.3 | 73.5 | 85. | 99.7 | 81 | 70 | 110 | 22 days showers, 1 of them with lightn'g. |
| November. Mean 72.7° | 70.7 | 75.7 | 69.8 | 83.9 | 96.3 | 80 | 65 | 121 | 2 days showers. |
| December. Mean 67.9° | 66.8 | 71.3 | 64.6 | 91.9 | 101.6 | 77 | 51 | 122 | 6 days showers, 2 of them with lightn'g. |

| | |
|---|---|
| Mean temperature of the spring, . . . . | 75.2° F. |
| Mean temperature of the summer, . . . . | 79.6 |
| Mean temperature of the autumn, . . . . | 75.7 |
| Mean temperature of the winter, . . . . | 69.7 |
| Mean temperature of the year, . . . . | 75. |

The greatest variation of temperature in one day during the month of January, was 13°; in February, 13°; in March, 13°; in April, 12°; in May, 13°; in June, 11°; in July, 12°; in August, 13°; in September, 15°; in October, 9°; in November, 11°; in December, 18°.

*Note.* The degree of humidity of the atmosphere was imperfectly determined by wetting the bulb of a delicate thermometer covered with cambric, with 40 grs. of alcohol, and noting the number of degrees which the mercury fell below the temperature of the air in the shade.

To the very useful averages of the author for the year, we take the liberty of adding the following derived from his records.—EDS.

| | |
|---|---|
| Average of the maximum temperature in the sun's rays, | 122.66° |
| Average of the temperature at noon in the sun's rays, | 110.3 |
| Average of the maximum temperature in the shade, . | 82.42 |
| Average of the temperature at noon in the shade, . | 78.1 |
| Average of the minimum temperature in the shade, . | 64.93 |
| Average of the temperature in the evening, . . . | 72.2 |
| Average of the temperature at 8, A. M. in the shade, . | 74. |
| Average of the temperature at 8, A. M. in the sun's rays, . | 92.8 |

## Art. XII.—*Reply to Dr. Hare's Objections to the Whirlwind Theory of Storms;* by W. C. Redfield.

An article entitled "*Objections to Mr. Redfield's Theory of Storms, with some strictures on his reasoning;* by Robert Hare, M. D., Prof. of Chem. in the Univ. of Pennsylvania," which appears in the last number of this Journal, and is also found in a modified form in the London, Edinburgh and Dublin Philosophical Magazine for December, has given occasion for the notes and remarks which follow.

The several series of facts and observations, showing both the rotary and progressive movement of great storms, which I have published, together with those which have also been adduced by Reid, Milne, Dové and Piddington,* are deemed sufficient to establish the whirlwind character of these storms. In the absence, therefore, of contravening facts of a reliable character, it seems incumbent on an objector to set aside these facts and observations as unfounded and inaccurate, or to show that the results which they appear to establish have been deduced erroneously. This task Dr. Hare has not attempted; and I might therefore have been excused from replying to his objections and strictures; as these cannot affect the results which it has been my chief aim to establish.

But the observations which I have published extend also to the so-called tornado or water-spout, and with similar results:† while Mr. Espy and Dr. Hare have each in turn advanced his theory of tornadoes and storms, founded on *a priori* reasoning or speculation, and on alleged deductions from phenomena observed. Hence, perhaps, originates this fourth attempt, from one or other of these sources, to discredit the results of my principal inquiries; being, however, the first from Dr. Hare.

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* See this Journal, 20 : 20–40; 25 : 114–121; 31 : 115–130; 35 : 201–223; also a paper read before the Am. Philos. Soc. 1841, (Trans. N. S. vol. 7,) and copied into the present volume of this Journal, p. 112–119.

Reid on the Law of Storms, Weale, Lond. 1838.

Transactions of the Royal Society of Edinburgh, Vol. 14, p. 467–487.

Poggendorff's Annalen, Jan. 1841, &c.

Piddington's first and second Memoirs on the Law of Storms in India. Calcutta.

† See this Journal, Vol. xli, (July, 1841,) p. 69–77. Do. Jour. Frank. Instit., Vol. 3, third series, p. 40–49.

Moreover, I have sometimes ventured to offer summary sketches of other results or conclusions which seemed to follow from the above mentioned and other developments, which came under notice in pursuing my meteorological inquiries.* These sketches or conclusions were given, partly as *notifications* and partly because I was not willing it should appear in after years, that such results or conclusions as I have noticed had been overlooked in conducting my examinations. These inceptive statements seem to have occasioned many of the "strictures" and criticisms which I am now to notice.

Dr. Hare says that my "idea that tornadoes and hurricanes are all whirlwinds, involves some improbabilities," and that it requires that "during every hurricane, there should be blasts of a like degree of strength coinciding with every tangent which can be applied to a circle," and that "thirty two ships equidistant from the axis of gyration, and from each other, should each have the wind from a different point of the compass with nearly equal force." The only modification he admits, "is that resulting from the progressive motion which tends to accelerate the wind" on one side, "and to retard it upon the other."

I could never have imagined that any "idea" of mine necessarily involved the conditions here specified; and if the fact be such, Dr. Hare would have rendered some service by making it manifest. The modification admitted by him, vitally important as it is, shows only *one* of the conditions which would doubtless prevent any such perfect symmetry of results as he demands; to say nothing of the practical error of supposing that the course of the wind in a whirlwind must coincide with the tangents of a circle. He alleges also, "that as respects any one station, the chances would be extremely unfavorable that the same hurricane should twice proceed from the same quarter." If by this is meant that the changes of wind at any one station in the same gale, are not likely to come back to the same point of the compass from which it had before blown, except by an extraneous force or influence, we shall in this be able to agree. He states further, that "in the course of time it would be felt, at any station, to proceed from many different directions, if not from every point of the com-

* See this Journal, 33: 50-65; also, various incidental remarks and statements in other papers.

pass." The first of these conditions is verified by observation, except as I have shown that the changes in a regular whirlwind storm will not, in the true wind of the gale, be likely to exceed sixteen points of the compass at any one station. It will be difficult, however, for Dr. Hare to show, that the regular changes in a progressive whirlwind storm, as truly exhibited at any fixed station, should run through every point of the compass; although this may sometimes happen to a ship moving in the storm.

Dr. Hare does not appear to perceive, that the several conditions above referred to, are for the most part, no more predicable of the whirlwind storm, than of the affluent theory of storms which he advocates.

Dr. Hare states, that "the fact that during the same storm different vessels variously situated, are found to have the wind in as many different directions, may be explained by the afflux of winds from all quarters to a common focal area, as well as by supposing them involved in a great whirlwind." This might be true, as I have virtually stated elsewhere, provided that the direction of the wind at such vessels was found, at a given time, to be towards such a "focal area;" *which does not happen:* the observed differences of the winds from these centripetal directions being nearly equal to ninety degrees, (or a right angle,) as has been repeatedly shown.*

I have formerly stated that "I have observed in the effects of the New Brunswick tornado, numerous facts which appear to demonstrate the *whirling* character of this tornado, as well as the *inward* tendency of the vortex at the surface of the ground."† But Dr. Hare thinks, "that the survey of Bache and Espy shows that it would be inconsistent with the facts to suppose such motion, unless as a *contingent* result." Now, without inquiring whether the constant whirling action to which I alluded be a contingent or a necessary result, it is proper to notice, that the great question between us is and has been, *have storms a gyratory character?* To me, the facts established by all the strict observations which have been made and properly stated, proclaim the affirmative. We shall probably find, on a strict examination, that even the

* See this Journal, 25 : 116; 31 : 117–118; 35 : 210–215. Jour. Frank. Instit. 1839, p. 323–336, and p. 363–378. Dové in Poggendorff's Annalen, Jan. 1841. pp. 10, 11, seq.

† See this Journal, 35: 207.

surveys of Prof. Bache, though not comprising all the particulars which I deem essential to a right view of the case, may yet be best explained by admitting a general and continued whirlwind action.

Dr. Hare next adduces an imperfect quotation on the law of atmospheric circulation, as depending on the earth's rotation, centrifugal action, &c.: and presumes me to mean, "that the centrifugal force communicated to the air at the equator, causes it to rise and give place to those portions of the atmosphere," from adjacent latitudes, which "have less rotary motion;" and proceeds to comment on this presumption. I beg leave to assure Dr. Hare that he has greatly misapprehended my meaning: and furthermore, that I have never found any evidence of the supposed general ascent of the air from the lower to the upper atmosphere in the equatorial regions.

In my first essay, the prevalence of westerly winds in the upper regions of the atmosphere, was incidentally and partially ascribed to the deflection of the trade winds by mountains. Dr. H. alleges that this explanation harmonizes with the theory of Halley. He adds, "In fact as the water accumulated by these winds in the Gulf of Mexico, is productive of the Gulf Stream, is it not reasonable that there should be an aerial accumulation and current, corresponding with that of the aqueous current above mentioned?" This comes nearer to my views of the *course* of circulation in the atmosphere, but does not so well accord with the common theory of the trade winds. That the alleged accumulation of water in the Gulf of Mexico by the trade winds, is the main cause of the Gulf Stream, Dr. Hare may perhaps show hereafter. The contrary would appear to have been settled by the levellings which have already been obtained.

Dr. Hare intimates that the trade winds "cannot be explained without the agency of temperature;" he alleges also that I "reject the influence of heat;" and proceeds to quote a paragraph from which, as well as others, he infers that I "consider gravitation, uninfluenced by heat or electricity, mainly the cause of atmospheric currents;" and he inquires, "what other effect could gravitation have, in the absence of calorific and electrical reaction, unless that of producing a state of inert quiescence?" He also speaks of my treating momentum as "the antagonist of gravitation." [p. 141–142, par. 5–8.]

Now to all this, I answer: 1. That, to my apprehension, the essential features of the trade winds can be best explained without assigning the agency of temperature as the chief moving power. 2. It is an error to say, that I reject the influence of heat. 3. I consider the influences of momentum, centrifugal force, and centripetal action, as being comprised in the laws of gravitation. 4. It is true that I do not consider "electricity" as a general *cause* of atmospheric currents; for the reason, that so far as I know, this has never been shown. 5. That the only effect of gravitation, without calorific or electrical reaction, would be to produce "a state of inert quiescence," in the atmosphere of a moving and rotative planet like our own, is to me inconceivable. 6. I have never considered nor asserted "momentum" to be "the antagonist of gravitation." In the paragraph which is quoted by Dr. Hare, I had suggested *the courses of great storms as indicating the law of circulation in our atmosphere, and which I deemed to be founded mainly on the laws of gravitation.* By some mistake, he has given the phrase "*causes* of great storms" instead of *courses;* and proceeding on this error, he calls it a summing up of the "causes" of atmospheric currents: although he alleges at the same time, that I here admit but *one* cause.

It is next asked, "If the minuteness of the altitude of the atmosphere in comparison with its horizontal extent, be an objection to any available currents being induced by calorific rarefaction," as he states I have alleged, "wherefore should not momentum or any other cause *diminishing or counteracting the influence of gravity*, be on the same account equally inefficient?" To this I answer:—1. Momentum, and the other modifications of the gravitating power, are of far greater magnitude and force than the influence of the mere difference of temperature in the several geographical or climatorial zones. 2. The main tendency or result of this greater force is to produce *horizontal*, not vertical motion. 3. The words which I have italicised, show only the misapprehension corrected above, and which appears to run through the strictures which I am noticing. By "available currents," as above quoted, I here understand the great currents of the atmosphere, constituting the trade winds, &c.

In succeeding paragraphs [10–12] Dr. H. criticises the terms by which I have endeavored to point out, that a whirling or rotative movement *is the only known cause of a violent and destruc-*

*tive force in winds or tempests;* as the last clause of the paragraph quoted by him should read. There is little probability that my meaning has been misunderstood by general readers; and it appears afterwards to have been divined by Dr. Hare himself.

After a short comment on the functions of gravitation, Dr. H. inquires—"But if neither gravity, nor calorific expansion, nor electricity, be the cause of winds, by what are they produced?" I answer, 1. According to my apprehension, the gravity which induces a nearly equal "distribution of the atmosphere over the surface of the globe," may and does, in its modified influences, constitute the main basis of winds and storms. 2. That calorific expansion is *a* "cause of winds" is universally admitted; but, that it is the *chief* cause I cannot perceive. 3. If "electricity" be the cause of winds, it seems incumbent on Dr. H. to show it.

For my own part, having never attempted to write out or establish a *theory* of the winds, in the common acceptation of the term, nor yet, of the origin or first cause of storms, I have no occasion to go into these inquiries any further than relates to my present purpose. It is true that I entertain some definite views on these points, which have resulted from observation and inquiry; but the choice of time and occasion for their more full development, and also of the evidence on which they rest, belongs to myself rather than to another. I do not intend being diverted from my ordinary business, or from the results of direct observations in storms, by engaging in a controversial discussion of those general views of the alleged cause of winds, and of the physico-mechanics of the atmosphere, which now prevail; and which are held by men of the highest attainments in physical science. And in relation to storms, I have long held the proper inquiry to be, *What are storms?* and not, *How are storms produced?* as has been well expressed by another. It is only when the former of these inquiries is solved, that we can enter advantageously upon the latter.

I have stated, incidentally, that all fluid matter has a tendency to run into whirls or circuits, when subject to the influence of unequal or opposing forces, &c. Dr. Hare says that, "if this were true, evidently whirlpools or vortices of some kind, ought to be as frequent in the ocean, as agreeably to my observation, they are found to be in the atmosphere." That "the aqueous Gulf Stream, resulting from the impetus of the trade winds, ought to produce as many vortices in its course as the aerial currents derived from the same source;" and he adds, "there are few vortices or whirlpools in the ocean," for reasons which he has chosen to assign. [14–16.]

Now the alleging that aqueous currents have an equal tendency, with aerial ones, to run into "vortices," belongs to Dr. H., not to me. In the ocean, we can but partially observe the upper surface of superficial currents, moving apparently unobstructed on the more quiescent waters beneath, and with the relative equality of motion in the parts generally maintained. I see not how the unimpeded movements of this denser and nearly non-elastic fluid are to produce vortices equal in number or magnitude to those which occur in the inferior layers of an elastic aerial current, moving on or near the surface of the earth, over obstructions and inequalities, and with other disturbing conditions almost innumerable. Of Dr. Hare's views of aqueous vortices it is unnecessary to speak, but, there are mariners, if I remember their statements aright, who can give him an account of the frequency of ocean or Gulf Stream vortices, somewhat different from that which he advances. Whenever a stream or current of water of moderate depth moves over an unequal bottom, there is found no lack of vortices, of various forms and dimensions, some of which exhibit both upward and downward movements, often of considerable velocity.

Dr. H. doubts if a whirlpool ever takes place without a centripetal force resulting from a *vacuity*. I see not how this doubt can militate against my views of vortical action; but I have myself seen many hundreds of such whirlpools or vortices, and have occasionally watched their developments with much interest.

After commenting on certain arbitrary conditions "of opposing or unequal forces," Dr. Hare desires to be informed how "unequal and opposing forces" are generated in the atmosphere; producing sometimes whirlwinds of unmeasured violence. [17–18.] It may be readily seen, that aerial currents of unequal temperature and velocity, superimposed one upon another, and all moving over a surface of unequal character and with frequent elevations, and subject also to the influence of adjacent currents, must often move *unequally*, and in *unconformable directions;* thus unavoidably running, to some extent, into vortices, eddies or circuits, of various magnitudes and activity; some of which, may occasionally become extended and spin on an upright and moving axis, with that violent and continued action which characterizes the tornado or water spout. Indeed, it must be obvious, that uniformly direct lines of motion, belong not to our atmosphere or system. But, as before observed, I have here no special concern with the origin of these or other vortices; the simple fact of their existence being all that is necessary for me to maintain.

Dr. Hare then proceeds to state, that in former papers on the causes of tornadoes, he has adduced facts and arguments "tending to prove that the proximate cause of the phenomena of a tornado is an ascending current of air, and the afflux of wind from all points of the compass to supply the deficiency thus created." He also states, that "in this mode of viewing the phenomena, no difference of opinion exists between Espy and himself, however they may differ respecting the cause of the diminution of atmospheric pressure," &c. [19–20.]

I have no desire to offer strictures upon the views of a respected professor of science; but it seems proper here to inquire how an ascending current of air is thus obtained, and whether this *effect*, which perhaps may be due only to an excess of lateral and subjacent pressure, on the exterior of the tornado, be not here adduced as the cause of the effect.

Dr. Hare has been "led to consider gyration as a casual and not an *essential feature*" in tornadoes, and he adduces the dislocation and partial turning of a chimney top on its base, in the New Brunswick tornado, as being due to a *local* whirl within the body of the tornado, and proving that in tornadoes and hurricanes there are local whirls. p. 144. [21.]

I have long since ascertained that local whirlwinds are not of very rare occurrence in great whirlwind storms; the New Brunswick tornado itself having been one of several violent local whirlwinds which occurred within the limits of a somewhat remarkable storm of the above character. This tornado also sent off a duplicate vortex or whirl not long after its passing the Raritan; the path and violent effects of both whirlwinds having been distinctly traced on a field of unripe grain; the smaller one branching off to the right of the main track, where, after causing some prostrations, it passed into the Raritan marshes, and was no more seen. But the whirling motion so far from being only of "casual" and limited occurrence, appears to be a constant attribute of the tornado; although not always exhibited with uniform intensity and effect in its path, owing apparently, to the frequent rising or narrowing of the vortex, and perhaps other causes.

In his paper as found in the English Journal, Dr Hare says,—"A fact which is admitted by Mr. Redfield, was considered by Espy and Bache, as well as myself, to be irreconcilable with the idea that a general whirling motion is essential to tornadoes. I allude to the circumstance, that when several trees were prostrated one upon the other, the uppermost was found to have fallen with the top directed towards the point towards which the meteor was moving; while the direction in which the lowermost trees were found to have fallen indicated that they were overthrown by a force in a direction precisely the opposite of that which had operated upon those above mentioned."—*Phil. Mag.* [24.]

It is an error to allege that I have "admitted" a fact such as is here stated. On the contrary, in careful explorations made on foot, through an aggregate extent of more than fifty miles of the tracks of various tornadoes, I have never met with such "a fact," or combination of facts, as Dr. Hare describes. In all the cases that I have met with in which trees have fallen one upon another, if their tops pointed in opposite or nearly opposite directions, these directions *have never been parallel to the course pursued by the tornado;* but always in directions more or less transverse to the same: and I consider the opposing allegation as one of the chief errors of my opponents.

The trees which have fallen in directions which are more or less *backward* from the course pursued by the tornado, are almost invariably found *on the left side of the track, exterior to the line of its axis:* But few of these point directly backward, and still fewer can be found near the axis, as the hypothesis of my opponents requires. Of the trees found with their tops pointing *directly forward,* or nearly so, a small number have been seen on or near *the right margin of the track,* with appearances which showed them to lie as they first fell; a fact which seems equally fatal to their hypothesis. Some trees, along and near the line of the axis, are, however, found pointing in this onward direction, and much stress has been laid on *this* fact, by one of my opponents: But it appears, on examination, that in all these cases the trees *have been torn or twisted from the transverse position in* *which they first fell;* owing, as I infer, to the more violent force exhibited at and immediately behind the center of the whirl, or at the point which may not inaptly be termed the heel of the vortex.*

It is true, however, as I *have* "admitted," that when trees are found to have fallen one upon another, the top of the uppermost tree points in a direction *more* outward than the one beneath; as is seen by the diagrams and schedules of Prof. Bache, and as may be inferred, perhaps, from the sketches given by Professors Olmsted and Loomis:† And it is *equally* true, that this fact no more favors the hypothesis of a directly inward motion, than that of a whirlwind; but, as an abstract deduction, is "reconcilable" with either. The proper generalization of this class of facts I have attempted to give in my paper on the New Brunswick tornado; which is 'that the uppermost or last fallen of these trees points *most* [or more] nearly to the course pursued by the tornado;' i. e. more nearly than the underlying tree which first fell; divergence from the course of the tornado being still a marked feature of these overlying prostrations.

*I have never found a directly backward prostration on the line of the center, or axis, of the tornado.* This, as well as the above mentioned facts, will be found sufficiently "irreconcilable" with a direct "afflux of the wind from all points of the compass," 'in a central and non-whirling course,' "towards a common focal area."

In the same Journal, Dr. Hare says he "cannot understand how the opposite forces belonging respectively to the different sides of the whirlwind, can be made to bear successively *upon one spot,* so as to cause trees to fall in diametrically opposite directions." *Phil. Mag.* [25].—Neither can I understand this, if each of these "opposite directions" *be parallel to the course of the tornado,* as is alleged by Dr. Hare, in the passage last noticed.

Dr. Hare next tells us—"A fact, irreconcilable with a general whirling motion, has been recorded by Messrs. Espy and Bache. A frame building was so situated as to be protected by another edifice in one direction from the suction of the tornado, and yet was exposed to its influence as it advanced, and as it moved away. Hence two of the four parts, on which the frame

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* See this Journal, July, 1841, pp. 69–79.

† See this Journal, Vol. XXXIII, p. 369; Vol. XXXVII, p. 343.

rested, were so impelled by the wind as to make furrows in the ground, of which one was nearly at right angles to the other. Evidently such furrows could not rise from the transient tangential impulse of a whirlwind." pp. 144, 145. [22.]

In the English Journal, Dr. Hare alleges that one of the four posts on which the building was supported, "*was first moved towards the tornado*, as it advanced:" while Prof. Bache shows us that the tornado advanced from south 80° west, to north 80° east; and that the posts were first moved "*to the west of north.*"

But on what grounds this "fact" is pronounced "irreconcilable with a general whirling motion," I am wholly unable to perceive. For, had he closely examined the whole case, he would hardly have failed to see that the movements of this building, as described by Prof. Bache, are fully "reconcilable" to an involute "whirling motion," such as I allege to be characteristic of these tornadoes; and that there was no necessity for resorting to the gratuitous hypothesis of its being "protected by another edifice in one direction," or even that of "the suction of the tornado."

If a whirlwind figure having a diameter of three or four hundred yards by the scale of Prof. Bache's figure, [Plate III, fig. 3,]* be drawn on tracing paper, with involute whirling lines representing, horizontally, the course of the wind from the exterior to the interior of the tornado, and if the center or axis of this figure be passed from west to east along the line pursued by the axis of the tornado as indicated on the plate, revolving at the same time to the left with a velocity greatly exceeding its advancing motion, it may be seen that the wind of the whirl will be indicated as beginning at this building from nearly south, *i. e.* moving "to the west of north," nearly, or in the general direction of the first furrows in the ground. It will also be seen, that the wind of the whirl, changing by southwest, and having its gyrations quickened near the center, would, immediately after the passing of its axis, exhibit its greatest force from the western quarter, corresponding to the second movement of the posts in the ground; the wind veering from thence towards the northwest as the tornado passed away: thus showing two directions of wind which sufficiently coincide with the first movements of the posts of the building "to the west of north," and subsequently "to the

* See Jour. of Franklin Institute, Vol. III, third series, 1841, pp. 273 and 276.

eastward," or "nearly at right angles" to its first course; according to the descriptions and plan of Prof. Bache, who gives the course of the axis as "east 10° N.," the building being to the southward or on the right of this line.

I say nothing here of the protection afforded by "an edifice" which after the first moment, according to the hypothesis of motion adopted by Messrs. Espy and Hare, was constantly more or less to *leeward* of the building so protected. By applying to Prof. B.'s plan, as before, a compass card, moved from west to east without revolving, we shall find their wind to commence nearly at east, passing thence through south to southwest, and possibly to west southwest, near which it would terminate. Thus, the first effects of the wind, when, even upon the hypothesis of "suction," the building was unprotected, could not produce the first motion in the direction "to the west of north," which may perhaps be fairly taken at 5° or 10° west of north; and the wind, on their hypothesis, would hardly appear to have reached a point which could produce the second movement "to the east."

I have been thus particular in this examination, because the case thus alleged by Dr. Hare is a further specimen of the erroneous inductions which have been made and relied on by my opponents. In examining the plans referred to, it should be observed, that the sketch of prostrations in the orchard, which is included in fig. 3, is evidently on a more reduced scale than that given in the plan of the building; otherwise, the buildings must be of size sufficient nearly to have covered the orchard. This change of scale may cause some confusion unless particularly noticed.

That the velocity and consequent force of the whirling movement of the tornado is maintained by the direct *pressure* of the surrounding atmosphere, rather than by the "suction" alleged by Dr. H. I can readily conceive; but that the "impulse of a whirlwind" of this character is generally found to be "tangential" to its axis, which he seems to consider a necessary condition, I do not admit.

Dr. Hare appears to concede, that my survey of this tornado shows effects which accord with whirlwind action; but he seems desirous of limiting this admission to the prostration of "certain trees," and alleges that this survey "does not demonstrate gyration to be an essential feature of tornadoes," and that "it is sufficiently accounted for by considering it as a fortuitous consequence of the conflux of currents rushing into a space partially exhausted." [23.]

Now I cannot but think, that readers who have no theory to support, will view the results of my survey in a very different light. Dr. Hare omits to mention, that the survey comprised the entire breadth of the visible track, at perhaps its broadest place; that it was intended to include every tree prostrated within its limits; that it essentially agrees with the main features of the more partial surveys of Prof. Bache; that I have shown by clear inductions from all the prostrations in the survey that the whirling motion was one general effect, comprising the entire width of the track; that the tornado must have arrived at this ground in nearly its most perfect action, having just left the surface of the Raritan river; that the axis of prostration was not found in the center of the track, but nearest its left margin; that the main rotation was wholly to the left or in one constant direction; and, that the leading features of the prostration found in this survey, have also been observed as constantly occurring, in the tracks of many other tornadoes.*

I may add, that in a careful exploration of the track of this tornado for several miles, I found nothing to contravene the results presented in my published survey; the general features of the prostration being greatly analogous to those which I have given.

Dr, Hare thinks it singular, that I should have declined noticing the "insuperable difficulties" of the hypothesis of 'a central and non-whirling course in the wind of the tornado,' to which I have alluded in bringing forward facts and inductions which seem to contravene this hypothesis. He states, also, that "the advocates of the disputed hypothesis are not aware of any such difficulties," and intimates the impropriety of the allusion "without naming the facts and arguments" which justify it. [24.]

I considered it more proper, however, to rely solely on the survey and inductions which I then presented; as these appear sufficient to set aside, not only the hypothesis itself, but also some of the chief deductions from the phenomena of this tornado which

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* See this Journal, 41: 69–77. Do. Jour. Frank. Instit. Vol. 2, third series, p. 40–49.

have been put forth and relied on by Mr. Espy and Dr. Hare.* Besides, I had no wish to assume a controversial attitude, in assailing by argument, an hypothesis which virtually discards the observations of mankind in all past ages down to the year 1835. The testimonials of these observations appear in the names and terms applied by all people in all languages to this small but violent class of storms. "The facts" demanded, I had supposed, were furnished on that occasion in sufficient numbers.

Dr. Hare next adduces "the statement of a most respectable witness, that while the tornado at Providence was crossing the river, the water which had risen up, as if boiling, within a circle of about three hundred feet, subsided as often as a flash of lightning took place;" which he alleges to be a "fact which is utterly irreconcilable with Mr. Redfield's "rotary theory." He adds: "now supposing the water to have risen by a deficit of pressure resulting from the centrifugal force of a whirl, how could an electric discharge cause it to subside?" [25.]

For the supposition here made, as well as for "the water which had risen up," Dr. H. seems alone accountable; as his witness, Mr. Allen, speaks only of "the effervescence produced by the tornado in the water" having "perceptibly abated." The water he states to have been "in commotion like that in a huge boiling caldron;" but, *that which rose up* from the surface, he describes as "misty vapors resembling steam," which "after the flash, seemed sensibly to diminish for a moment."† I cannot perceive that the fact thus alleged has the least unfavorable bearing upon my views of rotative action. Therefore, without considering the optical effect which may result from a flash of lightning, or the immediate conversion of clouded vapor into rain, which oftentimes suddenly follows, I will only state, that another competent observer, who was very near this whirlwind when it left the western shore and who watched its progress across the river, has described to me the appearance of the cloudy sprays or mists blown from the surface of the water, and which filled the lower extremity of the tornado, but he has mentioned no sudden disappearances of the same. He did, however, observe the *whirling action* of the tornado with great distinctness, both when it

* See Journal of the Franklin Institute, Vol. 20, new series, 1837, p. 56–61; also Vol. 2, third series, 1841, p. 356–359.

† See this Journal, Vol. XXXVIII, p. 76.

first entered upon the river, and in its effects upon the sails and position of a schooner with which it came in contact; and likewise, as exhibited by the circling or whirling directions of the various objects carried into the air, as it came off the high grounds on its approach to the river. The highly intelligent eye-witness of my opponent, also describes "the misty vapors" as "*entering the* WHIRLING VORTEX;" thus showing from his own observation, a fact which fully supports my views, and is fatal to the objections, and hypothesis of motion, set forth by Dr. Hare. Moreover, there were decisive memorials of a general whirling action found along the path of this tornado.

Dr. Hare chooses also to say, "that the explanation which Mr. Redfield dignifies with the title of his 'theory of rotary storms,' amounts to nothing more than this, that certain imaginary nondescript unequal and opposing forces produce atmospheric gyration, that these gyrations by their consequent centrifugal force, create about the axis of motion a deficit of pressure, and hence the awful and destructive violence displayed by tornadoes and hurricanes."—"I cannot give to this alleged theory the smallest importance, while the unequal and opposing forces, on which it is built, exist only in the imagination of an author who disclaims the agency either of heat or electricity." p. 145. [26–27.]

The recital of this passage appears necessary on account of the gross error into which Dr. H. has here fallen. I have never attempted to dignify any "explanation," induction, sketch, or essay, "with the title" of my "theory of rotary storms." It must, at least, have been a mistake of person. I have little fondness for theory-making; and as little respect for hypotheses of winds or storms, other than those which result directly from sufficient and reliable observations. Neither have I disclaimed "the agency of heat," as already stated; but it may have been my offense to have disclaimed "electricity" as a known cause of storms. My cursory explanations of the action of a whirlwind or tornado, even as shown up by Dr. Hare, are, in my view, better suited to the observed facts of the case than any which he or Mr. Espy has offered.

I do not solicit for my views even that "smallest importance" which is denied them in the mind of my critic; but the attention with which he has treated them, both here and abroad, does not appear to agree well with the disavowment. With the facts before him which are shown in my survey of the tornado, and also with the numerous observations made in great storms, which I have published, it is both vain and absurd to pretend that my views of their rotation are founded only in imagination. I am not conscious of having "built" or indicated any "theory," views, suggestions or explanations of storms or whirlwinds which have not been based on observations of my own and facts otherwise ascertained, sufficient in my view to warrant them; the 'unequal and opposing forces' even included: although, I have not always urged these facts upon the attention of my readers; having, not unfrequently, reserved them for more appropriate occasions. Hence, my alleged proofs have been chiefly confined to the progressive course and rotative action developed in storms; which last, strangely enough, has been so pertinaciously denied by Mr. Espy, and now by Dr. Hare.

My opponent next attempts to show, "that any deficit of pressure about the axis" of a whirlwind, "consequent to the resulting centrifugal force, could only cause in the atmosphere a descending current, while it could not tend in the slightest degree to carry solids or liquids aloft." p. 146. I was also surprised to find this hypothetical downward current in the midst of a whirlwind alleged as a necessary condition, on former occasions, by Mr. Espy. If the allegation be true, it must be easy to show that the ascending currents in chimneys should become inverted: for, so far as simple gravitation is concerned, it can make little difference whether the rarefaction be mechanical or calorific.

But the ascending effects in the interior of a whirlwind have been too often witnessed by myself and others to require discussion. Indeed, it would almost seem that the objectors had been precluded from all opportunities for correct observation. There are numerous cases, however, in which the upward movement of the objects elevated cannot be seen in the central and lower parts of the whirlwind; owing, as I have had good occasion to know, to the great angular velocity of the central gyrations.

Dr. Hare appears to suppose, that gyration in a revolving fluid mass will not quicken as it approaches the center, unless as resulting from a centripetal force "caused by suction at the axis."

A constant centripetal *force* I have already recognized on this as well as former occasions. But this by no means requires or produces a direct centripetal *course* in the moving air which yields to its influence. But in the cause assigned for this force, as well as in the specific directions of the movements produced, we differ essentially. So far from ascribing this quickened gyration to the "suction" alleged by Dr. Hare, I know of no such power in the uninclosed atmosphere; conceiving, that neither rarefaction nor any other known cause can here occasion "suction," according to the common use of this term. Air, whether rarefied or not, can never ascend but in obedience to a *pressure* or *force*, sufficient to exceed both its own weight and that of all the atmosphere which lies immediately above it, or in the immediate direction or locality of its motion. This erroneous hypothesis of "suction," in some form or other, appears to lie at the bottom of the various speculations and inductions of my opponents.

In noticing the spirally involute and quickening motion which I allege as observable in 'all narrow and violent vortices,' Dr. H. gives an erroneous reference for his quotation; and the latter seems also to be somewhat inaccurate. I do not see that his speculations on this quickened motion 'towards the center or axis of the whirl,' can affect either my views, or the disputed fact of gyration; and they are sufficiently answered by observations published in my first paper,* as well as by the remarks made above on centripetal force.

Dr. Hare thinks that so far as my observations show the quickening of the whirling motion towards the center of the tornado, they tend to confirm the views of my opponents and to refute those which I uphold. To me it appears that this is an entire abandonment of his ground. It is the general fact of gyration which I am chiefly concerned to uphold, and which has been combated by him and his predecessor in this controversy. I dispute with no one as to how it may be produced. Should better explanations of this fact than mine be offered, they will be cheerfully adopted. In the mean time, I shall adhere to my observations and opinions, rather than to the hypotheses and speculations of my opponents.

Dr. Hare thinks, "that any theory of storms which overlooks the part performed by electricity, must be extremely defective." I do not perceive that the part performed by electricity in a gale

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* See this Journal, Vol. xx, p. 45–46.

of wind, squall, tornado, or other storm, ever constitutes an essential feature of the same: but, the part so performed, appears to me to be only incidental and subordinate to the action and main effects of the storm. Electricity is not wind, nor water, nor vapor; but an imponderable matter or effect, which is not known to exert any constant mechanical force or action upon the effective currents of the atmosphere. "Thunder and lightning and convective discharge," are but momentary or transient exhibitions of electricity, producing no visible effects upon these currents; whatever may be their agency in restoring the disturbed equilibrium of the different atmospheric elements. The electricity developed by a steam boiler is not considered as producing the steam or its jet, or the condensation of the latter; but is itself produced by these. Even were it shown that a stream of electricity was constantly developed between the rarefied column of a moving tornado and the surface beneath, I cannot see how this could be assumed as the *cause* rather than the *effect* of the local rarefaction. If the part which electricity performs in a storm be essential, or controlling, its functions ought to be distinctly pointed out.

I would humbly suggest that the old practice of forming or inventing theories or schemes of action for the powers of nature, ought to be mainly abandoned. The Wernerian and Huttonian theories are well remembered; and how small would have been the progress of the science to which they relate, had its cultivators continued to exhibit only the spirit and philosophy of the early advocates of these theories; and how much less, if guided by a philosophy so speculative and untenable as that of the affluent and up-moving hypotheses of winds and storms? More strict and extended observations and inquiry, with greater caution in the adoption of hypotheses, whether old or new, would in my opinion, tend greatly to the advance of meteorological science.

Observation, rather than "lucubration," has been my employment when exempted from other duties: and if the results of observation do not accord with the "lucubrations" of Mr. Espy and Dr. Hare, I conceive that I am in no degree responsible for the difficulties of their position.

New York, January 13, 1842.

ART. XIII.—*Abstract of the Proceedings of the Eleventh Meeting of the British Association for the Advancement of Science, held at Plymouth, September*, 1841. [*Prepared from the Report in the London Athenæum.*] Concluded from page 164.

Sect. B. *Chemistry and Mineralogy.*

Mr. R. HUNT communicated a paper on the *influence of the ferro-cyanate of potash on the iodide of silver, producing a highly sensitive photographic preparation.* The author being engaged in experiments on that variety of photographic drawing which is formed by the action of the hydriodic salts on the darkened chloride of silver, with a view to the removal of the iodide formed by the process, from the paper, was led to observe some peculiar changes produced by the combined influences of light and the ferro-cyanate of potash. He found that the ordinary photographic paper, if allowed to darken in sunshine, and then slightly acted on by any hydriodic salt, and washed when dry, with a solution of the ferro-cyanate of potash, became extremely sensitive to light, changing from a light brown to a full black, by a moment's exposure to sunshine. Following out this result, it was discovered that perfectly pure iodide of silver was acted on with even greater rapidity, and thus it became easy to form an exquisitely sensitive photographic paper. The method recommended is the following: highly glazed letter paper is washed over with a solution of one drachm of nitrate of silver to an ounce of distilled water; it is quickly dried and a second time washed with the same solution. It is then, when dry, placed for a minute in a solution of one drachm of the hydriodate of potash in six ounces of water; and being placed on a smooth board, gently washed by allowing pure water to flow over it, and dried in the dark at common temperatures. Papers thus prepared may be kept for any length of time, and are at any moment rendered far more sensitive than any known photographic preparation, except the Calotype, which it quite equals, by simply washing it over with a solution formed of one drachm of the ferro-cyanate of potash to an ounce of water. These papers may be washed with the ferro-cyanate and dried in the dark: in this dry state they are absolutely insensible, but they may at any moment be rendered sensitive by merely washing them with a little cold water. The paper is rendered quite insensible by being washed over with the above hydriodic solution, and from the photograph thus fixed many copies may be taken.

*Some researches on the development of the Electrical Force, and an inquiry into the nature and properties of the New Element or product of electrical action described by Schönbein, by Mr. F. De Moleyns.* The statements made by Prof. Schönbein at the Glasgow meeting (see Vol. XLI, p. 43) respecting the new element which he called *ozone,* attracted the attention of Mr. De Moleyns; and the paper now read contained some of the more important results of his experiments. In the report alluded to, Prof. S. states that the disengagement of the "odorous substance" depended, 1, upon the nature of the positive electrodes; 2, upon the chemical constitution of the electrolytic fluid; and 3, upon the temperature of that fluid. He added, that his experiments went to show that well-cleaned gold and platina were alone capable of disengaging the odoriferous principle, and that the *more easily* oxidable metals, as well as charcoal, did not possess that property at all. The results of Mr. De Moleyns's investigations appear to prove: 1, that the disengagement of the peculiar odor is not confined to the *less easily* oxidable metals: 2, that by certain arrangements, *all metals,* when positive electrodes, may be made to develope the odoriferous principle: 3, that certain positive metals, not acting as electrodes, will evolve this principle: 4, that charcoal forms no exception to this rule: 5, that all substances, whether crystalline in structure or otherwise, possessing the property of appearing luminous by friction, or of yielding sparks when struck, also possess the property of discharging, under such circumstances, the peculiar odor: 6, that iron and nickel develope this principle more strongly than any other metal. Mr. De Moleyns, observing the odor to be produced at the points connecting an electro-magnetic machine with the battery, constructed an apparatus by which magnets were made to revolve within a glass cylinder, which could be exhausted at pleasure, or filled with various gases; by such means he obtained a vacuum, and operated in dry air, collecting the matters evolved over distilled water, and by such modes he proved that ozone could not only be evolved in a dry atmosphere, but also in a vacuum—mercurial and common. These and other experiments led Mr. De Moleyns to the conclusion that the *ozone* of Schönbein, which he proposed to name *electrogen,* must be admitted into the list of supposed elements: that it was *not* a union of an electrolytic compound whose action was *unknown;* and that probably it exists in combination in various forms of matter, which at present are considered elementary, but which in reality are not so.

A paper on *manures considered as stimulants to vegetation,* was communicated by Dr. Daubeny. The author discusses the question as to the sense in which manures can be considered to act as stimulants to plants. It is evident that if the term *stimulus* be understood in an acceptation similar to that in which it is employed with reference to the animal economy, it ought to be confined to bodies, which by their presence, assist in promoting the secretion and assimilation of the nutritious materials present, and ought not to include such as themselves afford materials for secretion. Thus salt and other condiments do not themselves nourish the animal; but by their presence, induce its secreting surfaces to assimilate more readily the substances presented to them. Now, it becomes a fit subject for inquiry, whether manures operate in the former manner or in the latter; and likewise whether the fact, that certain of them act less beneficially at subsequent periods of their application than they did at first, admits of being explained on the recognized principle that "stimuli lose their full effect upon living matter when frequently repeated." Dr. D. adduced several facts which led to the inference that the nitrates of soda and of potassa operate favorably upon certain crops by communicating to them nitrogen; and the reason why these salts sometimes have appeared to leave the land in a worse condition than before their use, is not owing to their being stimuli, and therefore amenable to the law above quoted; but is because the free supply of nitrogen afforded by the decomposition of the nitrates, had caused the plant to absorb a larger portion of those other ingredients, such as phosphate of lime, silicate of potassa, &c., which are present only in a limited quantity in the soil, thus tending to exhaust it of these materials, and causing thereby an inferior crop to be produced on the following year. Now, though it may be true that the nitrates in this manner indirectly stimulate the vital energies of the plant, yet it was conceived that the term *stimulus* had better be abandoned with reference to such cases, as its adoption might lead to an erroneous impression in the mind of the farmer with respect to the proper mode of restoring to the land its original fertility. If the theory suggested by the author be the true one, it will follow, that the proper remedy would be, not to discontinue the use of the nitrates, but by the application of bone manure, &c. at intermediate periods, to restore to the land those other ingredients which had been abstracted from it in too large a quantity. To determine what materials are wanting, and in what proportions they ought to be applied; (independently of the empirical plan of ascertaining, by repeated trials, the substances, which, by their addition succeed best in remedying the deficiency,) two methods present themselves. The first, a difficult one, is to learn by a minute analysis of the soil, whether the ingredients which the crop requires are actually present, and to add of these a quantity equal to that which the intended crop is calculated to contain. The second, a more practical scheme, is to estimate in the first place, how much of these substances exists in the crop taken off the ground, and then to add to it at least an equivalent quantity of manure. The Doctor suggested, that in farming establishments, a kind of book-keeping should be undertaken, on this principle: a debtor and creditor account being made out of the quantity of nitrogen, of earthy phosphates, of alkali, &c. abstracted in the form of crop, and restored in that of manure each year. He concluded by specifying certain points relative to this subject which require further investigation. 1. To confirm or disprove his theory, with respect to the operation of the nitrates, by determining whether they actually diminish in quantity, and finally disappear after several successive crops have been grown upon land impregnated with these salts. 2. Whether the same applies to common salt and other mineral manures as to the nitrates, or whether any of them act directly as stimuli. 3. More extended and exact data relative to the amount of alkaline and earthy salts, and of nitrogen present in the various crops cultivated by the farmer, as well as in the manures he employs.

*A practical method of determining the quantity of real Indigo in the Indigo of Commerce*, by Dr. Samuel L. Dana, of Lowell, Mass. U. S. A. Dr. D. directs that 10 grains of indigo reduced to an impalpable powder should be boiled in a Florence flask a few minutes, in 2½ oz. of a solution of carbonate of soda, making 30° to 35° on Twaddel's hydrometer; then add 8 grains of crystals of muriate of tin, and boil for half an hour: a beautiful yellow solution of indigo will be obtained. Withdraw the flask from the lamp, and introduce into the solution 500 water-grain measures of a solution of 50 grains of bichromate of potash in 4000 grains of water. The indigo blue, with a trace of indigo red, will be precipitated, while the other components remain in solution. Filter the precipitate through a double weighed filter, washing the mass with 1 oz. of muriatic acid, diluted with 3 oz. of boiling water; wash with hot water till water only returns; separate, dry and weigh the filters; note the weight of the precipitate, burn one filter against the other; the difference is the silica contained in the indigo, which deducted from the weight of the precipitate, gives the quantity of pure indigo. Mr. Walter Crum, who communicates the above, adds, that carbonate of soda with protoxide of tin does dissolve indigo, and forms a yellow solution, but so slowly that he doubts if all the ten grains are acted upon. He thinks Dr. Dana must mean soda-ash, which contains a notable quantity of caustic soda; but a much weaker solution of caustic soda would answer the purpose.

*On the disintegration of the Dolomitic Rocks of the Tyrol*, by Prof. Daubeny. The author attempted to explain, without resorting to volcanic agency, the abrupt form, extraordinary height, naked outline, and fissured surface of the dolomitic rocks of the Tyrol. He attributed these characteristics to the slow rate at which decomposition proceeds in rocks consisting of pure dolomite, and the strength of the cohesion which binds together the particles of this rock, owing to which, even those portions which stand prominent in consequence of the removal, by the agents of destruction, of their contiguous parts, often remain unaffected by those mechanical forces which would cause the projecting portions of a rock less unyielding in its texture, to become detached. The cause therefore of the greater height maintained by the dolomites of the Tyrol, than by the pyroxenic rocks which accompany them, seems to be the inferior rate at which decomposition has proceeded in the former, whilst the bold and jagged outline they display, may have been produced by the tenacity with which their parts cohere. The sterile character of these same rocks, even in parts which are not precipitous, appears to be owing to the slowness with which they decompose, as well as perhaps to the absence of organic remains. The Professor concluded with some suggestions as to the means of fertilizing rocks containing magnesia, when from the slowness of their decomposition they continue sterile; and proposed in such cases to accelerate the disintegration by pouring upon the sub-soil dilute sulphuric acid.

Mr. Prideaux communicated the *results of inquiries into the causes of the increased destructibility of modern copper sheathing.* Experiments made on various kinds of copper sheathing immersed in sea water, showed, that in the laboratory, under parallel circumstances, they do not observe the same order of durability and waste, as they had done in use. The cause of comparative waste appears therefore to be, in part at least, due to *external conditions;* and of these, two classes may be noticed; one depending on the connexion with the ship, the other on the circumstances of her employment. Of the first class, two suggested themselves,—the position on the ship's side, and the nails by which the copper is fastened. The lower part of a ship's copper seems to suffer much less than the upper, so long as she continues in deep water; but when she grounds at low water, if on black mud, this part suffers most from the action of sulphuretted hydrogen, peeling off in blue flakes. The influence of the nails offers rather more chemical interest. They are never of pure copper, and being very numerous, all in contact with the copper sheets, whilst their heads present also a considerable metallic surface to the salt water, they may produce very decided effects, either preservative or destructive, by a slight electro-chemical difference. Various experiments were tried, which proved that most nails are destructive. The conclusion resulting was this, that the nails might be rendered slightly electro-positive to rolled copper, by the addition of zinc, which would not injure their flexibility nor enhance their cost. The test by the galvanometer would, after a little practice, be easily applied, in making up the metal for casting them.

Another mode of protection is offered, by coating the copper when new, with fish oil, which in one instance has been of signal service. The preservative effect of coal-tar was also noticed. This tar had trickled down over the copper from the wood-work above, and had crossed the sheets just where most subject to the wash and friction; and whilst the naked metal had been quite worn away, the coal-tarred streaks remained entire; the surface of the copper, on melting off the tar, being as perfect as when fresh from the roll. But it remains to be seen whether it will keep a clean surface free from organic adhesions and earthy incrustations. Experiments are now in progress to determine this question.

*New extemporaneous process for the production of Hydrocyanic Acid for medical use*, by R. D. Thomson, M. D. The importance of this acid as a remedial agent, induced the author to bestow much attention upon a mode of producing it always of uniform strength. Having tried all the processes for this purpose, proposed in this country, he was satisfied that none of them afforded an acid of uniform strength. The process recommended by Dr. Clark of Aberdeen, was superior to every other, but an objection to it is the great difficulty of procuring pure cyanide of potassium. The author believes the following process to be less liable to objection than any at present used. The first step consists in forming a pure cyanide of lead. This may be done in various ways, either by precipitating acetate of lead by hydrocyanic acid, as prepared from the ferrocyanide of potassium and sulphuric acid, in a stoppered bottle, or by distilling the mixed materials into a Wolff's bottle containing a solution of acetate of lead. In either case a definite compound of cyanogen and lead will be obtained, which is to be carefully washed and gently heated. The next step in the process is to decompose it by means of sulphuric acid. In order to obtain an acid of the strength of the *Acidum Hydrocyanicum dilutum* of the London Pharmacopœia, or containing about two per cent. of absolute acid, the following formula is recommended.

46.36 grains of cyanide of lead.
2 fluid drachms of dilute sulphuric acid. Lond. Pharm.
6 fluid drachms of pure distilled water.

Introduce the cyanide of lead into a stoppered bottle; mix the acid and water in a glass vessel; allow the mixture to cool, and then pour upon it the cyanide of lead. Close the stopper, and agitate the fluid and salt together. After standing for some time, pour off the supernatant liquor from the precipitated sulphate of lead, and preserve it in a stoppered bottle. This formula is founded upon the circumstance that the dilute sulphuric acid of the London Pharmacopœia contains in each fluid drachm about 9.5 grains of oil of vitriol ($SO^3HO$). Two drachms will therefore contain nineteen grains of oil of vitriol. The quantity required for saturating 43.36 grains of cyanide of lead, is only 17.4 grains; but the small excess is useful in preserving the acid.

*On the radical of the Kakodyle Series*, by Prof. Bunsen.—The easiest method of procuring pure kakodyle is the following. Chloride of kakodyle, carefully freed from the oxide by treatment with strong hydrochloric acid, is allowed to stand some time over chloride of calcium and quick lime, to remove the water and all excess of acid. It is then introduced into a distillatory apparatus carefully filled with carbonic acid, and containing some slips of clean sheet zinc. Any of the metals which decompose water will answer, but zinc is the best. It is probable that hydrogen or carbon would produce a similar decomposition with suitable modifications of the apparatus. The vessel is then hermetically sealed, and the mixture of zinc with the chloride, is exposed for some hours in a water bath to a temperature of 212° F. When the decomposition is complete, a white saline mass is formed, which melts into an oily liquid between 240° and 248° F.; while the tube is still hot, the point of the tube leading into the condenser is dipped below the surface of boiled distilled water: as the apparatus cools, the water rises into it. The tube is hermetically sealed: the water dissolves chloride of lime, leaving the excess of zinc and the *kakodyle,* which falls as an oily liquid to the bottom. This is rectified twice or three times, filled with carbonic acid as before; the water being afterwards removed by chloride of calcium in the usual way. Thus obtained, it is a colorless liquid, transparent and of a high refractive power, in appearance and odor much resembling the oxide of kakodyle, and ignites instantly on being brought in contact with air, giving off water, and carbonic and arsenious acids.

*Abstract of a letter from Prof. Liebig to Dr. Playfair.*—This letter announces the discovery of a white crystalline substance, in large quantities, obtained by M. Schunk from the lichens which are employed in preparing archil, (*Lecanora tartarea*, &c.) by extraction with ether. It differs from *erythrine,* and the compounds described by Dr. Kane, in its insolubility in water. It dissolves readily in alkaline solutions, and is capable of being again precipitated by acids, if the solution be recently made; but if kept standing for some hours, acids produce no precipitates: it has been decomposed, and is converted into carbonic acid, and *orceine.* If the substance be dissolved in baryta water, and the clear solution boiled, a large precipitate of carbonate of baryta occurs, and the filtered solution gives, on evaporation, large quantities of *orceine.* From this circumstance a number of phenomena in the color of lichens can be explained, which Dr. K. has described in his work on that subject. Prof. L. also states that he has performed many experiments on the legumin of beans, and some other leguminous plants. He has arrived at the conclusion, that this body is identical with the casein in milk of animals. It has precisely the same composition, and contains the same salts,—(phosphate of potash, potash, magnesia, lime and iron,)—as the casein of milk. Prof. L. also mentions, that Drs. Will and Varrentrapp have devised an excellent method for determining the amount of nitrogen in organic bodies. The substance is mixed with a quantity of caustic potash and hydrate of soda, and heated to redness in an ordinary combustion tube. All the nitrogen in the substance escapes as pure ammonia, which is condensed in a small and neat apparatus, containing dilute hydrochloric acid. This solution is mixed with chloride of platinum, evaporated to dryness in a water-bath, and the excess of chloride of platinum is washed from the ammonia chloride by a mixture of ether and alcohol. From the metallic platinum which remains after the ammonia chloride is heated to redness, the quantity of nitrogen is to be calculated. In conclusion, the Professor states that he has repeated all the experiments of Dr. Brown on the *production of silicon from paracyanogen,* but is not able to confirm one of his results. His experiments prove that paracyanogen is decomposed by a strong heat, into nitrogen gas, and a residue of charcoal which is exceedingly difficult of combustion.—Dr. Parnell stated that he too had repeated the experiments of Dr. Brown, without being enabled to verify any one of his results.

The following papers were also read before the Section.

On some instances of restrained chemical action; by E. A. Parnell.

On some subjects connected with the sulpho-cyanides; by the same.

On the direct formation of cyanogen, from its elements; by G. Fownes.

Experiments showing the possibility of fire from the use of hot water in warming buildings, and of explosions in steam-engine boilers; by Goldsworthy Gurney.

On the production of sulphuretted hydrogen by the action of vegetable matter on solutions containing sulphates; by E. Lankester, M. D.

On the composition of crystallized diabetic sugar; by R. D. Thomson, M. D.

On spontaneous combustion; by Messrs. Booth, Hunt, and Hearder.

## Section C. *Geology and Physical Geography.*

Mr. J. E. Bowman read an extensive paper *on the Upper Silurian Rocks of Denbighshire,* and stated that a re-examination had furnished him additional proof of the correctness of the arrangement of these rocks, which he had proposed in a paper read at the Glasgow meeting.

A report was read from the committee appointed at Glasgow, for obtaining instruments and registers to *record shocks of earthquakes in Scotland and Ireland.* Two instruments were devised and set up for this purpose, about January 1, 1841, near Comrie, in Scotland, viz. the *common Pendulum Seismometer*, and the *inverted Pendulum Seismometer.* No very important results had hitherto been obtained, and it is now proposed to adopt new instruments of greater scope and sensitiveness than those before employed.

On the *occurrence of some minute Fossil Crustaceans in Palæozoic Rocks*, by Mr. John Phillips.—After mentioning various places in which these animals have been found, he states that he had lately observed in Pembrokeshire, in the lowest shales of the mountain limestone, within ten feet of the old red sandstone, beds of Cyprides very similar to those in the black shales of the upper coal measures in Manchester. These are probably the most ancient specimens of the group yet discovered. The circumstances under which these Crustaceans are found at the present day, appear to agree with those attending their occurrence in a fossil state; the recent Cyprides seem destined to consume the perishing parts of animal and vegetable substances, and the fossil species are generally associated with portions of fishes near Manchester, and elsewhere. Probably these remains occur under many circumstances, but to ascertain all the conditions under which they lived, requires attention to many sorts of strata not often suspected to contain remains. Very remarkable conditions occurred when the old red sandstone ceased to be deposited: for then, after a long series of formations, with no trace of organic remains, we find in the beds immediately above, thousands of minute Crustaceans, bone beds, layers of Brachiopoda, &c. of marine origin; and encouraged by this example, we may expect to find them in beds of still higher antiquity.

A paper was read by Mr. W. Walker, on the *Geological Changes produced by the* Saxicava rugosa *in Plymouth Sound.*—The *S. rugosa* appears to be the prevailing perforator of the limestone rocks, and it is the author's opinion that these operations have been carried on during such long periods as to destroy rocks, and make deep water where shoals previously existed.

*An account of the Fossil Organic remains of the southeast coast of Cornwall and of Bodmin and Menheniott*, by C. W. Peach.—The line of coast examined commences at Veryan, four miles south of Tregoney, and extends eastward by Gorran, the Blackhead, and Fowey, to East Looe. The cliffs are composed throughout of quartzose and slaty rocks, hitherto supposed by Mr. Conybeare and others to be destitute of fossils. But along the whole line, Mr. P. has detected traces of Brachiopodous shells and corals, and the stems of encrinites are of frequent occurrence. From Veryan to Gorran the quartzose rocks rarely contain traces of shells, but in the calcareous slates in contact with dykes of greenstone at Blackhead, remains of corals resembling Turbinolepsis, and of the genera Cyathocrinus, Spirifera, and Orthoceras occur. Eastward, at Pridmouth, a fine specimen of the Platycrinite was found, with the column, pelvis, arms, &c. In the slate quarries of Fowey, remains supposed to be those of fish, and corals of the genus Favosites were detected. Near Polman, occur encrinital stems nearly a foot long, together with remains of trilobites, corals of the genera Cyathophyllum, and Favosites, Spirifers, Orthoceras, and a fossil with a structure resembling that of the Sepiadæ. At Pentlooe, an equal-valved bivalve, resembling Uncula, and a species of Orthis, have been found; and at East Looe another fine specimen of an encrinite, with column, arms and tentacula attached; also specimens of Cyathocrinus, Fenestella, Turbinolopsis and Orthis. At Bodmin, the author has detected encrinites in the slate quarries, and in those of Menheniott in Liskeard the eye of a trilobite in good preservation. On the beach below the cliffs at Port Mellin, near Mevagissey, the author observed traces of a lacustrine deposit, containing roots and branches of trees, and the elytra of beetles, exposed after a heavy gale.

A letter was read from Mr. T. B. Jordan, of the Museum of Economic Geology, *on copying Fossils by a galvanic deposit.*—In applying the method ordinarily used in electrotyping, some difficulty was experienced by the author in consequence of the irregular form of the fossils, parts of which would not relieve from the wax or plaster matrix in which the copper is afterwards deposited. Mr. J. therefore adopted a compound of glue and treacle, (used by printers for their inking rollers,) as the material of the moulds, the elasticity of which admits of its leaving the adherent portions without breaking. The mixture is applied hot, and allowed to harden for twenty four hours, when it will come off without injuring the finest parts. The matrix thus prepared requires a strong varnish to protect the back and sides from the action of the liquid in which it is to be placed, and only one copy can be made from each matrix, but the impressions have none of the defects so apparent in those produced in the ordinary moulds. Different lights and shades may be given to the copper impressions, by a galvanic process, which the author considers capable of improvement, and application to other purposes. For a dark object on a light ground, the surface is brushed over with the argento-cyanide of potassium, giving it a silver face, which may be removed to the desired extent from the portions requiring to be dark, by a dilute solution of nitro-muriate of platinum. Other tints may be produced by using a solution of gold; and all may be considerably varied by changing the time during which each solution is allowed to act.

Prof. Owen communicated the second and concluding portion of his *Report on British Fossil Reptiles.* After some prefatory observations on the general nature and affinities of the recent and extinct reptilia, and the parts of the organization of the latter, which by their modifications afford the best character for their determination, the author proceeded to give a recapitulation of the leading peculiarities of the *Enaliosauri*, which formed the subject of the first part of his Report: and a brief summary of the results of the labors of previous geologists and anatomists, in the field which the second part of his Report had led him to explore. The first section of the Report was devoted to a description of a large reptile, the type of a new genus, to which the name *Pliosaurus* was given, and which formed the link connecting the Plesiosaurus with the crocodile family. The most conspicuous character of this genus consists in the cervical vertebræ, which are considerably shorter than those of the dorsal region: in this respect it differs from all recent Saurians, the vertebræ of which are characterized by retaining the same length throughout. From this cause, the neck of the Pliosaurus is short, compared with that of the Plesiosaurus, and approaches the condition of that region in the Ichthyosaurus. The more crocodilian proportions of the teeth also distinguish it from the Plesiosaurus, which in other respects it strikingly resembles. Remains of it have been found in the Kimmeridge clay of Market Rasen, Weymouth, and Shotover. From differences in the relative proportions of these bones, Prof. O. considers them to have belonged to two distinct species of Pliosaurus. The remains of the Saurians of the crocodilian family, which complete the transition from the Enaliosaurians to the terrestrial lizards, were next noticed. The Report included descriptions of the fossil crocodiles in the British formations below the eocene tertiary strata to the oolite inclusive; and it was observed, that the extinct species deviated from the organic type of the existing crocodiles, in proportion as their remains occurred in strata geologically more remote from the present time. Not any of the species were identical with those now known to exist, and the modifications of structure in which they differed, were much more considerable than any which distinguish the skeletons of existing species from each other. The extinct species agreeing with the present crocodiles in possessing the ball-and-socket articulation of the vertebræ, in which the cavity is on the fore part, were first described. Of these, the *Crocodilus Toliapicus* is found in the London clay of Bracklesham, at Sheppey, and in beds of sand underlying the red crag at Kyson. The *Crocodilus cultridens* of the Wealden formation Prof. O. now considered sub-generically different from the crocodiles, and proposed for it the name of *Suchosaurus*. *Goniopholis crassidens*, another species from the Wealden, was described by Prof. O. as more completely mailed than any of the crocodile family; its remains occur in the Tilgate Forest and near Battle Abbey, and in the Purbeck limestone at Swanage. The next family of extinct crocodilians considered by Prof. Owen, are characterized by the biconcave structure of the vertebræ. Remains of the first of these, *Teleosaurus Chapmanni*, are abundant in the lias of the Yorkshire coast; and *T. Cadonensis*, which abounds in the oolitic formations near Caen, in Normandy, also occurs in the oolite near Woodstock, and at Stonesfield. Remains of two other species were noticed. The second genus, Steneosaurus, distinguished from the last by the sub-terminal position of the nostril, is from the Kimmeridge clay at Shotover, and from the oolite of Stonesfield. One of the most interesting specimens, exhibiting the form of the brain in a cast of that part, is in the Woodwardian Collection at Cambridge. A third division was for the first time described as occurring in British strata, possessing the ball-and-socket articulation of the vertebræ, but with the position reversed, to which the name *Streptospondylus* has been given by Von Meyer. It has been found in the lias near Whitby, and the oolite near Chipping Norton. Prof. Owen next proceeded to describe the remains of some gigantic Saurians, ranging from the greensand to the oolite, and which rivalling the modern whales in bulk, may be presumed to have been of strictly aquatic, and probably of marine habits. They have the biconcave structure of the vertebræ, and the long bones show no trace of a medullary cavity. Of the first of these, named by Prof. Owen, *Cetiosaurus*, (described in report of *Proc. Geol. Soc.*) the vertebra and other bones, found in the lower oolite of Chipping Norton, belonged probably to an individual forty feet in length. Prof. O. has assigned to this species the name of *C. hypoölithicus*; and to another species the name of *C. epioölithicus*, remains of which, including a vertebra eight inches in length of body, and nine inches in transverse diameter, occurs in the Yorkshire oolite at White Nab. The ninth section of the Report was devoted to the description of a large marine Saurian, teeth of which were frequent in the chalk of Barnwell, and in Sussex, in the Folkstone galt, and the lower greensand near Maidstone. From the structure of the teeth, Prof. O. had assigned to it in his "Odontography," the name of *Polyptychodon*. Several bones of a gigantic Saurian, discovered by Mr. Mackeson in the greensand quarries near Hythe, were considered as probably belonging to the same genus. Of the genus *Mosasaurus*, only a few vertebræ have been found in the English chalk formation. Teeth, resembling those of the Mosasaurus, but differing in the elliptic form of the base of the crown in a transverse section, have been found in the chalk of Norfolk, and were described by the generic appellation, *Leiodon*. The report next proceeded to the account of the extinct species, which manifested, in the enduring parts of their organization, an intimate relationship with the numerous and varied tribes of the smaller and lower organized Saurians of the present epoch, to which the term *Lacertians* or *Squamate Sauria* were applied. Prof. O. observed that in this, as in the foregoing divisions of the Saurian order, the ancient world possessed very singular and also very gigantic species, which have now utterly perished, and have given place to carnivorous and herbivorous quadrupeds of more active habits and higher organization. The first fossils noticed, were referred to a small genus of Lacertians from the chalk formation in Cambridge and Maidstone, to which Prof. O. had given the name *Raphiosaurus;* a portion of the lower jaw containing twenty two awl-shaped teeth, and another specimen consisting of twenty dorsal, two lumbar, two sacral, and a few caudal vertebræ, with the pelvic bones, were described. Part of the lower jaw, with teeth, of another lizard about as large as the Iguana, was described as occurring in the eocene sand under the red crag at Kyson. Remains of a Lacertian were next described from the celebrated oolite at Stonesfield. The structure of these bones indicates a close affinity to the scincoid lizards, the largest forms of which now exist in Australia, where they are associated with Araucariæ and Cycadeous plants, with living Clavagellæ, Terebratulæ, and Trigoniæ, and with the peculiar marsupial quadrupeds, the remains of all which forms of organized beings characterize the same stratum and locality as does the present extinct Lacertian. Prof. O. next proceeded to notice the more remarkable and gigantic forms of terrestrial Saurians of the same period, from the eocene tertiary to the oolites. Of these, the Megalosaurus, Iguanodon, and Hylæosaurus had been described by their original discoverer, Dr. Mantell, and by Dr. Buckland in his 'Bridgewater Treatise.' Prof. O. after pointing out additional peculiarities of structure discovered in specimens subsequently found, and the new localities from which these specimens were derived, observed that the name *Iguanodon*, by conveying the idea of a gigantic *Iguana*, created an erroneous idea of its affinities. No existing lizard differed more from the Iguana than did the Iguanodon, in the absence of the ball-and-socket joint of the vertebræ, and likewise in the structure of the teeth, which is characterized in the gigantic extinct herbivorous reptile by numerous parallel medullary canals. The femur of the Iguanodon, in the process continued from the inner side, near the upper third of the bone, deviates from all modern Lacertians, and approaches nearer the crocodiles, but surpasses them in the development of the ridge in question. A detailed description of the skeleton, founded upon nearly all the remains of the Iguanodon yet discovered, was next given; the form of the claw-bones of the Iguanodon, and especially of some enormous ones recently discovered with other bones at Horsham, was described, and from a comparison of these with other specimens from the Isle of

Wight, and with those preserved in the slab containing the Maidstone Iguanodon, Prof. O. stated it to be his opinion, that the animal did not possess the peculiarity of having the fore legs provided with compressed, and the hind legs with depressed claws, but that the narrow compressed curved claws occasionally found in the Wealden, belonged to another extinct reptile. This section of the Report concluded with a notice of all the British localities, and the strata in which those remains had been discovered. The anatomical peculiarities of the Hylæosaurus, another large extinct reptile of the Wealden clay, discovered by Dr. Mantell, were next described; and an account of the microscopical structure of the dermal bones was given. This remarkable reptile combines the sub-biconcave structure of the vertebræ, with crocodilian scutæ, and a plesiosauroid form of the scapular arch. The teeth not uncommonly found in the Wealden strata, formerly supposed to belong to the *Phytosaurus cylindricodon* of Jaeger, and more recently to the genus *Rhopalodon* of Fischer de Waldheim, Mr. O. showed to be quite distinct from both, and stated that if they were not the teeth of the *Hylæosaur*, they must belong to some unknown genus of Lacertine Saurian. The remains of the genera *Thecodon* and *Palæosaur*, from the magnesian conglomerates near Bristol, and of the genus *Cladeiodon* from the Keuper sandstone of Warwickshire, were next described. These were the most ancient of the Saurians yet discovered in Great Britain, and although they differ from modern Lacertians in the implantation of their teeth in distinct sockets, agreed with them in the form and structure of the teeth. The last genus of Saurians described, (*Rhynchosaurus, O.*) is new to science, and the remarkable peculiarities of its cranial anatomy, together with its vertebral characters, and the structure of the ribs, and some of the long bones, were given in detail. Characters of the crocodile, lizard and tortoise were combined in the forms and connexions of the bones of the skull, a nearly entire specimen of which had been transmitted by Dr. O. Ward, of Shrewsbury, to Prof. Owen from the Grinsill quarries of the new red sandstone, where the foot prints of a reptile agreeing in size with the Rhynchosaurus were not uncommon. Reasons were adduced showing the high probability that they were the foot prints of the Rhynchosaurus: they differ in shape from those of the Chirotherium, which were shown, in the concluding part of the Report, to belong to Prof. Owen's new genus *Labyrinthodon.* In the seventeenth section of the present Report, were described the remains of the flying reptiles (*Pterodactylus macronyx*) from Lyme Regis and the oolite of Stonesfield. Some remains of undetermined Saurians from the bone bed at Aust Passage, and other localities, were noticed. The nineteenth section contained an account of the fossil Emydes, Trionyces, and Cheloniæ, hitherto discovered in British strata. The *Chelonia Harvicensis*, and two new species (*C. breviceps* and *C. acutirostris*) from the eocene clay at Sheppey, were described; and the characters of a new genus, (*Cimochelys,*) the remains of which are found in the chalk near Maidstone, were given in detail.

The indications of Chelonian reptiles in more ancient strata were then noticed, and the femur of a tortoise, from the new red sandstone near Elgin, was described. The fossil reptiles of the order Ophidia, discovered by Mr. Owen in the London clay at Sheppey, have already been noticed; to these were added descriptions of a smaller species of *Palæophis*, from the eocene sand at Kyson, and of a much larger species not less than twenty feet in length, from the London clay at Bracklesham. The last section of the Report was chiefly devoted to the details of the determination of remains of the fossil Batrachians, identical with the so-called genera *Mastodonsaurus* and *Salamandroides* of the German Keuper, and on which the characters of the genus Labyrinthodon are based. Reasons were given, showing the high probability that the foot prints referred to the Chirotherium, were those of the Batrachian genus Labyrinthodon.

The following papers were also communicated:

On the Post-Tertiary Formations of Cornwall and Devon, by Mr Bartlett.

On the stratified and unstratified volcanic products in the neighborhood of Plymouth, by Rev. D. Williams.

On the genus Cardinia of Agassiz, as characteristic of the lias formation, by H. E. Strickland.

On the discovery of organic remains in a raised beach, in the limestone cliff under the Hoe, at Plymouth, by E. Moore, M. D.

Account of the strata penetrated in sinking an Artesian well at the Victoria Spa, Plymouth, by Edward Moore, M. D.

Notice of the discovery of some fossils on Great Hangman Hill, near Combe Martin, North Devon, by Major Harding.

## Sect. D. *Zoology and Botany.*

*On the Geographical Distribution of the Animals of New Holland*, by Mr. Gray.—Of the ninety four species of mammalia, (belonging to thirty three genera,) which are found in Australia, it appears that fifty eight inhabit New South Wales, of which forty one are peculiar to it, and thirteen common to it, and other parts of the country; twelve species inhabit South Australia, six are peculiar, and six are common to other parts. Nineteen species inhabit Western Australia; twelve peculiar, and seven common. Five species inhabit the Northwest coast, all of which are peculiar to it; two species the north coast, one of which has not been found elsewhere. In Van Diemen's Land are found twenty one species; eleven are found only in that country, and ten common to it and the continent. One species is found in Norfolk Island, which is also found in New South Wales, but not in Van Diemen's Land.

*On two remarkable marine invertebrata inhabiting the Ægean Sea*, by Mr. E. Forbes.—These animals were taken in the harbor of Nousa, in the island of Paros, which is extremely rich in marine productions. The depth of the bay is generally from seven to ten fathoms; the bottom, sand and weed. Amongst the sandy heaps at the bottom of this bay are two new animals. The first, a zoophyte of the family Actiniadæ, which is free and vermiform, and which lives in a tube of its own construction,—a combination of characters hitherto unnoticed among the helianthoid polypes. The second is a tubicolar annelide, which lives in a strong gelatinous tube, bearing a remarkable analogy to the sac of certain entozoa. These two animals are noticed together, as in each case the peculiarity of the organization and habits is the result of a similar adaptation of form, in two very distinct tribes, to a similar locality.

*On a new Glirine Animal from Mexico*, by J. E. Gray.—This animal was brought from Mexico by Mr. J. Phillips, and is peculiar for having large cheek pouches which open externally on the sides of the cheek. This conformation has hitherto been observed only in four genera of glirine animals, which inhabit exclusively the northern half of the American continent, as the genera Saccophorus, Saccomys, Anthomys, and Heteromys. These cheek pouches are used by the animals to carry their food, as the monkeys of the Old World use their internal pouches, which are found between their cheek and the mouth. The first of these genera has been long known; and it has been believed that these cheek pouches hung out of the side of the cheek like pockets; but this does not appear to be the case with the genus under consideration, or with the Anthomys, which was so called because F. Cuvier found their cheek pouches filled with flowers. If it were not for these cheek pouches, the animal before us might be taken for a Gerboa, with which it perfectly agrees in the softness and color of the fur, and in the length of the hind-legs and tail, which has a brush at the end, so that it may be at once distinguished from the other American genera, above enumerated, which either have an elongated scaly tail, like a rat, or a very short one, like a lemming. Mr. Gray is inclined to consider this animal as the representative of the genus (Dipus) Gerboa, which is confined to the more temperate part of Africa, as the genus Harpalotis is representative of the same genus in Australia. The combination of the forms and color of the Gerboa with the external cheek pouches of the pouched rat, at once marks this animal as a new genus, which I propose to call Dipodomys or Gerboa rat, designating the species after its discoverer, ***D. Phillipsii.***

Col. Hamilton Smith read a paper *on the Colossal Sepiadæ.*— He detailed all that was known of the existence of animals of enormous size, inhabiting the ocean, belonging to the class of Cephalopods. However incredulous some naturalists might be regarding the existence of these animals, he had collected sufficient evidence to convince him that animals of a very large size belonging to this class now inhabited the waters of the ocean. The paper was illustrated by numerous drawings, and one was a sketch of the beak and other parts of an enormous Sepia, still preserved at the Museum of Haarlem, where they were seen by the author.

The following papers were also read:

Some inquiries on the Natural History of the Wheat Midge, Cecidomyia Tritici, by Prof. Henslow.

On the zoology of the county of Cornwall, by J. Couch.

On some species of European Pines, by Capt. Widdington, R. N.

On the existence of organic beings in mineral waters, by Dr. Lankester.

Report on the drawing up, printing and circulating of queries concerning the human race, for the use of travellers and others.

Report of the Committee on the growth and vitality of seeds.

On the habits of the eel, and on the freshwater fishes of Austria, by Capt. Widdington, R. N.

On animal exhalations as affecting plants, by Mr Ball.

On natural history as a branch of general education, by Mr. R. Patterson.

Scheme for yearly observations on the periodicity of birds, by M. de Longchamp, of Liege.

Comparative view of animal and vegetable physiology, by Mr. Bartlett.

Remarks on the Flora of Devon and Cornwall, by Rev. W. S. Hore.

Account of a Thylacinus, the great dog-headed opossum, one of the rarest and largest of the marsupiate family of animals, by Prof. Owen.

Account of two Peruvian mummies, by Mr. P. F. Bellamy.

On the varieties of the human race, by Dr. Caldwell.

## Sect. E.—*Medical Science.*

The following papers were communicated to the Section.

Facts as yet unnoticed in the treatment of squinting, by Mr. J. V. Solomon.

General observations on the pathology and cure of squinting, by J. Butter, M. D.

A case of albuminous Ascites, with Hydatids, by Sir David Dickson.

Observations on a pustular disease hitherto undescribed by writers on diseases of the skin, by Dr. A. T. Thomson.

Report on poisons, by Dr. Roupell.

On the treatment of Rheumatism by opium, by Dr. Theophilus Thompson.

On Empyema, by Mr. Square.

On two fasciæ on the eyeball, by Mr. B. Lucas.

Some observations on a case of deafness, dumbness and blindness, with remarks on the muscular sense, by Dr. Fowler.

## Sect. F. *Statistics.*

The following papers were communicated to the Section.

Statistics of Plymouth, Stonehouse and Devonport, by Mr. H. Woolcombe.

On the vital statistics of Sheffield, by a local committee.

Account of the Polytechnic School of Paris, by J. Heywood, Esq.

On the loan funds in Ireland, by Mr. H. J. Porter.

On the income of scientific and literary societies, and the amount paid for rates and taxes in the year 1840, by Mr. Ryland.

Account of the Central Statistical Commission in Brussels, by the Belgian government; from Prof. Quetelet.

Results of experiments on a system of small allotments and spade husbandry, by Mrs. Davies Gilbert.

On the agricultural products of Cornwall, by Sir C. Lemon.

Report of the Manchester Statistical Society, on the state of the working classes in the borough of Kingston-upon-Hull.

Statistics of education in the city of Bristol, by Mr. Fripp.

Comparative statement of the income and expenditure of certain families of the working classes in Manchester and Duckenfield, during the years 1836 and 1841, by Mr. W. Neild.

Account of the Monts de Piété of Rome, Paris, and other continental cities, by Mr. Porter.

On the stipends of the clergy of the Established Church in Scotland.

Address on the importance of keeping exact registers, in different districts, of facts in meteorology, physics, chemistry, botany, agriculture, zoology, human physiology and economy, by Prof. Quetelet.

On the economic statistics of Sheffield.

## Sect. G. *Mechanical Science.*

Mr. G. Rennie read a paper on *the Propulsion of Vessels by the Trapezium Paddle-wheel and Screw.* The author gave an account of the various experiments to which he had been led, on the propulsion of vessels by various forms of paddle-floats and by the screw. It was generally admitted that the paddle-wheel is the best means of propulsion with which engineers are at present acquainted, and various attempts have been made for its improvement. There are several objections to the square or rectangular floats, particularly the shock on entering the water, and the drag against the motion of the wheel on the float's quitting the water; both of which gave rise to considerable vibrations. He had been led, in considering the improvement of the paddle-wheel, to have recourse to nature; and the form of the foot of the duck had particularly attracted his attention. The web of the duck's foot is shaped so that each part has a relation to the space through which it has to move, that is, to the distance from the centre of motion of the animal's leg. Hence he was led to cut off the angles of the rectangular floats; and he found that the resistance to the wheel through the water was not diminished. Pursuing these observations and experiments, he was led to adopt a float of a trapezium or diamond shape, with its most pointed end downwards. These floats enter the water with their points downwards, and quit it with their points upwards, and then arrive gradually at their full horizontal action, without shocks or vibrations, and after their full horizontal action, quit the water without lifting it or producing any sensible commotion behind. After a great variety of experiments, he found that a paddle-wheel of one half the width and weight, and with trapezium floats, was as effective in propelling a vessel as a wheel of double the width and weight with the ordinary rectangular floats. The Admiralty had permitted him to fit Her Majesty's steam-ship *African* with these wheels, and he had perfect confidence in the success of the experiment. Another means of propulsion is the *screw*, which had been applied with success by Mr. Smith in the *Archimedes*. In examining the wings of birds and the tails of swift fish, he had been particularly struck with the adaptation of shape to the speed of the animals. The contrast between the shape of the tail of the codfish—a slow moving fish, and the tail of the mackerel—a rapid fish, is very remarkable; the latter going off to a point much more rapidly than the former. From these observations he was led to try a screw with four wings of a shape somewhat similar to these, but bent into a conical surface, the outline being a logarithmic spiral. He found also that certain portions of these might be cut off without diminishing the effect. With respect to ascertaining the friction of the screw on the water, great difficulty exists; but he would refer to his experiments, published some years ago in the Philosophical Transactions, in which he measured the friction of the water against a body revolving in it, by the time which a given weight took to descend; this body consisted of rings, and he found that the friction or resistance through the water did not increase in proportion to the number of rings.

The following papers were also communicated.

Report on railway constants, by Dr. Lardner.

Remarks on the connexion which exists between improvements in pitwork and the duty of steam-engines in Cornwall, by Mr. Enys.

On Mr. Truscott's plan for reefing paddle-wheels, by Mr. Chatfield.

On a plan of disengaging and reconnecting the paddle-wheels of steam-engines, by Mr. J. Grantham.

On a floating breakwater, by Capt. Taylor, R. N.

Further report of the committee on the forms of vessels, by Mr. J. S. Russell.

On an improved sight for rifles and other fire-arms, by Mr. C. T. Coathupe.

On Capt. Couch's chock channels, by Mr. Snow Harris.

On Arnott's stove, and the construction of descending flues, and their application to the purposes of ventilation, by Mr. J. N. Hearder.

Report of the committee on railway constants, by Mr. Edward Woods.

On the granite quarries of Dartmoor, and their railways and machinery, by Mr. W. Johnson.

Report of the committee for applying a principle of Dynamometrical admeasurement, invented by M. Poncelet, to the construction of a permanent indicator for steam-engines.

On a system of trussing for the roadways of suspension bridges, by Mr. Rendel.

On the Plymouth breakwater, by Mr. Wm. Stuart.

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## ART. XIV.—*An Astronomical Machine, the Tellurium;* by EDWIN C. LEEDOM, M. D., of Plymouth, Penn.

THIS is a machine for representing the motions of the earth and moon. The earth, whose axis has its proper obliquity to the ecliptic and keeps its parallelism, revolves round the sun in an ellipsis similar to the natural orbit, and moves with such a velocity that an imaginary line joining the centres of these two bodies, the latter being situated in one of the foci of the orbit of the former, describes equal areas in equal times. The diurnal rotations of the planet are also shown, each complete turn on its axis being made in a sidereal day, or 23h. 56m. 4s. The moon moves eastward round the earth and completes a sidereal revolution in 27d. 7h. 43m.; its nodes shift round contrary to the order of the signs, and its apogee has its direct motion eastward, the former completing a sidereal revolution in 18.6 years, and the latter in $8\frac{17}{20}$ years.

In contriving this machine I have availed myself somewhat of the inventions of other artists. To effect the unequable motion of the earth in its orbit, I have had recourse to a combination of elliptical wheels similar to that used by Dr. Desaguliers in his Cometarium. There is a little Planetarium described in Ferguson's Astronomy, in which the parallelism of the earth's axis is preserved in the same manner as in this. But this machine, independently of the elliptical orbit and unequable motion of the earth, is very different from that, as will be apparent to any one who may compare them.* (See Brewster's Ed. Ferg. Astron. Vol. II, p. 6.) Although these particular parts are the inventions of preceding artists, still I think I may venture to assert, that this machine, considered as a whole, constitutes a new combination in mechanics.

In Plate IV, this machine is represented as it would appear to an eye situated directly above it. Plate V exhibits a lateral view of the wheelwork. In either plate the ball W represents the sun, the ball U the earth, and V the moon: *k* is an index for showing the place of the moon's ascending node, *e* is another index for showing the place of its apogee, and *n* is a winch by which the machinery is moved. The earth is surrounded by a little brass ring *s*, which is set upon four pillars *t t*, and has the signs of the zodiac marked upon it. Upon this ring, which moves with the earth and keeps its parallelism, the geocentric places of the sun, moon, its ascending node and apogee, can be seen. 1 2 3 4, Plate V, is a wooden frame, in the top of which are two equal elliptical grooves similar to the earth's orbit, and which have their foci all situated in one straight line. Within the frame are two elliptical wheels, K and L, which are of the same size and eccentricity as these grooves, each wheel having its axis

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* About fourteen years ago I made the first machine of this kind. At that time and for several years after, I believed myself to be the original inventor of this mode of preserving the parallelism of the earth's axis, but I was at length undeceived by a perusal of Ferguson's book.

situated in one of its foci. The axis of the wheel L also carries a large circular wheel M; next to which is placed a pinion N, upon the upper end of whose axis the winch *n* is fixed. Q is a stout metallic axis of the same size as that which carries the wheel K. These two axes pass perpendicularly through the boards 1 and 3, the upper part of each axis where it comes through the board 1 being situated in one of the foci of one of the elliptical grooves. Upon the upper ends of these axes two arms *h* and *i* are tightly fixed. Two other arms R and S are fixed upon their lower ends so as to be perpendicular to *h* and *i*. T is a narrow metallic plate which is connected with the arms R and S by two movable joints: this plate assists in regulating the motion of the machine. Into the arms *h* and *i*, are inserted two axes *f* and *g*, which pass up through a movable frame 5 6 7 8 and turn freely within it. The lower ends of these axes project into the elliptical grooves in the board 1 and slide along these grooves when the machine is in motion, the arms *h* and *i* being so contrived as either to lengthen or shorten according as the distance of the groove from its focus increases or diminishes.

The movable frame 5 6 7 8 contains a number of wheels, which serve to rotate the earth on its axis and give motion to the moon, its nodes and apogee. A metallic supporter Y has inserted into it a long and narrow socket, which passes up through a hole in the plate Z. Upon the upper end of this socket a small brass arm *a* is fixed, which holds a pinion *o*, whose axis forms an angle of 23½ degrees with the perpendicular, and carries the earth U. C is a pinion whose axis passes up through this socket and is surmounted by a very small wheel whose teeth act upon the leaves of the pinion *o*. D, F, and H, are three wheels, each of which is fixed upon a separate socket. The socket of the wheel D turns upon the socket which is fastened into the supporter Y. The socket of F turns upon the socket of D; and the socket of H turns upon that of the wheel F. Upon the upper end of the socket of D a small circular brass plate *c* is fixed, into which, near its edge, is inserted a small flattened socket, through which passes a flattened wire which carries the moon V. The lower end of this wire rests on another circular plate *d*, which is fixed upon the socket of the wheel F and has an oblique position, forming an angle of 5½ degrees with a horizontal plane passing through its centre. This wire is kept constantly applied to the plate *d* by means of its own gravity, and slides along this plate as *c* turns round, the wire alternately rising and falling in its socket; consequently the orbit in which the moon V moves must always be parallel to the plate *d*, and form an angle of 5½ degrees with the plane of the ecliptic. The index *e*, which points to the moon's apogee, is fixed upon the socket of the wheel H. The axis *g* carries four wheels A, E, G, and I, which all turn as one wheel. Next to the wheel A is placed the pinion of a wheel B, whose teeth act upon the teeth of a small wheel *p*, which transmits motion to the pinion C. The teeth of the wheel E act upon the teeth of the wheel O, whose axis also carries a wheel P, which gives motion to the wheel D. The teeth of the wheel G act upon the teeth of the wheel F; and lastly, motion is transmitted from the wheel I to the wheel H by means of an intervening wheel *r*.

When the winch *n* is turned by a steady hand, the leaves of the pinion N act upon the teeth of the large circular wheel M, and turn it and the elliptical L on their common axis with an equable motion. The teeth of L at the same time act upon those of the wheel K. As K turns, the arms *h* and *i* both move in the same direction and carry the movable frame 5 6 7 8 parallel to itself, over and over the top of the large stationary frame 1 2 3 4. The earth U is carried along with the moving frame, and has the parallelism of its axis also rigidly preserved. As the ends of the axes *f* and *g* slide round in the elliptical grooves, in the board 1, it is apparent that the orbit described by the earth U, must be an ellipsis of the same size and eccentricity as either of these grooves. When the earth is in its perihelion, as represented in the drawing (Plate V,) that part of the circumference of the elliptical wheel L, which is farthest from its axis and has the greatest velocity, is applied to a part of the circumference of K which is nearest to the axis of the latter wheel, consequently the earth must have its quickest motion. When the earth comes to its aphelion, these elliptical wheels have a reverse position with respect to each other, which gives the earth its slowest motion. These elliptical wheels working together in this manner, give the earth U the same unequable motion in its orbit, that the real earth has in nature.

The wheels A, E, G, and I, all make one complete turn on their common axis *g* during an entire revolution of the earth round the sun. The wheel A contains 293 teeth, and the pinion which belongs to the wheel B contains 8 leaves, consequently B must make $36\frac{5}{8}$ turns during one turn of the wheel A. The wheel B contains 80 teeth, and the pinion C contains 8 leaves; consequently C must make ten turns during one turn of the wheel B, and ten times $36\frac{5}{8}$ or $366\frac{1}{4}$ turns during one revolution of the wheel A, that is, in one year. The little wheel upon the upper end of the axis of the pinion C contains the same number of teeth as the pinion *o*, therefore the earth must turn on its axis in the same time as the pinion C; it must make $366\frac{1}{4}$ diurnal rotations in a year, each rotation being performed in a sidereal day or 23h. 56m. 4s. The wheel E contains 167 teeth, and the wheel O contains 25 teeth. Consequently O, and also the wheel P, must make $6\frac{17}{25}$ turns during one turn of E. The wheel P contains 72 teeth, and the wheel D contains 36 teeth, consequently D must make two turns during one turn of P, and twice $6\frac{17}{25}$ or $13\frac{9}{25}$ turns during one turn of the wheel E, or in one year. As the circular brass plate *c* is fixed upon the socket of the wheel D, this plate must turn with the wheel and carry the moon V $13\frac{9}{25}$ times round the earth U in a year, which is equal to the number of the moon's sidereal revolutions in this time. The teeth of the wheel G act upon the teeth of the wheel F. The wheel G contains 20 teeth, and the wheel F contains 372 teeth, consequently G must make $18\frac{6}{10}$ turns, while F turns once round. As the wheel G makes but one turn on its axis in a year, the wheel F must require $18\frac{6}{10}$ years to perform a revolution. The oblique plate *d*, to which the moon's orbit is parallel, being fixed upon the socket of the wheel F, the plate must turn with this wheel and carry the moon's nodes round contrary to the order of the signs, so as to perform a sidereal revolution in $18\frac{6}{10}$ years. The teeth of the wheel I act upon the teeth of the wheel *r*, which, as before stated, transmits motion to the wheel H. The wheel I contains 20 teeth, and the wheel H contains 177 teeth, consequently I must make $8\frac{17}{20}$ turns in order to turn F round once. As the wheel I makes only one turn in a year, the wheel H must be $8\frac{17}{20}$ years in performing a revolution. The index *e*, which is fixed upon the socket of H, must turn with this wheel and also perform a revolution in $8\frac{17}{20}$ years, which is the time in which the moon's apogee performs a sidereal revolution; therefore, this index will show the proper motion of the apogee.

This machine being rectified by the astronomical tables for any particular time, if the winch *n* be then turned from right to left, the machine will exhibit the vicissitudes of day and night, variety of seasons, new and full moons, eclipses, anomalies of the sun and moon, or year after year.

As the earth has the same unequable motion in its elliptical orbit that the real earth has, this machine will show the sun's true place correctly for a great length of time.

*A table showing the dimensions of the wheels of the Tellurium, number of teeth, &c.*

Wheel A, 293 teeth, 12 teeth in an inch of circum. Diam. 7.77 inches.

Wheel B, 80 teeth, 8 teeth in an inch of circum. Diam. 3.18 inches.

Pinion of wheel B, 8 leaves. Diam. $\frac{21}{100}$ths of an inch.

Wheel *p*, 24 teeth, 8 teeth in an inch. Diam. $\frac{95}{100}$ths of an inch.

Pinion C, 8 leaves. Diam. $\frac{31}{100}$ths of an inch.

Wheel E, 167 teeth, 8 teeth in an inch of circum. Diam. 6.64 inches.

Wheel O, 25 teeth, 8 teeth in an inch. Diam. $\frac{99}{100}$ths of an inch.

Wheel P, 72 teeth, 8 teeth in an inch. Diam. 2.86 inches.

Wheel D, 36 teeth, 8 teeth in an inch. Diam. 1.43 inches.

Wheel G, 20 teeth, 12 teeth in an inch of circum. Diam. $\frac{53}{100}$ths of an inch.

Wheel F, 372 teeth, 12 teeth in an inch. Diam. $9\frac{86}{100}$ inches.

Wheel I, 20 teeth, 8 teeth in an inch of circum. Diam. $\frac{79}{100}$ths of an inch.

Wheel H, 177 teeth, 8 teeth in an inch. Diam. $7\frac{4}{100}$ inches.

Wheel *r*, 40 teeth, 8 teeth in an inch. Diam. $1\frac{59}{100}$ inches.

Elliptical wheels K and L. The longer diameter of each wheel, 10 inches. Distance between the two foci $\frac{17}{100}$ths of an inch. Both of these wheels contain the same number of teeth.

Wheel M, 280 teeth, 8 teeth in an inch. Diam. $11\frac{14}{100}$ inches.

Pinion N, 16 leaves.

Elliptical grooves in the board 1. The longer diameter of each groove, measuring from the middle of the groove on one side to the middle of the groove on the opposite side, 10 inches. Distance between the two foci $\frac{17}{100}$ths of an inch.

## Art. XV.—*Abstract of a Meteorological Journal, for the year* 1841, *kept at Marietta, Ohio, Lat.* 39° 25′ *N., Lon.* 4° 28′ *W. of Washington City;* by S. P. Hildreth, M. D.

| Months. | Thermometer. Mean temperature. | Thermometer. Maximum. | Thermometer. Minimum. | Fair days. | Cloudy days. | Rain and melted snow. Inches. | Rain and melted snow. 100ths. | Prevailing winds. | Barometer. Maximum. | Barometer. Minimum. | Barometer. Range. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January, | 32.47 | 59 | –4 | 10 | 21 | 3 | 87 | N. W., W., S. W. | 30.10 | 28.98 | 1.12 |
| February, | 33.00 | 57 | 8 | 14 | 14 | 1 | 31 | N. W., S. W. | 29.70 | 28.90 | .80 |
| March, | 42.33 | 80 | 16 | 18 | 13 | 3 | 42 | S. W., E., S. E. | 29.80 | 28.95 | .85 |
| April, | 46.66 | 82 | 24 | 17 | 13 | 5 | 80 | N., S. W. | 29.80 | 28.75 | 1.05 |
| May, | 60.20 | 92 | 30 | 26 | 5 | 3 | 37 | N., S. W., S. | 29.50 | 29.05 | .45 |
| June, | 75.27 | 94 | 50 | 22 | 8 | 4 | 30 | N., S. W., S. | 29.52 | 29.20 | .32 |
| July, | 71.43 | 92 | 53 | 21 | 10 | 3 | 50 | S., S. W., N. | 29.60 | 29.25 | .35 |
| August, | 70.53 | 90 | 51 | 23 | 8 | 3 | 17 | N., S., S. E. | 29.65 | 29.30 | .35 |
| September, | 66.28 | 91 | 51 | 20 | 10 | 3 | 37 | S., S. E., N. | 29.63 | 29.05 | .58 |
| October, | 48.44 | 78 | 24 | 18 | 13 | 1 | 83 | S., S. E., N. | 29.75 | 29.05 | .70 |
| November, | 43.20 | 79 | 21 | 10 | 20 | 3 | 50 | W., S. W. | 29.75 | 28.90 | .85 |
| December, | 36.33 | 60 | 13 | 6 | 25 | 5 | 38 | S. W., S. E. | 29.75 | 28.78 | .97 |
| Mean, | 52.18 | | | 205 | 160 | 42.82 | | | | | |

### *Remarks on the year* 1841.

The past year has not been remarkable for any striking changes in the temperature, or commotion in the elements. The mean heat for the year is very near that of this climate for a series of years, being 52.18°. The distribution varies very considerably, as it is divided amongst the seasons; some springs being cool, others warm; so also with summers and autumns, while the general amount varies but little in different years. The winter was comparatively mild, the mercury sinking below zero only on two mornings during this period. The mean is 32.51°, being two degrees cooler than that of 1840. There fell but eight or ten inches of snow at different times. The Ohio river at Marietta was closed only for a few days by the ice—from the 3d to the 8th of January, but navigation was impeded by floating ice as early as the 21st of December. In February, there was some severe weather, from the 10th to the 15th of the month. The mercury was at 8° above zero on the morning of the 11th, and only 12° above at noon; at this period we often have the coldest weather in the year. The Ohio was again filled with floating ice, and for a few days boats ceased to run; after the 20th of the month, the river was free from ice until the breaking up of the Alleghany river. The Ohio has at no time been over its banks; on the 30th of March it was nearly "full banks."

The mean temperature for the spring months, was 49.73°, which is several degrees below that of 1840, or that for the average heat of this place. April was uncommonly cool, being only 46.66°, while the same month in 1840 was 56.57°—a difference of nearly 10°. The consequence was the retardation of the blossoming of fruit and other trees for several days past the usual period. In 1838, the apple bloomed on the 17th of April, and in 1840 on the 15th; while this year it was not in full bloom until the 30th of that month, and did not entirely shed its blossoms before the 20th of May. Other trees were retarded in nearly the same proportion. From the 10th of May to the 11th of June, there fell but little rain, being only about half an inch. The lack of moisture at this season of the year, when the roots of cereal plants are usually in their most vigorous state, was seriously felt in the crops of wheat and grass, especially the latter, which afforded but a small crop compared with other years. Indian corn, owing to the cool and dry weather in May, did but barely appear above ground, as late as the 10th of June, and many farmers feared an entire failure of the crop; but refreshing showers after that period, and the heat of June, soon awakened its dormant powers, and an average crop was obtained in this part of Ohio; while west of us on the Scioto river, this crop was nearly a complete failure, the drouth continuing in the valley of that stream till late in June.

The mean temperature of the summer months was 72.41°; which is nearly 2° above that of 1840. During these months, there was a seasonable supply of rain, and vegetation was healthy and vigorous. The last of June, when the wheat crop had nearly attained its growth, during a period of wet sultry weather, the cuticle of the stem was attacked with a rust or mildew; it appeared to arise from an exudation of the sap, like a heavy dew, on the leaves of forest trees; after a few days, the stalks were covered with minute reddish spots of mould, raising quite a cloud of dust when disturbed by the reapers. This took place while the grain was in the milk; the consequence was, a lack of those nutritious juices which perfect the kernel, and the grain was shrunken and tight, affording an undue proportion of bran when manufactured into flour. Very few fields in the southern portion of Ohio escaped this calamity; while the crops of this grain in the northern part of the state being later in ripening, suffered much less.

The summer was attended with no tornadoes, or violent gusts of wind, to do any material damage.

The mean temperature of autumn was 52.80°, which is about 2½° warmer than that of last year. The warmth of this period gave the Indian corn full time to ripen before the appearance of frost, the first of any severity being on the 18th of October.

Crops of potatoes, beans, and oats, were very good; that of sweet potatoes was uncommonly fine. Fruit was not abundant, being injured by the frosts of May; apples were plentiful in some districts, while in others within a few miles, they were an entire failure. Peaches were quite prolific on the hills back from the river, and near the Ohio, also, if located on the top of a high hill. Trees in this situation rarely fail of producing fruit; and those who set new orchards now, look out for exposures of this kind.

The amount of rain for this year has been $42\frac{80}{100}$ inches, which is about the average for this climate. It is $3\frac{75}{100}$ inches greater than that of 1840, and nearly a foot greater than that of 1839, which was an uncommonly dry year.

A brilliant aurora was observed about the 18th of November, but I did not happen to witness it.

Marietta, Ohio, January 5, 1842.

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Art. XVI.—*The Glacial Theory of Prof. Agassiz;* by Charles Maclaren.*

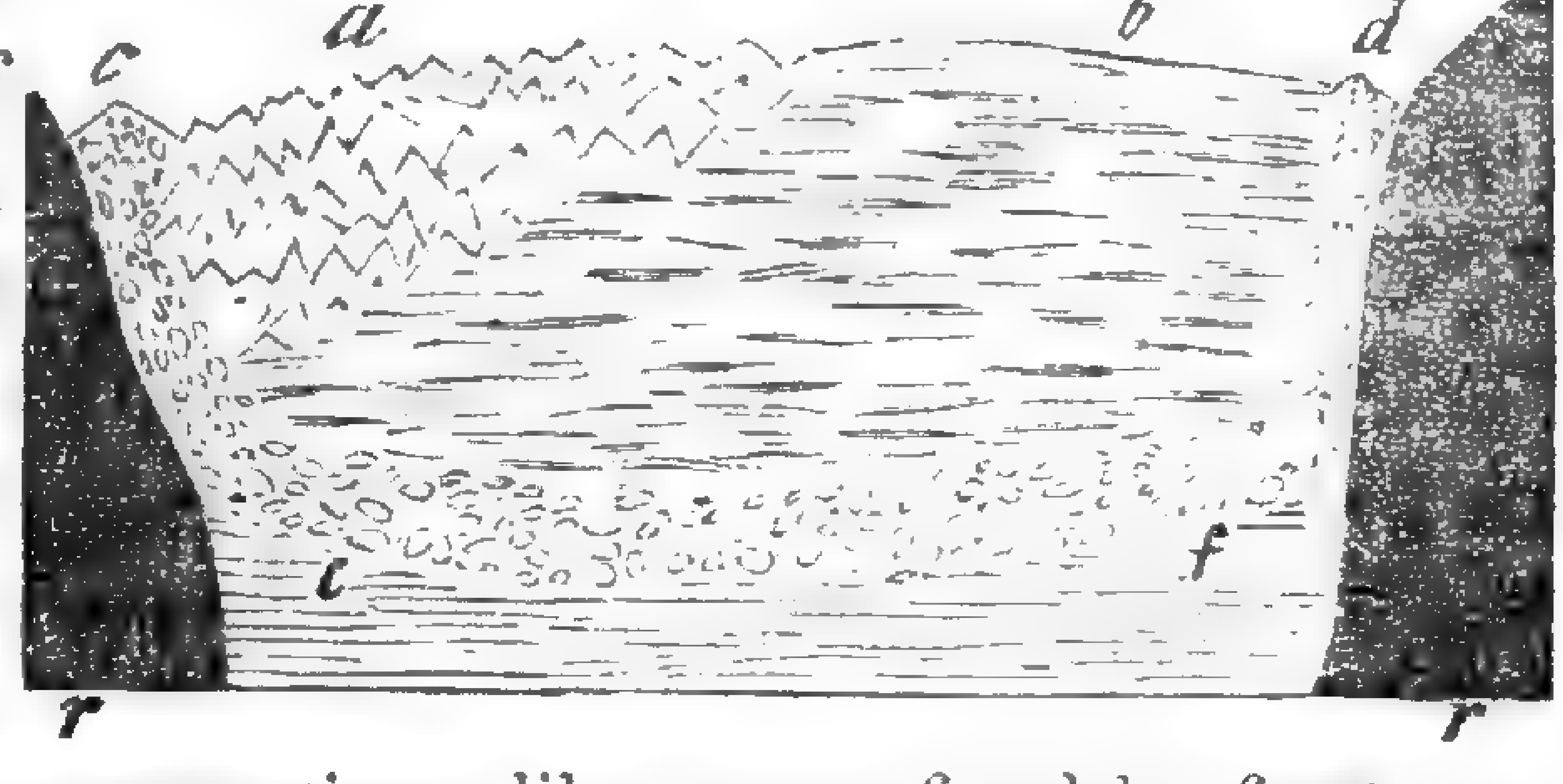
This is perhaps the fittest term to designate the novel opinions of M. Agassiz. Glaciers are properly long narrow masses of ice filling the bottom of Alpine valleys, but M. Agassiz thinks that sheets of ice, such as are met with in Greenland, covered the whole surface of Europe, and all Northern Asia as far as the Caspian Sea. This conclu-

* This article is republished from a little tract which Mr. Maclaren had the kindness to send us, entitled "The Glacial Theory of Prof. Agassiz of Neuchatel, being an outline of facts and arguments adduced by him to prove, that a sheet of ice enveloped the northern parts of the globe at a recent geological epoch; by Charles Maclaren." As it is the best review of the subject which has met our eye, we deem no apology necessary to our readers for republishing it here.—Eds.

sion, which has been adopted in whole or in part by Professor Buckland, Mr. Lyell, and other eminent geologists, has been deduced from a careful study of the phenomena attending glaciers, some of which are of so marked and peculiar a kind, as to afford satifactory evidence of their ancient existence in situations where none are now seen. The Swiss philosopher advanced in his opinions step by step. He first satisfied himself that in the Alpine valleys where glaciers still exist, they once rose to a higher level, and extended farther down into the low country than they now do. Next he discovered indications of their former existence on Mount Jura and over the whole Swiss valley; and connecting these with similar indications found in the Vosges, the Scandinavian Mountains, and elsewhere, and with the well known fact of sheets of ice covering the northern shores of Siberia and entombing the remains of extinct species of animals, he came to the conclusion, that at a period, geologically speaking, very recent, all the old world north of the 35th or 36th parallel, had been enveloped in a crust of ice. Whence the cold came which produced this effect, and why it afterwards disappeared, are questions he did not feel himself bound to answer, but which might, perhaps, be answered hypothetically. In reality, if we suppose the Northern Atlantic from the 39th parallel filled up and converted into dry land, it is extremely probable that Britain would have the ice-bound climate of Labrador, with which it corresponds in latitude; and the conversion of the said land into sea would bring back the order of the seasons which we now enjoy. Even though M. Agassiz's opinions should not be fully established, they still afford us a new geological agent of great power and widely applicable, which may help us to an explanation of some phenomena very difficult to account for with our existing means of information.

*Form, Magnitude and Composition of Glaciers.*—The subjoined figure is not a section, but a view of a glacier as it would present itself to an eye raised considerably above it.

Fig. 1.




*a b*, (fig. 1,) The glacier: *a* represents one of the forms of its surface, in which it is bristled with cones of snow or ice, called *aiguilles* or needles: *b* is the other and more usual form of the surface, consisting of narrow ridges or corrugations, like waves fixed by frost.

*c d*, *Lateral moraines*, consisting of long lines of boulders and gravel, which having been detached by frost, rain, lightning, or avalanches, from the rocks flanking the valley, settle on the two sides of the glacier.

The heat reflected from the rock fuses a portion of the ice nearest it, or hastens the evaporation, rendering the sides of the glacier a little lower than the middle, and giving the mass a convex shape. The fragments rest in the hollows thus produced, and assume the form of the roof of a house, one side sloping down to the rock and the other to the ice.

*e f*, The *terminal moraine*, a line of boulders and gravel at the lower end of the glacier, which it pushes before it when advancing, and leaves behind it when retreating. In the latter case it looks like a low mound or barrier across the valley. The terminal moraine is a continuation of the two lateral, but they are not always found united.

*r r*, The rocks forming the flanks of the valley.

In the higher parts of the Alps, the perpetual snow forms vast extended masses joining the peaks and ridges, and these, called *mers de glace*, or "seas of ice," exhibit scenes of grandeur and desolation which have been the wonder of travellers. The glaciers are branches or offshoots from these, filling the valleys which descend from the higher regions to the lower. Glaciers pass down sometimes to so low a level as 3000 feet above the sea in Switzerland; but they do not originate at a lower elevation than 7000 feet, and they rarely exist on isolated mountains, whatever be their height. In the upper part they consist of granular snow, called *nevé* in the Alps, which is changed into minute crystals of ice by the infiltration of water, arising from the outer portion of the snow being melted by the sun. As we descend from the higher end of the glacier, the crystals, which are rather irregular fragments, become gradually larger. Towards the lower end they are from half an inch to an inch and a half in diameter, and in some rare cases three inches. If a section of the glacier is exposed, the upper strata (for it is generally stratified) are found to be full of cells, and its substance becomes gradually more compact downward, the lowest part being the most solid. The strata are thick at top, thinner in the middle, and disappear towards the bottom. Glaciers contract in breadth and depth as they descend; one a league broad at the head will sometimes be only 150 or 200 yards at the foot. The thickness varies from 80 to 100 feet at the lower, and from 120 to 180 feet at the higher end. M. Agassiz adopts these measures from Hugi, and seems to reject the notion of older writers, that some glaciers are 500 or 600 feet in depth. Glaciers are of all lengths—from 100 yards to 15 miles.

Every glacier discharges a stream from a vault in its lower end in summer, which disappears in winter, except in some cases, where the water is believed to come from deep springs, with a temperature sufficiently high to keep their channels open.

There are numerous open rents or fissures (called *crevasses*) in every glacier, caused partly by the uneven surface over which the glacier glides in its downward motion—partly by the unequal expansion of the upper and under strata of ice. These fissures are of all widths—from a quarter of an inch to thirty feet or more ; they are largest and most numerous at the sides, but sometimes extend completely across ; they occasionally reach from top to bottom, but more frequently stop at a certain depth. Their direction is generally across the glacier, but they often become oblique at the sides, as the ice moves faster there than at the middle ; and hence, viewed on the great scale, they present a curved or arched appearance, with the convexity turned towards the head of the glacier. The fissures are largest and most numerous at the lower end, and in the parts which are much inclined. In a steep valley, a glacier, with its wave-like ridges, its bristling cones, and the pointed rocks piercing its surface here and there, has been aptly compared to a cataract stereotyped.

The cones or needles of ice, as at *a*, figure 1, are thus accounted for by Agassiz : The glacier, in passing along a valley whose bottom is very uneven, breaks into numerous vertical prisms ; and the summits of these, having their angles wasted away by the sun's heat and evaporation, gradually assume the conical shape.

Glaciers descend into regions where the annual temperature is eight or nine degrees above the freezing point ; and, to use the words of Cox, there are localities in Switzerland where you may almost touch growing corn with the one hand, and the ice of the glacier with the other. They of course waste away at their lower end rapidly in summer, partly by fusion, and partly by huge fragments of the ice falling off, in consequence of the upper beds expanding faster than the lower, till the outer mass loses its balance and topples down.

*Motion of Glaciers.*—The geological action of glaciers depends chiefly on their motion, the true cause of which has been clearly ascertained for the first time by M. Agassiz. Previous writers on the subject, including the celebrated Saussure, attributed the motion of the glacier to gravitation, or the tendency of the mass of ice to descend by its weight from the upper part of the valley to the lower. This explanation accounted very imperfectly for the phenomena, and the opinion of Agassiz, deduced from a careful attention to facts, is now almost universally adopted. He considers the motion of the glacier as the consequence of expansion, and this expansion operates chiefly in the direction in which least resistance is experienced, that is, along the valley downward, and is caused by the congelation of infiltered water. The influence of the sun and of warm winds melts part of the upper surface, and the water so produced percolates into the spongy mass, where it is soon frozen, and in freezing expands, according to a well known law. The upper strata, imbibing more water than the lower, dilate in a greater degree, but the lower strata, in dilating, carry the upper with them, and thus produce rents or *crevasses.* Again, the flanks of the glacier imbibe more water than the middle, and by their greater expansion give a curved form to the *crevasses*; and the lower end imbibes more water than the upper, in consequence of the more frequent rains and alternations of frost and thaw. Besides, as the upper end of the glacier, in expanding, pushes the rest before it, the accumulated effect of the whole expansion falls upon the lower end, which is found to travel quickest. The motion, too, is most rapid in summer, and nearly ceases in winter, in consequence of the water being then constantly frozen. From the effect of this internal movement of its parts, the glacier creeps along slowly but surely. In 1827, M. Hugi constructed a hut on the glacier of the Aar, at the foot of a fixed rock called *Im Abschwung.* It was found that the hut had receded 2200 feet from the fixed rock in 1836, and 4400 in 1840, showing that it had advanced about 250 feet per annum in the first nine years, and 550 in the four last. Taking summer and winter together, its motion had been about eight inches per day in the first period, and eighteen inches in the second. In glaciers which are much inclined, the motion is more rapid than this.

*Polished and Grooved Surface of Rocks.*—The glacier in its course downward carries with it the fragments of rock, gravel, and sand which lie under it. These adhere to the ice, or are embedded in it, and as the mass glides slowly along, they abrade, groove, and polish the rock, and the larger masses are reciprocally grooved and polished by the rock on their lower sides. The effects of this abrasion on the bottom of the valleys may be conceived from the pressure applied. A cubic yard of sandstone weighs two tons, and if we assume the average density of glacier ice to be two-thirds of that of common river ice, the pressure upon each square yard of rock at the bottom of a glacier 100 feet deep, will be equal to about sixteen tons, or the general pressure will be as great as would be produced by a bed of sandstone twenty four feet thick. Thus the various materials under the ice are pressed against the rock with an enormous force, while an equally great force of another kind, produced by the congelation of water, propels them downwards. The sand, acting like emery, polishes the surface; the pebbles, like coarse gravers, scratch and furrow it; and the large stones scoop out grooves in it. Portions of these substances, and of the rock too, are ground to the state of fine clay, and the whole of the movable matter, stones, pebbles, sand, and clay, are in course of time thrown out at the lower end of the glacier, where they form the terminal moraine.

The ice, in consequence of its tendency to dilate, and its numerous fissures, accommodates itself to the sinuosities of the rocks which confine it, cutting off the smaller projections, and rounding and polishing the larger, which assume the form of domes, and were termed *roches moutonnées* by Saussure. Agassiz's eighth plate gives some fine examples of these rounded swells. Owing to the immense pressure, the included pebbles of conglomerates, and the hardest veins in veined rocks, are cut away to the very same level with the softer parts which envelop them.

Thus, one of the marks by which the ancient existence of glaciers can be detected in situations where they are no longer seen, is the polished, striated, or grooved appearance of the rocks. Sometimes it is very distinct, but in many cases it is not visible, because the surface of most rocks wastes away by disintegration or decomposition, unless it is well protected by a covering of clay or turf. The most satisfactory specimen near Edinburgh, is in the quarry on the south side of Blackford Hill, at a place laid open a few years ago, where the rock leans forward, forming a sort of vault. The surface of the clinkstone here, for a space of ten or twelve feet in length, is smoothed, and marked by *striæ* or scratches in a direction approximating to horizontal. We accompanied M. Agassiz to the spot about two months ago; he had expressed doubts as to some other supposed marks of glacial action near this city, but on seeing those at Blackford Quarry, he instantly exclaimed—" That is the work of the ice." On the top of Salisbury Crags, at a quarry about two hundred yards from their south extremity, the polishing is very well seen at intervals over a space of twelve or fifteen feet just at the edge of the precipice; and *striæ*, running east and west, will also be discovered here by an eye accustomed to observe them, though they are much less distinct than at Blackford Hill. In quarrying the Crags at this spot, the rock had been cut back about one hundred and twenty feet from what was originally the edge of the precipice, and this part, which had been well protected by the turf, was only exposed about 1822 or 1823. We have little doubt that similar appearances would be presented if other parts of the greenstone, equally distant from the edge of the precipice, were *newly* laid bare. Parts of the north end of the Castle-rock are also curiously polished, and the groovings on the western slope of Corstorphine Hill, described many years ago by Sir James Hall, are well known. We have observed similar marks of abrasion at Craigleith Quarry, Craigmillar Hill, and elsewhere.

These marks of abrasion, both on rocks *in situ*, and on boulders found in the soil, have been usually attributed to the action of the currents of water, rolling along stones and gravel, an explanation felt not to be satisfactory, but adopted for want of a better. It is admitted that rocks in the channels of rivers are often worn smooth; but Dr. Buckland contends, and apparently on good grounds, that straight parallel *striæ* and grooves never are, and cannot possibly be, produced by the action of gravel and stones in a stream. The abrading material, say a fragment of rock, if it rolls along, will perhaps make occasional indentations, or now and then an irregular scratch; but it cannot produce straight, parallel, continued *striæ* or grooves, unless held fast by some substance which prevents it from rolling, and gives its motion a determinate direction, as the cutter in a grooving plane is kept in a fixed position by the wood. Now, the ice of a glacier (or iceberg) is an agent which answers this purpose admirably; we see that it actually produces the effects described; we know no other agent capable of producing them; and it is therefore inferred that where well defined *striæ* or grooves are found on rocks, we have evidence of the former existence of moving masses of ice.

*Moraines.*—These afford other evidence of the ancient existence of glaciers after they have disappeared. Long terraces or banks of gravel are occasionally found on rocks forming the sides of valleys, high above the bottom, and where the surface they rest on is much inclined. Geologists have felt the difficulty of accounting for these deposits. Their situation is inconsistent with the idea that they were formed by running water; neither could they be deposited on the margin of lakes, because their parts are often found not to be on the same level. Again, they are found stretching like bars across the mouths of valleys, in situations from which a great current, so far from depositing them, would have swept them away, if they had previously existed. Now, both kinds are well accounted for on the supposition that they were the *moraines* of glaciers; those on the sides of the valley being *lateral*, and those barring up its mouth being *terminal* moraines.

Again, we sometimes find one or two long ridges of gravel stretching through a wide valley lengthwise or obliquely, without discovering any thing in the shape of the valley to indicate why the current, if water was the agent, should have accumulated the movable matter here, rather than spread it over the surface. This also is explained, if we assume that it was a *medial* moraine. When one valley opens into another, the two lateral moraines on the inner sides unite, and the compound glacier, besides having a line of blocks and gravel on each side, has a third stretching along the middle, and which is therefore called a *medial* moraine. There are examples in Switzerland of glaciers with three, four, or six medial moraines. Now, were the glacier to melt away, owing to a change of climate, these three, four, or six medial moraines would form as many ridges of gravel running along the bottom of the valley, or obliquely through it, and would resemble deposits occasionally seen in this country.

When a compound glacier is long, the different moraines, lateral and medial, sometimes become blended in their progress downwards, and spread out into a broad sheet; and if the ice were to disappear, we should find the whole bottom of the valley at this part covered with a confused assemblage of fragments of rock. This is also a deposit occasionally met with in Scotland.

The materials of moraines are not stratified, but huddled together in confusion. The fragments are generally somewhat rounded by mutual attrition, but some are angular. They may be distinguished from the banks of gravel formed at the margin of lakes by their internal structure, by the difference of level between their distant parts, and also by their form.

We are not quite sure of the precise shape of *terminal* moraines, but the terms employed by Agassiz (*digues ou remparts*) lead us to suppose that they form long mounds with rounded sides. Like the others, they are not stratified internally; but, from the manner of their formation, they contain more finely triturated matter, namely, clay, sand, and small gravel. Agassiz seldom gives precise measurements; but he mentions one terminal moraïne, (that of Viesch,) which is thirty feet high, and much more in breadth. Glaciers sometimes advance for a term of years, and then retreat for another term. When a glacier is retreating, it forms a new terminal moraine every year, and when it again advances, it pushes the more recent ones before it till the whole are blended into one mass. Now, if the disappearance of the glaciers took place gradually, as it seems most reasonable to suppose, we ought to find in the lower end of some of our valleys a series of little transverse mounds, like $x$, $y$, in figure 5, below.

Lateral moraines increase in size towards the lower end of the valley, and for an obvious reason: The fragments which fall at the head of the valley are slowly carried downwards by the glacier in its course, and they are joined in their progress by those which fall from the rocks in the lower part of the valley. Blocks which fall into the *nevé* or granular snow high up, sink into it and disappear for a time; but it is curious, that except those which tumble into *crevasses* and reach the bottom, they all afterwards rise to the surface. Agassiz thinks, that the internal dilatation which makes the glacier travel downwards, also operates upwards, and carries all included masses to the surface. It is certain that an enclosed boulder is never seen in the terminal section of a glacier, where the composition of the mass can be best observed. In consequence also of the sides of the glacier travelling faster than the middle, and of its breadth generally diminishing towards its lower end, it very often happens that the blocks of medial moraines find their way to the sides and join the lateral ones.

The ascent of blocks from the middle or lower part of the ice to the surface, explains another curious fact—that though the general motion of the glacier is along an inclined plane downwards, scratches are often found on the rock inclined in the opposite direction; that is to say, supposing the surface of the glacier to dip at 10 degrees to the north, you will find scratches dipping at 10 or 20 degrees to the south, or even vertical. These are caused, in Agassiz's opinion, sometimes by inequalities in the bottom of the valley, but frequently by enclosed blocks working their way upward by the expansion of the ice, while the glacier is travelling downwards.

Figure 2 represents the usual form of a lateral moraine in the cross section, and as it would appear on a surface considerably inclined; *m* the mass of gravel forming the moraine; *r k* the rock on which it rests. Figure 3 represents the form which, it is assumed, a compact medial moraine would have if the ice were melted, and the matter left on the surface of the valley.

Fig. 2.

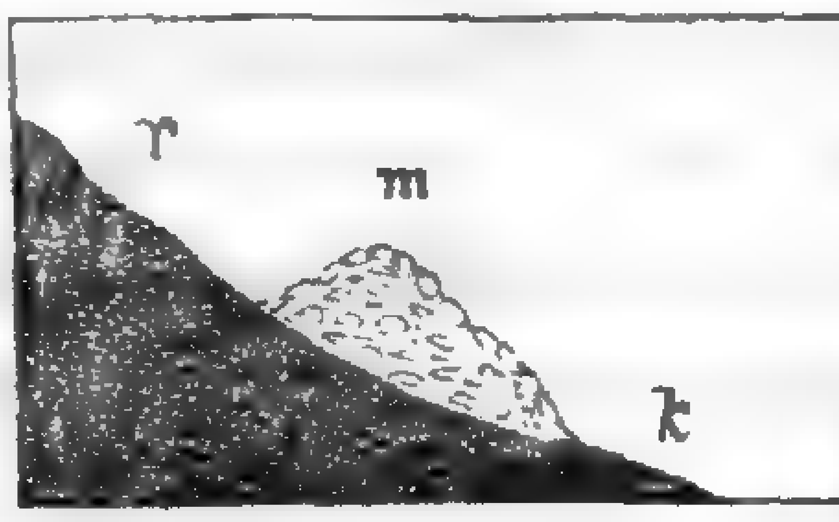



Fig. 3.


Retreating glaciers form a terminal moraine every year, as mentioned in page 353; and in this case we might expect to find a series of mounds transverse to the valley, like *x y*, figure 5.

Fig. 4.

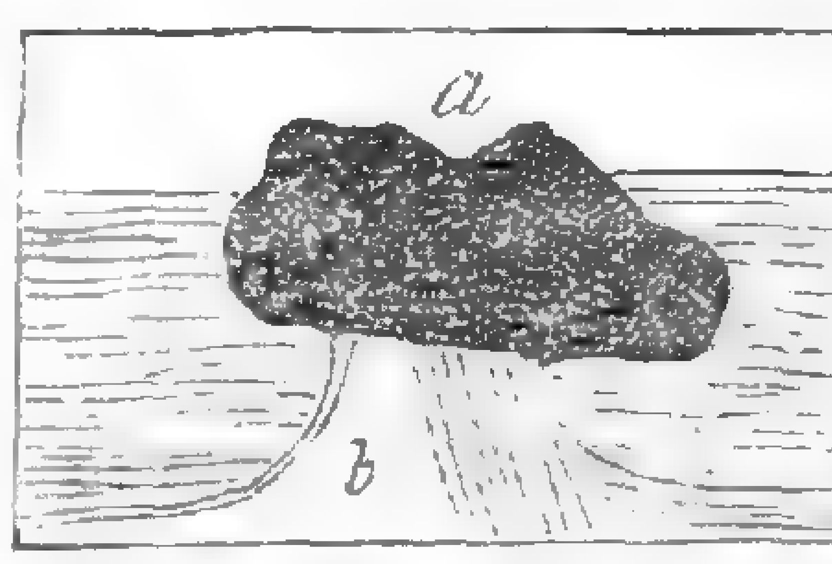
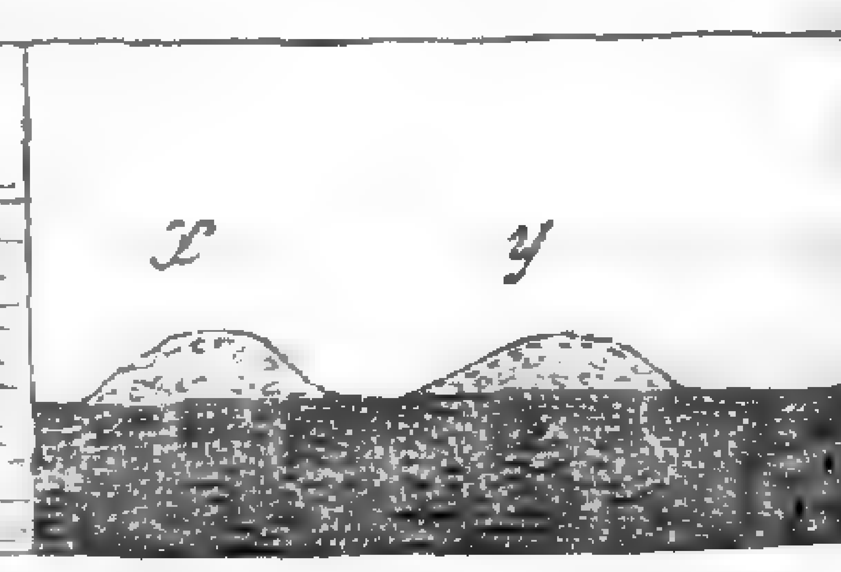



Fig. 5.




*Erratic Blocks.*—Single blocks of huge size are often seen resting on the surface of the glacier, and travelling downwards with it. These are generally angular, and they often stand on pedestals of ice, as in figure 4, where *a* is a tabular mass of rock, and *b* the pedestal of ice.* Agassiz describes one he saw on a glacier, which measured 20 feet by 12, and must have weighed 100 tons or more. In accounting for the pedestal *b*, he observes that gravel, when it rests on the surface of a glacier, being heated through and through by the sun's rays, melts the ice below it, and gradually forms a pool or well in it. A large block, on the other hand, has only its upper surface heated, while the inferior mass, remaining cold, protects the ice below—both from the action of the sun's rays, and from the evaporation by which ice, like water, wastes away in the open air, and thus,

* This figure is borrowed from Agassiz's fourteenth plate. Figure three, and all the others, are ideal, and are suggested by his descriptions.

while small stones often sink into cavities, large ones seem hoisted on pedestals. Masses of all kinds tend towards the sides of the glacier, and many of these huge blocks are found scattered along the flanks of the Alpine valleys, some having remained there, stranded as it were. Others are found in the middle, far from existing ice, and were probably left there when the glacier disappeared. We have thus an explanation of the erratic blocks so common in this country, when these do not come from very distant stations. Being stranded by their greater weight, while the smaller matter moved onward, or left sticking on the soil in consequence of the final fusion of the ice, we can understand why they are often found *perched* on the sides of steep declivities.

*Blocs perchés*, so named for the reason just given, are sometimes found in very singular situations.

Let *a*, figure 6, be the surface of the glacier, *r* the top of a projecting rock *in situ*. The ice has the block *b* floating on it; it encompasses the fixed rock nearly on a level with its summit, and in travelling downward strands the block upon it. The block may be stranded on the very summit, as *c*. Supposing the glacier afterwards to disappear, here we would have an angular block perched on an isolated hill, or as Agassiz terms it, a pyramid, with a steep declivity below it, and we would be puzzled to conceive by what agent it was planted in so singular a situation.

Fig. 6. Fig. 7.

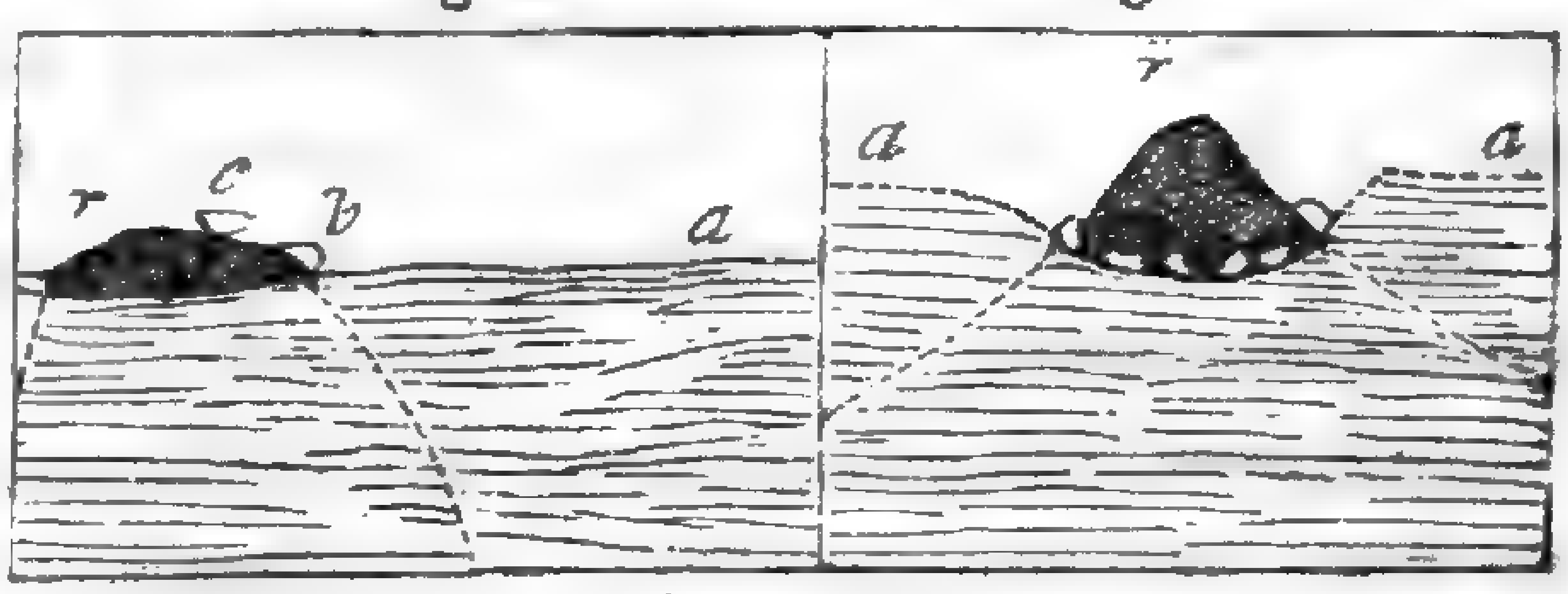



Figure 7 represents erratic blocks in a different situation, but quite as singular. *r* is a projecting fixed rock, rising considerably above the glacier *a a*; the reflection of the sun's heat from its surface melts a portion of the ice, and forms a cup-shaped cavity round it. Into this cavity blocks of various sizes fall by their weight from the surface of the ice as it glides onward, and settle on the flanks of the hillock. Supposing the glacier to disappear, this conical rock would have a ring of stones like a coronet encircling its summit, and we would be apt to wonder at the mysterious agency which brought them there, and left the lower parts of the hill destitute of them. Agassiz names various isolated rocks amidst the Alpine glaciers with such circles of stones round them, or with single blocks stuck upon them, as in figure 6. The same phenomena reappear on Mount Jura, where no glaciers now exist.

*Creux and Lapiaz.*—On the sides of the Swiss valleys, round holes, such as cascades make, are sometimes found in the rock; but in places remote from running waters, and where the form of the surface will not permit us to suppose that any cascade could ever have existed. In other cases, a long, sinuous, dry, water-worn gutter or channel is observed, the course of which runs *across*, instead of along, the natural declivity of the ground. The study of the glaciers has enabled Agassiz to find a key to these enigmatical phenomena, which had perplexed previous inquirers. Streams of water flow along the surface of a glacier, and when one of these falls into a fissure which is open to the bottom, it often forms a cascade, and cuts a round cavity in the rock with the gravel and sand which it either finds there, or carries down with it, as some of our rivulets work out the hollows termed cauldrons. When no fissure exists, the stream sometimes cuts a funnel or shaft (*couloir*, *entonnoir*) through the ice by the action of gravel. If the glacier is travelling downwards, the cascade will travel with it, and convert the round cavity in the rock into a long gutter; or, supposing the water to reach the bottom without falling in a cascade, still, in finding an issue below the glacier, it will be compelled to follow the sinuous openings left by inequalities in the bottom of the ice, and thus take a course at variance with the natural inclination of the surface. We have here an explanation of the *creux*, or holes, and the long water-worn gutters found in such unlikely situations, which bear the local names of *lapiaz* or *karren*. These are chiefly observed where the rock is soft, and are seldom visible on the granite.

*Stratified Gravel on sides of Valleys.*—When a small portion of stratified gravel or sand is found adhering to the side of a valley, high above its bottom, the conclusion usually come to is, that a lake or arm of the sea had once filled the whole up to that level, and that the deposit is merely a remnant of one much more extensive. Agassiz has shown that this conclusion may be erroneous. When the streamlets flowing on or under a glacier, cannot find an escape below, they often form small lakes at the surface on its flanks, and, as in other lakes, the gravel and sand carried into these, arrange themselves in strata. This stratified deposit may be continuous with, and form as it were a portion of, a lateral moraine, which is not only unstratified, but which follows a line probably far from level. Here again the study of existing glaciers enables us to explain very anomalous appearances.

*Glacier Barriers.*—A glacier descending a valley opening into another, sometimes pushes forward till it forms a dike or barrier across the latter. Behind this the water collects and constitutes a lake, which augments till it breaks the icy barrier, or flows over it, producing frightful inundations. In 1815 the glacier of Getroz formed a dike across the valley of Bagnes. This dike went on increasing till 1818, when it was 500 feet high and 800 long. It was then burst by the pressure of the waters of the Drance, which committed terrible ravages as far down as Martigny. The lake of Distel, on the Saas, those of Rufnen and Gurglen, in the Tyrol, and that of Passey, on the Adige, are also formed by glaciers. The last has burst its dike six times, with the most destructive effects, since 1404. Agassiz traced decided marks of an ancient glacier at the north side of Ben Nevis. This glacier, he thinks, had closed up the valley of the Spean, and formed a lake in Glenroy, in which the banks of gravel, called Parallel Roads, were deposited. The barrier being of ice, which subsequently melted, the absence of any marks of its existence is accounted for. At present we shall not stop to inquire whether this theory or Mr. Darwin's is the more probable.

*Alluvial Deposits.*—Agassiz thinks that the floods produced by the bursting of such lakes as those described, and by the fusion of the ice, tore up the moraines, scattered their materials over the country, and formed the unstratified boulder clay, and the stratified sand and gravel resting upon it, which now cover nearly the whole surface of the low country.

*Ancient extent of Glaciers in Switzerland.*—The traces of ancient lateral moraines are seldom very distinct; yet in the lower valleys, where no glaciers now exist, in that of the Rhone, for instance, between Martigny and the lake of Geneva, several may be seen ranged in parallel lines, one above another, at 1000, 1200, and even 1500 feet above the river. Terminal moraines are found half a mile, a mile, a league, and even several leagues from existing glaciers; but these are in secondary valleys, and belong to the period when the glaciers were retreating into the narrow limits which they now occupy, while the floods which occurred at this period had obliterated those of the principal valleys. The striated and polished surfaces, which had a more durable existence, are found at great heights; among other examples, on Seidelhorn, (an isolated mountain in the Alps, now destitute of glaciers,) 2590 feet above the bottom of the valley, indicating that ancient glaciers of this depth or more existed here. The boulders also, or *blocs perchés*, the *creux* or pits, and the *lapiaz* or water-worn gutters, were all observed far beyond the present limits of the glaciers. This first step in the argument conducts Agassiz to the conclusion that *the whole of the Alps, at some ancient period, formed one vast mer de glace*, the ice descending to the level of the great Swiss valley which separates these mountains from Jura.

But the same indications of glacial action exist on Mount Jura, which runs parallel to the Alps, divided from them by the great Swiss valley, fifty miles in breadth. This chain, which is of moderate height, is now entirely destitute of glaciers, and, owing to the nature of the rock, the marks of abrasion are remarkably numerous and distinct. They are found *on the side fronting the Alps* from the bottom to the summit, and from Ecluse, near Geneva, to Aarau, a distance of 130 miles. (*Sur tout le versant meridional de Jura*, depuis le Fort de l'Ecluse jusqu'aux environs d'Aarau.) When the surface is newly exposed, it is smooth as a mirror, marked with furrows and fine scratches, and exhibits the *roches moutonnées*, or rounded undulations and domes. But the most characteristic fact is, that *the furrows do not run from the summit downward, but in a horizontal or oblique direction, along the face of the ridge*, showing that they were impressed by a body moving parallel to the chain along its southern flank. In form and position, they are, in short, precisely similar to the furrows produced by existing glaciers on the sides of the valleys *along* which they move. Further, these polished and striated rocks are not confined to the declivities of Jura, but are found equally at their foot, in the bottom of the great Swiss valley, wherever the rock is calcareous.*

In addition to these striated and polished surfaces, Jura has its moraines, and in these moraines patches of stratified deposits are found, such as are now formed in small lakes on the flanks of glaciers. It has thousands of erratic blocks, distinctly derived from the Alps ; and, that nothing might be wanting to complete the chain of evidence, Jura has its *lapiaz*, or water-worn gutters, where no water now runs ; its *creux*, or water-worn pits, in situations not dominated by any rock whence a cascade could fall ; and its salient peaks, surrounded by coronets of boulders, as in figure 7. Now, as no ridge occurs between the Alps and Jura, it is evident that the mass of ice which pressed against the southern declivities of the latter to the height of 3500 feet or more, with a force sufficient to cut and groove the surface longitudinally, must have extended far into the great valley or low country ; and as striated rocks and travelled boulders are also found all over the bottom of that valley, and on the Alps at its opposite side, we have before us a concatenated series of facts, leading almost inevitably to the conclusion that a *mer de glace*, or vast sheet of ice, once enveloped the Alps and Mount Jura, and covered the whole of the low country between them. Hemmed in by the two mountain chains, the ice could expand only in a northeast or southwest direction, and Agassiz infers from the direction of the *striæ*, that in the middle and northern part of the valley the motion was northeastwards, or towards the lake of Constance.

*Erratic Blocks of the Alps and Jura.*—The large Alpine boulders found on Mount Jura, forty or fifty miles from their native rock, have been a stumbling block to geologists for the last half century. As the subject, though often discussed in books of science, may be new to some individuals, we shall premise a short account of the phenomena.

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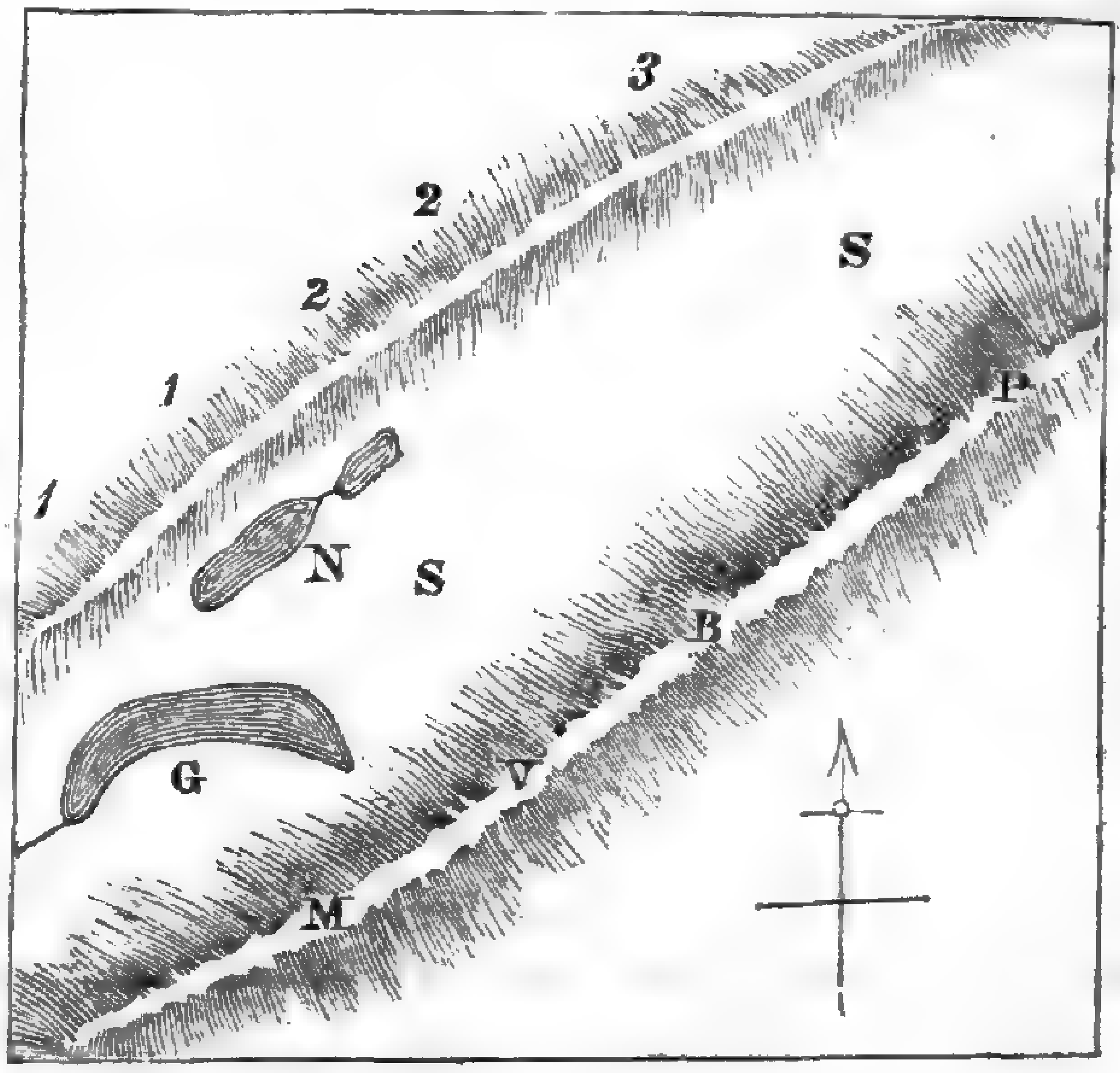
* Etudes sur les Glaciers, p. 291.

Mount Jura rises at some points to the height of 5,000 feet* above the sea, and 3,500 above the great valley of Switzerland on its south side. The Alps run parallel to Jura at the distance of fifty miles, and their higher summits have an elevation varying from 11,000 to 15,000 feet above the sea; but the northern skirts of the chain are a great deal lower, and their distance from Jura scarcely exceeds thirty miles. The following diagram will convey an idea of their relative position:

Fig. 8.




M V B P, The chain of the Alps extending northeast and southwest.

1 1, 2 2, 3, The chain of Jura, running parallel to the Alps.

S S, The great valley of Switzerland separating the two chains.

G, The lake of Geneva; N, the lake of Neuchatel.

The Alps consist of primary rocks, granite, gneiss, &c., in the centre, flanked by secondary. Jura consists of different formations of limestone, all belonging to the oolitic series.

The two chains, in distance, bearing, and position, may be compared to the Ochil and Lammermuir hills. If we suppose the Ochils to be *twice*, and the Lammermuirs *six times* as high as they are, and the valley between them, constituting the basin of the Forth, to be three or four times as deep as it is, we shall have a pretty good idea of the physical features of the district under consideration.

Now the fact which has so long exercised the ingenuity of geologists is this. Hundreds of huge fragments of primary rocks, distinctly recognizable as portions of the Alps, are found perched on the southern declivities, or resting in the interior valleys of Jura, forty or fifty miles from their native locality; and geologists have been perplexed to discover by what agency these erratic blocks have been transported across the great Swiss valley, and placed in the singular situations where we find them. The magnitude, external appearance, and distribution of these masses, present circumstances worthy of notice.

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* The measures are always in French feet, which may be converted into English by adding one fifteenth.

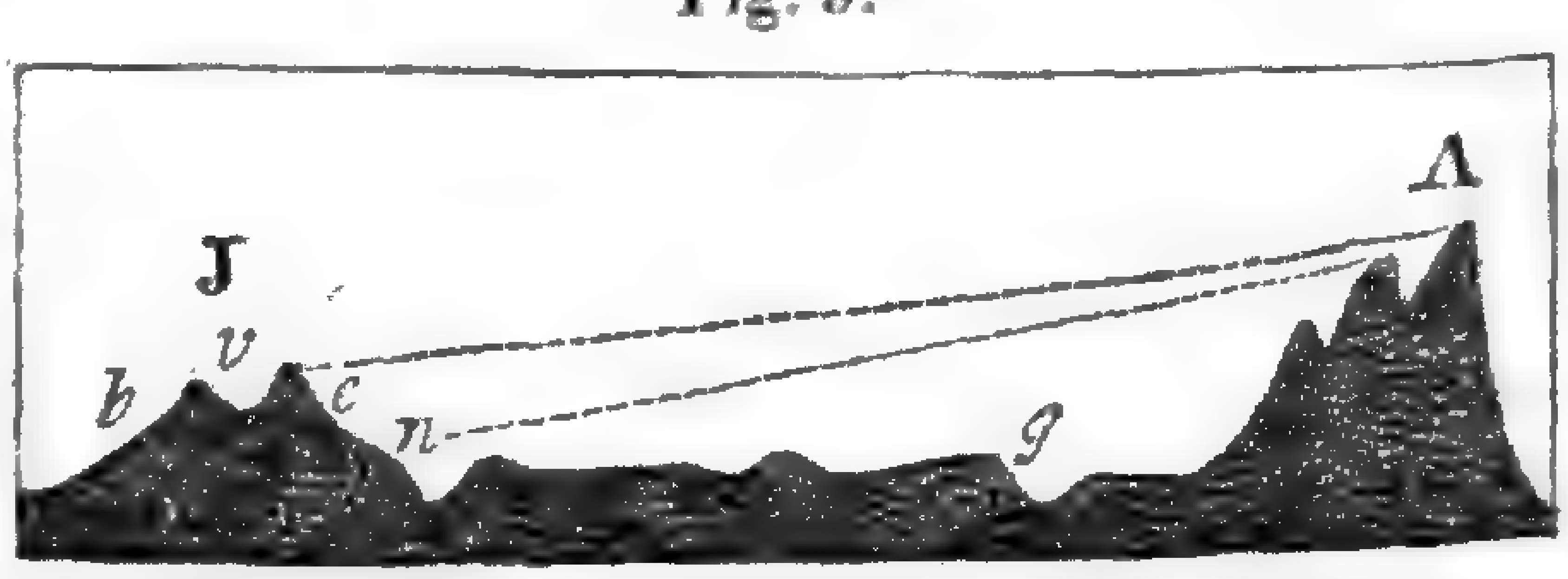
Von Buch, Escher, and Studer, have shown, from an examination of the mineral composition of the boulders, that those on Western Jura, 1 1, have come from the region of Mont Blanc, M, and the Valais, V; those on the middle parts of Jura, 2 2, from the Bernese Oberland, B; and those on Eastern Jura, 3, towards Aargau and Zurich, from the Alps of the Petits Cantons, P. The blocks have thus been derived from the parts of the Alps nearest, generally speaking, to the localities where we now find them, as if they had passed across the valley in a direction at right angles to its length.

The blocks are generally angular, and therefore had not been exposed to much attrition, either from agitation amidst gravel, or from mutual action. Many of them are of prodigious magnitude. The famous mass of *Pierre à Bot*, containing 50,000 cubic feet, and weighing probably 4,000 tons, equals a goodly mansion in size, namely, one of 30 feet in front, 40 in depth, and 40 in height. It rests on a part of Jura 2,177 feet above the sea, and about 900 feet above the level of the lake of Neuchatel, N. Near Chaumont there is a group of granite blocks, which, from their magnitude, their number, and their juxtaposition, look like a hamlet of cottages. The large Alpine boulders of Jura, in short, may be counted by hundreds, and the small ones by thousands.

The boulders are distributed in zones on the terraces, which, like the steps of a stair, form the out-goings of the different formations. The highest are disposed in rings, as in figure 7, round the lower summits of Jura, at a height between 3,000 and 3,300 feet above the sea. The other zones occur on the terraces below this; the first at elevations from 1,900 to 2,400 feet; the next at 1,600 to 1,800 feet; and the last descends to the level of the lake of Neuchatel, 1,324 feet above the sea. Moreover, these travelled blocks penetrate into the transverse and into the interior valleys of Jura, and some are even found at the back of the chain, near the Doubs.*

Saussure attributed the transportation of these boulders to a *debacle*, or great current, rushing from the Alps; and Von Buch, finding that one current would not account for the phenomena, assumed the existence of several. But the inadequacy of such explanations is obvious.

Fig. 9.




A, The Alps; J, Mount Jura, with the great valley, fifty miles wide, between them.

*e*, The southern declivities of Jura, upon which most of the erratic blocks rest.

* Etudes, p. 278–280.

*v*, The interior valleys, and *b*, the back of the chain, where some of them are found.

*n*, The lake of Neuchatel.

*g*, The lake of Geneva.

The difference of altitude between the Alps and Jura, distributed over a space of fifty miles, gives an inclination of no more than two degrees. Now, no current could force, or rather float, masses of stone, weighing 1,000 tons, across an uneven valley of such breadth, although the difference of level were much greater. Even if the valley had then been filled up with gravel, or other solid materials, and formed a regular inclined plane, as Ebel and Dolomieu assumed, the blocks could not have been moved over it by water; or, if moved, they would have been rounded by attrition; and, instead of being disposed in zones, they would have been accumulated *pel mel* at the bottom of Jura. It must be kept in mind, that the erratic blocks are found on the Italian side of the Alps as well as the Swiss, and that currents and inclined planes would be required in both directions.

A more recent hypothesis, which assumes that the boulders were transported by icebergs when the great Swiss valley was under the sea, is much more plausible. Agassiz objects to it, that it does not account for the coat of sand and gravel covering the sides of the mountain on which the large blocks generally rest, nor for the striated, grooved, and polished surfaces, nor (he might have added) for the *lapiaz* and *creux*, and the lateral moraines which deviate from a horizontal position.

It will be anticipated that Agassiz transports the boulders across the great valley on a bridge of ice. He observes that the eastern Alps, as they have disturbed the *diluvium* containing bones of elephants, must have been raised up since that deposit was formed, and their upheaval is the last *cataclysm*, or geological convulsion, which has visited Europe. Previous to this event, an immense mass of ice had covered the surface of the northern parts of the old and new world; "but when the upheaval of the Alps took place, this formation of ice was raised up like the other rocks; that the fragments detached from the fissures of upheaval (*fentes du soulevement*) fell upon its surface, and without being rounded—since they were not exposed to friction—moved along the inclined surface of the sheet of ice, in the same manner as the fragments of rock which fall upon glaciers are carried to their sides in consequence of the continual movement produced in the ice by its alternate thawing and congelation, at the different hours of the day, and the different seasons.

"After the upheaval of the Alps, the earth must have recovered a higher temperature; the ice in melting produced large funnels (*entonnoirs*) at the places where it was thinnest; valleys of erosion were excavated at the bottom of these openings, in localities where no current could exist unless enclosed between walls of ice; and, when the ice disappeared, the large angular blocks were found resting on a bed of rounded pebbles, of which the smallest, often passing into a fine sand, form the base."

The description of the supposed phenomena attending the upheaval of the Alps, though it forms the very kernel of his theory, is less clear than the other parts of M. Agassiz's work, which is generally very perspicuous; and instead, therefore, of giving the substance of his statements in our own language, we have translated the two most important passages literally. In a paper read before the Helvetic Society of Natural History in 1837, containing the germs of the theory, more fully unfolded in his new work, he thus expresses himself:—

"The appearance of the Alps, the result of the greatest convulsion which has modified the surface of our globe, found its surface covered with ice, at least from the North Pole to the shores of the Mediterranean and Caspian Seas. This upheaving, by raising, breaking, and cleaving in a thousand ways, the rocks which compose the prodigious mass that now forms the Alps, at the same time necessarily raised the ice which covered them; and the debris detached from so many deep upbreakings and ruptures, naturally spreading themselves over the inclined surface of the mass of ice which had been supported by them, *slid along the declivity to the spots where they were arrested*, without being worn or rounded, since they experienced no friction against each other, and, even when arrested, came in contact with a surface so smooth; or, after being stopped, they were conveyed to the margin or to the clefts of this immense sheet of ice, by that action and those movements which characterize congealed water when it is subjected to changes of temperature, in the same manner as the blocks of rock which fall upon glaciers, approach their edges in consequence of the continual movements which the ice experiences, in alternately melting and congealing at the different hours of the day and seasons of the year."—*Edinburgh New Philosophical Journal, No.* 48, *p.* 378.

The words in italics indicate an opinion that some of the boulders might have *slid* from the Alps to Jura on the surface of the ice, while others adhered to it, and only travelled as the angular blocks resting on glaciers now travel. Nothing equivalent to these words occurs in the *Etudes*, and even the distribution of the fragments by the more tardy process is not very clearly explained. We are not sure, for instance, whether he means that the ancient *mer de glace* rose above Jura, and determined the progressive motion of the ice in a direction away from the Alpine chain at right angles, bearing the boulders first detached over Jura into the basin of the Doubs, and that, owing to the gradual fusion and subsidence of the ice, the later boulders were stopped in their motion by that mountain and settled on its southern declivities. He seems, however, we rather think, to mean, that the glaciers of the Aar, the Kander, and the Rhone, were lateral and auxiliary to that of the great valley; that the dilatation of the ice (and the motion of the boulders) following the course of the troughs in which it lay, was northwest in the lateral valleys, and northeast or southwest in the great valley; and that the blocks resting on Jura are to be considered as stranded on one side of the great glacier, the motion of the eastern portion of it being northeast, while that of the western was southwest. We see some objections to this conclusion. The transference of blocks from B, for instance, (figure 8,) should not have been right across to 2-2, but diagonally to 3, or 1-1, according as the expansive motion of the ice was northeast or southwest. A theory, however, which explains so many facts, is not to be rejected on account of minor difficulties, which future researches may clear up.

When the *mer de glace* was melting, the first openings through it would be formed where it was thinnest. The water engulfed in these would seek out channels where the fissures or vaults under the ice left room for it, and *valleys of erosion* would thus be excavated, sometimes at variance with the natural declivity of the ground, and which would afterwards become the channels of rivers. Such valleys do occur, and the explanation is simple and probable. But account should have been taken of the heat developed along the fissure of upheaval, which would produce floods of water at the most elevated points; for when the granite ascended from below, though it was in a solid state, it must have brought with it the temperature of the region from which it came. The heat thus generated must have been increased by the enormous friction on the pre-existing primary strata, when they were fractured and bent up; and the ice in contact with these strata, which surrounded the highest summits of the Alps, must have been first melted. Here was an obvious source of formidable *debacles*, which must have produced great changes on the surface of the adjacent countries.

As portions of the old alluvium, containing bones of the fossil elephant, have been found turned up on the flanks of the Alps, Agassiz infers that deposits of clay and gravel existed before the icy envelope was formed; that these must have been broken up and remodelled by the streams arising from the fusion of the ice; and, consequently, that part of the existing alluvial cover is derived from the wrecks of one more ancient.

When the ice retired from the great valley or low country, into the lateral valleys of the Rhone, the Rhine, the Aar, and others, the formation of moraines would begin; and the clay, sand, and gravel thus collected at particular localities would be dispersed and remodelled by the bursting of glacier lakes, occasionally formed in the upper parts of valleys by barriers of ice. Hence the origin of a second portion of the existing alluvial cover.

The deposits of clay and gravel spread over the great Swiss valley, must be due to floods arising from both the causes just mentioned. These floods, Agassiz thinks, must have had a depth of not less than 300 feet, for the sand and fine gravel found on the higher parts of Jura have been washed off from the lower to this height. Masses of ice, forming icebergs, would occasionally float in them, and carry boulders from one place to another.

Sheets of ice occupied the lakes of Geneva, Neuchatel, and others, at this time, and prevented them from being filled up by the dispersion of the alluvial matter.

The clay containing the bones of fossil elephants on the sides of the Alps, he considers as contemporaneous with the deposits entombing similar remains on the northern shores of Siberia, and he infers that one and the same catastrophe had enveloped these districts, and all the northern parts of both continents, in ice. The catastrophe had arrived suddenly; for, as Cuvier remarks, the Siberian fossils show by their numbers that the animals had lived where their remains are found, and by the actual preservation of the flesh and skin in some cases, that they had rested but a short time on the ground before the ice covered them. The retreat of the ice, however, had been slow, as demonstrated by the moraines forming a series in some valleys, with a gradually decreasing range, both in extent and elevation. The present glaciers may be considered as the puny and feeble representatives of that vast crust of ice which formerly enveloped the northern parts of the globe.

The great incrustment of ice necessarily extinguished organic life, so far as its domain extended. The animal tribes which then perished —the mastodon, Elephas primigenius, rhinoceros, and others,—have left their remains in the alluvium, and are found closely to resemble the existing races, which were of course introduced after the ice disappeared, and the region acquired the temperature necessary for their support.

Agassiz thinks that a similar great and sudden depression of temperature probably served the same purpose at earlier periods, by clearing the globe of one zoological group, to make room for another.

Mountains, of whose rocks fragments are found transported to a distance, in different directions, are considered as *centres of dispersion*, by Agassiz. Thus, the Alps, whose boulders strew the plains of Switzerland, Italy, Austria, and France, form one centre of dispersion, embracing Jura within its range. The Vosges (in Alsace), which exhibit the same phenomena on a smaller scale, are another. The Cevennes are probably a third; and the Pyrenees a fourth. We have one of vast magnitude in the Scandinavian mountains, whose travelled blocks are found scattered over northern Europe, from the shores of England to Moscow. In this country Agassiz considers the Grampians, the Cumberland mountains, and those of Wales, as centres of dispersion.

There is a question arising out the theory, which he has not touched upon. If we suppose the region from the 35th parallel to the north pole to be invested with a coat of ice thick enough to reach the summits of Jura, that is, about 5000 French feet, or one English mile in height, it is evident that the abstraction of such a quantity of water from the ocean would materially affect its depth. The area of the space extending 55 degrees on each side of the pole, is pretty correctly *two-sevenths* of the whole surface of the globe. Supposing two-thirds of this space to be dry land, and the spongy coat of ice equal to two-thirds of its bulk of water, and assuming, what is pretty near the truth, that the sea occupies three-fourths of the surface of the globe, we find that the abstraction of the water necessary to form the said coat of ice, would depress the ocean about 800 feet. Admitting further, that one-eighth of the fluid yet remains locked up in the existing polar ices, it follows that the dissolution of the portion which has disappeared would raise the ocean nearly 700 feet. The only very uncertain element here is the depth of the ice; but even if this should be reduced one-half, we would still have an agent capable of producing a change of 350 feet on the level of the sea. We are besides leaving out of view the southern polar region, which it is now known embraces a great extent of land. If this was also covered with ice, the change would be much greater than we have assumed.

These very original and ingenious speculations of Professor Agassiz must be held for the present to be under trial. They have been deduced from a limited number of facts observed by himself and others, and skilfully generalized; but they cannot be considered as fully established till they have been brought to the test of observation in distant parts of the world, and under a great variety of circumstances. Supposing the theory to be substantially sound, the magnitude of the consequences it involves will undoubtedly bring objections to light, which may render modifications necessary, both in its principles and its details. In the mean time, it assists us in resolving some difficulties. It contributes, in a greater or less extent, to explain the dispersion of erratic blocks, the *bizarre* situations they occasionally occupy, the banks of clay and gravel found on the sides and at the mouths of valleys, the *striæ*, polishing and grooving, observed on the surface of rocks *in situ*, and of large stones in the till; and it promises to throw light on what is at present a very obscure subject, the origin of the older and newer alluvium.

ART. XVII.—*On a New Species of Trilobite of very large size;* by JOHN LOCKE, M. D., Prof. of Chem. and Pharm. in the Medical College of Ohio.* Communicated to this Journal by the author.

### *Isotelus megistos.*

Clypeo, antice elliptico attenuate marginato postice arcuato, et terminato utrinque aculio; cauda postice elliptica, antice arcuata; articulus abdominis octo.

The shield is anteriorly nearly perfectly elliptical, broadly and thinly margined, posteriorly arcuate, and terminated at the angles by spines or pointed processes extending backwards beyond the two first abdominal articulations. The eyes are prominent, large, furnished exteriorly each with a crescent-shaped cornea, and placed rather nearer to the posterior edge than to the outer margin of the shield. From the corner of each eye a sutural line extends forward, meeting at the anterior margin of the shield, and enclosing a lozenge-shaped, leaf-like frontal space. Abdomen trilobited; middle lobe cylindrical; articulations eight, bending flatly over the middle lobe, and descending abruptly at their lateral extremities, which are broad, flat, and rounded beneath, and admirably fitted to sliding over each other when the animal should contract or roll himself, according to a well known habit of the genus. Tail posteriorly elliptical, anteriorly circularly arcuate, length measured horizontally, less than two thirds of the width, having two obscure longitudinal depressions continuous with the abdominal furrows, and converging towards an obscure posterior tubercle. The anterior outline of the tail exhibits three slight lobes, (corresponding with those of the abdomen,) the two exterior of which are very distinctly marked by a transverse depression.

When the posterior shell of the tail is decorticated an interior shell is exposed, which forms all round a deep trough or "cavetto," beautifully marked with a "venalian" of eccentric curved and branched lines. The above named posterior tubercle is very nearly the "focus" of the "elliptic" outline of the tail, is just anterior to the marginal cavetto, and is the centre around which the curved lines originate, each passing a little further back than the other and advancing outwardly and forward until they successively disappear on the anterior margin of the "cavetto."

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* Read before the Association of American Geologists at Philadelphia, April 6, 1841.

*Distinctions.*—This Isotelus resembles the *gigas*, from which, however, besides the aculeate processes, it is distinguished by the perfectly elliptic terminations, by the simple (not raised) margin of the shield, and by the proportions of the tail, the *gigas* having the length $\frac{4}{5}$ths, and the *megistos* $\frac{3}{4}$ths only of the width. The latter is also much more prominent than the former, and the tail and sides much more abrupt in their descent. From the *megalops* and the *stegops* it is clearly distinguished by the eyes.

*History and mathematical proportions.*—The first fragment (see outline on Plate III) was discovered by myself in Adams county, Ohio, in 1838. It was about six inches of the marginal "cavetto" of the tail, beautifully veined, marked with the tubercle, perfectly elliptical, and coinciding with the end of an ellipse twenty two inches long and twelve inches broad. The second specimen was an entire tail found at the same locality; this, upon admeasurement, was found to coincide with an ellipse of exactly half of the dimensions of that which suited the first specimen, and showed, by a fortunate fracture, the internal marginal cavetto. These two specimens were both figured and described by me in the Ohio geological report for 1839.

The third specimen (see outline) was discovered in autumn of the same year by Wm. Burnett, Esq. on the hills at Cincinnati, and presented to me soon after. It was partly covered by the crystalline blue limestone in which it had been imbedded, and it was not until the winter of 1840–41 that I dissected it out of its gangue, and found that it had an aculeate shield, and that it exhibited the animal almost entire.

It is of the same dimensions as the second specimen, and measures nine inches and three fourths in length, and six inches in breadth. The first fragment must therefore have been from a specimen nineteen inches and a half long, and twelve inches broad. These gigantic dimensions suggested the name *maximus*, which I gave in the Ohio report, but which, for obvious reasons, I have changed to the more classical Greek term of the same import.

The fourth specimen was discovered by Mr. Carley, of Cincinnati, who was the first to discover the aculeate shield, for in the Burnett specimen this character was still concealed. Mr. Carley's specimen appears to be a young one, for it is only about three inches long. It was obtained in the bed of the Ohio river about four or five hundred feet lower than the situation which furnished the Burnett specimen. My own first specimens were found within thirty feet of the top of the blue limestone formation, where it is overlaid by the cliff limestone. Now the character of this magnificent species of trilobite has been ascertained, it is evident that fragments of it are abundant in our blue limestone, which is undoubtedly the equivalent of the limestone of Trenton

Falls, N. Y., called the Trenton limestone. The most common fragment found is the corner of the shield with its thorn-like appendage, (see the figure, Plate III.) For the information of geologists, I would observe, that figure 2 was found just below the stratum most abundant in the genera Delthyris, Turritella, and Trochus, and that Mr. Carley's specimen occurred in the region of the Isotelus gigas, and the Cryptolithus tesselatus.

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## Art. XVIII.—*Register of the Thermometer from* 1830 *to* 1839, *kept at Boston, Mass.;* by J. P. Hall.

| Years. | Jan. | Feb. | Mar. | Aprl. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Mean of year. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1830 | 25.73 | 25.94 | 37.55 | 48.07 | 57.08 | 66.67 | 72.04 | 69.95 | 59.27 | 52.70 | 46.68 | 35.22 | 49.74 |
| 1831 | 23.38 | 24.86 | 41.34 | 48.51 | 59.31 | 71.47 | 73.09 | 72.39 | 63.08 | 53.76 | 40.82 | 19.14 | 49.26 |
| 1832 | 27.38 | 28.73 | 36.98 | 41.99 | 53.15 | 64.48 | 68.04 | 69.85 | 61.24 | 52.15 | 41.78 | 31.35 | 48.09 |
| 1833 | 31.16 | 25.45 | 33.03 | 48.74 | 58.91 | 63.23 | 72.06 | 67.04 | 62.28 | 50.56 | 38.30 | 31.84 | 48.55 |
| 1834 | 24.85 | 34.23 | 37.53 | 46.88 | 53.44 | 63.84 | 74.03 | 68.28 | 62.86 | 49.03 | 38.52 | 28.55 | 48.50 |
| 1835 | 27.26 | 25.46 | 32.80 | 43.84 | 55.26 | 65.42 | 71.75 | 68.75 | 57.90 | 53.54 | 40.22 | 23.43 | 47.14 |
| 1836 | 26.94 | 20.95 | 31.84 | 43.73 | 55.44 | 58.91 | 69.19 | 65.12 | 60.46 | 45.22 | 36.77 | 29.52 | 45.34 |
| 1837 | 21.74 | 25 70 | 31.86 | 44.72 | 52.97 | 63.75 | 68.45 | 65.32 | 59.00 | 48.03 | 39.26 | 28.93 | 45.81 |
| 1838 | 33.28 | 19.27 | 35.79 | 41.66 | 54.84 | 68.86 | 74.22 | 69.14 | 61.03 | 47.70 | 35.65 | 26.72 | 47.35 |
| 1839 | 27.12 | 29.18 | 35.71 | 47.48 | 56.45 | 62.54 | 72.49 | 68.93 | 62.20 | 51.39 | 37.62 | 31.90 | 48.58 |
| Mean of 10 years, | 26.88 | 25.98 | 35.44 | 45.56 | 55.68 | 64.91 | 71.54 | 68.48 | 60.93 | 50.40 | 39.56 | 28.66 | 47.83 |
| Mean of th' 10 y'rs f'm 1820 to '29, | 26.23 | 29 57 | 36.14 | 46.13 | 57.57 | 67.00 | 72.41 | 69.89 | 62.60 | 51.35 | 39.87 | 32.38 | 49.26 |

From the table it will be seen, that the mean temperature of every month except January, was lower in the ten years from 1830 to 1839, than in the ten years from 1820 to 1829.

Two years (1836 and 1837) were of remarkable coldness. In these years, the crops of grain and corn were cut off to such an extent, that large importations were necessary to supply the demand.

The thermometer rose to 99° on the 21st and 22d of July, 1830, and the 26th of July, 1834, and fell to 10° below zero on the 4th of January, 1835, and 24th of January, 1839.

Hours of observation, 7, A. M., 2 and 9, P. M.

**Boston, Mass., 1841.**

Art. XIX.—*Chemical examination of Bituminous Coal from the pits of the Mid Lothian Coal Mining Company, south side of James River, fourteen miles from Richmond, Virginia, in Chesterfield County;* by B. Silliman, Professor of Chemistry, &c. in Yale College, and O. P. Hubbard, Professor of Chemistry, &c. in Dartmouth College.

Three specimens of fair average quality, not selected for any apparent superiority, were taken from a hogshead of the coal, sent by the President of the company, A. S. Wooldridge, Esq., and experiments were made upon portions of these samples indiscriminately taken.

*Physical Characters.*—The coal is in the fresh fractured surface of a jet black color; lustre, resinous and splendent; fracture, slightly conchoidal; splits easily, parallel to surfaces of deposition which are strongly marked; the two sets of slines considerably distinct in large masses and in small specimens very distinct, showing a rhombic structure, in several specimens before us, making with each other angles of 78° and 102°.

There is another series of faces, very lustrous and splendent, that also intersect at angles of 78° and 102°. These two series of faces cross each other and the surfaces of deposition, and give rise to two rhombohedra that incline in opposite directions. By these the coal is intersected so frequently as to divide it into layers of a line in thickness in one direction. The coal is compact, and the specific gravity of three samples taken as above, was

A. 1.281
B. 1.312
C. 1.284

$3.877 \div 3 = 1.292$. Sp. gr. water being 1.

No. 1. Sixty three and a half grains were coked for two and a half hours, in an iron bottle in a draft furnace, and the gaseous products were collected dry over mercury.

*a.* All the jars of gas, eighteen in number, were examined by caustic potassa; the carbonic acid was thus absorbed, and was equal to 80 cubic inches, or 1600 parts, being two fifth parts of the volume of the gas.

*b.* Binoxide of nitrogen gave in jar 1, a slight redness, thus indicating oxygen gas.

*c.* Acetate of lead added gave no indication of sulphuretted hydrogen.

*d.* Sulphate of copper gave no indication of ammonia.

*e.* The gas remaining in jar 1, after removal of carbonic acid gas, having been generated at the lowest temperature, burned with the clear, dense, yellow flame of *olefiant gas.*

*f.* The gas remaining in the other jars, after the removal of the carbonic acid gas, was entirely combustible, and burned with a flame resembling that of a mixture of carbonic oxide and light carburetted hydrogen.

*g.* The volume of all the gases of *f* and *g* was equal to 120 cubic inches, or 2425 parts.

Ratio of carbonic acid, 80 cubic inches, 1600 parts : 2
" combustible gases, 120 do. do. 2425 " : 3

*h.* The coke of No. 1, was very light, jet black, shining and soft, and was not estimated because it was mixed with portions of iron from the interior of the bottle.

The following samples were coked for two hours in a draft furnace, in covered Hessian crucibles. The coke was harder than in the process in the iron bottle. Its color was jet black internally, and gray at the top of the mass, where probably the air had slight access, and was about twice the bulk of the coal employed.

The coke of 2 and 5 was burned in a platina capsule over a spirit argand lamp, till the carbon was all consumed. The results are as follows in the table, reduced to centesimal proportions.

No. 2. 53.5 grs. coal gave - - - - 33.8 coke.
3. 63.5 " " - - - - 39.6 "
4. 100. " " - - - - 67.6 "
5. 200. grs. coal gave 128.45 grs. which for ½ = 64.2 "

| | 2 | 3 | 4 | 5 | Sum. | Average. |
|---|---|---|---|---|---|---|
| Carbon, | 54.76 | 62.36 | 67.6 | 56.1 | [4] 110.86 | 55.43 |
| Ashes, | 8.41 | | | 8.1 | [2] 16.51 | 8.25 |
| Volatile matter, | 36.82 | 37.63 | 32.4 | 35.8 | [4] 142.65 | 35.66 |
| | 99.99 | 99.99 | 100. | 100. | | 99.34 |
| Coke, per cent. | 63.17 | 62.36 | 67.6 | 64.2 | [4] 257.33 | 64.33 |

Three specimens, Nos. 6, 7, and 8, (taken as heretofore,) of 50 grains each, were coked in close covered platina crucibles over an alcoholic lamp, and then removed to and ignited in a draft furnace at a white heat. The coke from all these was jet black, shining, porous, and soft.

The carbon being burned off in a platina capsule, the results were as follows, reduced to centesimal proportions.

| | 6 | 7 | 8 | | Average. |
|---|---|---|---|---|---|
| Carbon, . . | 63.4 | 60.8 | 59.2 | | 61.1 |
| Ashes, . . . | 4. | 7.1 | 10.4 | | 7.1 |
| Volatile matter, . | 32.6 | 32. | 30.4 | | 31.6 |
| | 100. | 99.9 | 100. | | 99.8 |
| Coke, per cent. . | 67.4 | 68. | 69.6 | | 68.2 |

The average of both series is given below.

| | First series. | Second series | | Average. |
|---|---|---|---|---|
| Carbon, . . | 55.43 | 61.1 | | 58.26 |
| Ashes, . . | 8.25 | 7.1 | | 7.67 |
| Volatile matter, . | 35.66 | 31.6 | | 33.62 |
| | 99.34 | 99.8 | | 99.55 |
| Coke, . . . | 64.33 | 68.2 | | 66.31 |

Two specimens of 100 grains each, were heated in fine powder to 300°, and sustained a loss of 1.9 grains, and 2.1 grains; average loss 2 per cent.; this was moisture, which is of course included in the per centage of "volatile matter."

No bitumen or liquid matter was distilled over in the coking of No. 1.

The ashes in every case were very light, and of a clear grayish white, indicating no pyrites or peroxide of iron, and were in no degree attracted by the magnet.

The ashes of No. 7, being 3.6 grains, were treated with dilute nitric acid; 2.4 grains were insoluble residuum, chiefly silica; and the soluble matter was lime and alumina, slightly colored by oxide of iron and manganese.

The analysis of the coal, shows in the general average, (which may be regarded as approaching nearly to practical results, where the coal is employed in the large way,) proportions of solid carbon and volatile matters, which render it well adapted to the most important purposes in the arts, and probably, with a low and well managed heat, to the production of gas for illumination. Its ashes are of a kind and in such a state as to offer no inconvenience in using it as a fuel. The coke also is in excellent form for producing intense heat.

To show more particularly the resemblances of this coal, we cite below, a collection of the analyses of various coals, some *dry* and others *fat* coal, from a Report on the Manufacture of Iron, made to the Legislature of Maryland, by J. H. Alexander, Esq.

| | Frostburg. Maryland. * | Scotland. Clyde. * | Staffordshire. Tipton. * | Newcastle † | Newcastle. † | Staffordshire. † | Rive de Gier. † | Cannel. Lancashire. * | Mid Lothian, Va. | Mid Lothian, Va. Averages. |
|---|---|---|---|---|---|---|---|---|---|---|
| Carbon, | 66.3 | 64.4 | 67.5 | 60.5 | 67.5 | 62.4 | 66.5 | 64.72 | 61.1 | 58.26 |
| Ashes, | 14.3 | 4.6 | 2.5 | 4. | 2.5 | 3.5 | 2. | | 7.1 | 7.67 |
| Volatile matt'r | 19.4 | 31. | 30. | 35.5 | 30. | 34.1 | 31.5 | 35.28 | 31.6 | 33.62 |
| | 100. | 100. | 100. | 100. | 100. | 100. | 100. | 100. | 99.8 | 99.55 |

* Dry coals. † Fat coals.

The Newcastle coal, analyzed by Karsten, gave 68.5 per cent. of coke. The average of our results, by the last series of experiments, is 68.2 per cent. of coke.

The following table will show the relations of the Mid Lothian coal in its amount of coke.

| | | | |
|---|---|---|---|
| Clyde, | 69. | Rive de Gier, | 68.5 |
| Tipton, | 70. | Lancashire, | 64.72 Cannel. |
| Newcastle, | 64.5 | Mid Lothian, | 64.33 aver. 1st series. |
| " | 70. | " | 68.2 aver. 2d do. |
| " | 68.5 | " | 65.9 general average. |
| Staffordshire, | 65.9 | | |

The average of the three experiments upon the Newcastle coal, gives 67.6.

It appears that the Mid Lothian coal of Virginia, is substantially the same as the best coals of both Europe and America, while it is almost identical with the Newcastle coal of England.

Its proportion of excellent coke, is almost two thirds of the entire weight; of the volatile matter, which is about one third part, more than three fifths are combustible, and in a form to act very advantageously in producing a bright and hot blaze, while only one thirteenth part of incombustible, earthy and metallic matter remains in the form of ashes. This proportion of incombustible matter is a positive advantage, for being a bad conductor, it makes the fire hotter by retaining and accumulating the heat. Count

Rumford caused balls to be made of clay and fine coal moistened and kneaded together, the object being not only to economize the waste coal, but also to accumulate and radiate the heat.

As in the Mid Lothian coal there is very little iron, it is not likely that the ashes will readily form slag or clinker to obstruct the bars of a grate, or to accumulate like a fungus, upon the walls of a furnace.

Should there be occasion to convert the Mid Lothian coal into coke, it would afford that very important fuel of an excellent quality. If the process were conducted at a low heat, it is probable that a very brightly burning gas would be obtained, fitted for illumination, especially if it were mixed with a requisite proportion of the gas from rosin, as is done in the gas works in Boston, where Pictou coal of Nova Scotia is employed for this purpose. The Mid Lothian coal contains so little sulphur, that for every practical purpose it may be regarded as free from that combustible which is so injurious to the working of bar iron and steel by the forge and hammer, especially in the very important operation of welding. From repeated trials made with the Mid Lothian coal by our smiths in this city, it appears perfectly well adapted to their uses, especially where a hollow fire is desired, and when a powerful heat is necessary for large work with a strong blast. One of our best smiths, having made a comparative trial of the two, remarks, that it does not ignite as soon as the Newcastle coal, but gives a surer good welding heat, and lasts nearly one quarter longer.

This coal is an excellent fuel for a parlor grate. No bitumen exudes during its combustion; on breaking a heated mass by the poker, there is no liquid tar covering the separated fragments, but a bright flame instantly kindles on the newly exposed surfaces, which radiates heat powerfully and illuminates the room with a cheerful radiance.

There being no liquid bitumen, the combustion of this coal is attended with less smoke than is usual with bituminous coals; with a well drawing vent, there is scarcely a perceptible odor and no deposit of coal dust in the room and upon the furniture.

From a considerable experience in using it by us in a family parlor, it proves to be a very desirable fuel. We presume that it would prove an excellent fuel for locomotives and for steam engines, as it is abundant in flame so important to the production of steam, while its coke maintains a solid ignited mass, ready at all times for the renovation of the activity of the blaze on the addition of more coal or of wood.

In a grate it burns very well when mixed with the anthracite, and the fire is active, cheering and enduring.

The Mid Lothian coal, being remarkably free from pyrites, there appears to be no serious danger of its producing spontaneous combustion—an accident which, in the case of mineral coal, is generally attributed to the fermentation of pyrites; the sulphur and the iron both attracting oxygen from water, as well as from the air in the interstices of the coal, until it becomes ignited. It should not be forgotten, however, that many combustibles besides coal, are liable to spontaneous combustion, and therefore care is always to be observed in disposing of them in store-houses, on ship-board, &c., especially when accumulated in large quantities.

From the absence of sulphur, we should think this coal well adapted to the manufacture of bar-iron, and that in employing it for locomotive engines and the boilers of steam-ships, or of fixed establishments on shore, there can be no cause to fear that it will injure the metal, whether of iron or copper.

As to its use in sitting and sleeping rooms, there can be no injurious influence to health, provided there is a good draught up the chimney; otherwise every species of fuel is dangerous, as the gases produced by combustion are all deadly; but, with a good drawing vent, there is no more danger from the Mid Lothian coal than from any other, and no danger indeed from any.

It is worthy of remark that whenever a coal fire becomes languid on account of the discharge and consumption of the gas, a billet or two of wood instantly renews its activity and prepares it for the reception of more coal, which is then promptly kindled.

Presuming, of course, that the coal furnished to us by the president of the Mid Lothian company, presents a fair average of the produce of the mines, we hesitate not to recommend it as an excellent fuel, which has no occasion to shun a comparison with the best mineral coal of this country or of Europe.

Yale College Laboratory, Feb. 7, 1842.

## Art. XX.—*Bibliographical Notices.*

1. Caroli Linnæi *Systema, Genera, Species Plantarum uno volumine. Editio critica, adstricta, conferta; sive Codex Botanicus Linnæanus, textum Linnæanum integrum ex omnibus Systematis, Generum, Specierum Plantarum editionibus, Mantissis, Addimentis, selectumque ex ceteris ejus botanicis libris digestum, collatum, contractum, cum plena editionum discrepantia exhibens: In usum Botanicorum practicum edidit brevique adnotione explicavit* Hermannus Eberhardus Richter, M. Dr. Prof. Dresd., etc. Leipsic, (Wigand,) 1840.—This book is, as its title denotes, a complete digest of the writings of the immortal Linnæus upon systematic botany, an undertaking of great labor, and, we believe, very faithfully executed. It forms a volume of 1100 pages of the small folio or imperial octavo size, (the same as that of the new edition of Steudel's Nomenclator,) closely printed in double columns; prefaced by some critical and explanatory editorial observations, and by a complete list of the botanical writings of Linnæus, with notices of the different editions, a catalogue of the authors cited by Linnæus, &c. The prefaces, dedications, and introductory observations of all the systematic works are next given; and the body of the work is devoted to the genera and species, in which, by a well arranged system of abbreviations, nearly the whole Linnæan text, and the changes or variations of the different editions, are brought within a moderate compass. Such a *thesaurus* is of great value to botanists, and especially to those who do not possess the original editions of all the works it comprises, many of which are exceedingly rare. To the volume is appended a complete index to the Linnæan genera and species, with all the original synonymy, entitled: *In Codicem Botanicum Linnæanum Index Alphabeticus, Generum, Specierum ac Synonymorum omnium completissimus, composuit atque edidit* Dr. G. L. Petermann, which is paged separately, and occupies 200 pages, printed in triple columns, extending the work to above 1300 pages. It is published at 16 Saxon thalers.

2. *Genera, Species, et Synonyma Candolleana, alphabetico ordine disposita, seu Index generalis et specialis ad A. P. De Candolle Prodromum Syst. Nat. Regni Vegetabilis:* auctore H. W. Buek, M. D. (Berlin.)—An index of the genera and species contained in the Prodromus of the lamented De Candolle, and of their synonyms, has been greatly needed, those of the several volumes of that most important work extending only to the genera. This want Dr. Buek has in part supplied by publishing an index to the fifth, sixth, and first part of the seventh volumes of the Prodromus, that is, of the immense family of

the Compositæ. It is comprised in 223 pages octavo, (Berlin, 1840,) and is entitled the second part of the work: the first, an index of Vols. I–IV, of the Prodromus, although announced as in press a year or two since, has not yet reached us.

As to the Prodromus, although the gifted author was not spared to finish his herculean task, it will doubtless be continued, and, we trust, duly completed, by his justly distinguished son and successor, Prof. Alphonse De Candolle, with the aid of those botanists to whom a considerable portion of the remaining orders have from time to time been assigned. It may perhaps be important to the botanists of this country to know, that the elaboration of the *Scrophularineæ*, *Labiatæ*, *Hydrophyllaceæ*, and, we believe, the *Polemoniaceæ*, has been long since undertaken by Mr. Bentham; the *Convolvulaceæ*, by Prof. Choissy, of Geneva; the *Primulaceæ* and *Lentibulaceæ*, by Mr. Duby; and the *Plumbaginaceæ*, by Mr. Boissier, of Geneva; the *Solanaceæ*, by Prof. Dunal, of Montpelier; and the *Asclepiadeæ*, by Mr. Decaisne, of the Royal Museum, Paris; to all of whom good specimens of the rarer or less known and local species of these respective orders from different parts of this country would doubless be welcome and very useful.

3. *Kunth, Enumeratio Plantarum*, Vol. III. Stuttgardt, 1841. pp. 644, 8vo.—We learn that the third volume of this work has recently appeared; and that it comprises the orders *Araceæ*, (including *Lemna* and *Pistia*,) *Typhaceæ*, *Pandanaceæ*, *Naidaceæ*, *Juncagineæ*, *Alismaceæ*, *Palmaceæ*, *Juncaceæ*, *Phylidraceæ*, *Restiaceæ*, *Desvauxiaceæ*, and *Eriocauloneæ*.

4. *Loudon's Arboretum et Fruticetum Britannicum abridged: or the hardy trees and shrubs of Britain, native and foreign, scientifically and popularly described; with their propagation, culture, and uses in the arts, and with figures of nearly all the species: Abridged from the large edition in eight volumes, and adapted for the use of Nurserymen, Gardeners, and Foresters.*—This useful and well digested abridgment of a very important, but somewhat unwieldly and expensive work, is to be comprised in ten monthly parts, published at five shillings each, and will contain many species or varieties introduced into Great Britain since the year 1838, when the large work was completed. Only the first part (published in December last) has as yet reached us: this extends to p. 128, and includes the orders from *Ranunculaceæ* to *Æsculaceæ*, following the arrangement of De Candolle's Prodromus. The original work is highly and justly valued in this country, as well as in England; and the extremely moderate price of the new and abridged edition will doubtless secure for it a very extensive circulation.

5. *Steudel's Nomenclator Botanicus*, 2d edition.—We noticed this work in a recent number of this Journal, (Vol. XLI, p. 373,) while in the course of publication: the remaining fasciculi (XI–XIII) have since been received, which complete the work. It enumerates six thousand two hundred and eighty two genera, and seventy two thousand four hundred and seventy eight species of Phanerogamic plants.

6. *Torrey and Gray's Flora of North America:* Vol. 2, part 2. March, 1842. This number, as well as a large portion of the preceding, is occupied with the Compositæ; and this vast family is not yet finished; but will apparently require at least half of the ensuing number for its completion.

7. *Mr. Nuttall's Edition of Michaux's Sylva Americana.*—We are informed by Mr. Dobson, the publisher of this work, that it is at length definitively finished, in six volumes, imperial octavo, with 278 plates. Mr. Nuttall's additions can be had separate in three volumes, containing 122 plates, to complete *all* former editions of Michaux's Sylva.

This labor of Mr. Nuttall is looked for with great interest by all, and when it appears on our table will be the subject of further notice.

We also learn from the same source, that the first volume of the *revised edition* of Holbrook's North American Herpetology is also in the press.

8. *Botanical Teacher, Second edition;* by Laura Johnson.* (Second notice.) In 1834, the first edition was published under the supervision of Professor Eaton. It was dedicated to the Hon. Stephen Van Rensselaer, and received particular marks of his favor and patronage. In the present edition improvements have been made, and it is particularly prepared for the pupils of teachers, who use the eighth edition of Eaton's North American Botany. The last named work having grown to a large octavo of more than six hundred close pages, teachers were in want of a cheaper book, to put into the hands of pupils. Such a book was found to be very difficult to construct. It was necessary that it should be plain—though it must be technical and truly scientific—and contain all the genera and species of North American plants, excepting the lower orders of Cryptogamia, and so much of these orders as might be needed in students' exercises.

* Dr. Gray's notice of this book on page 184 of the present volume, having given dissatisfaction to the authoress and to Prof. Eaton, we have been requested by Prof. E. to publish the above, drawn up by himself. Miss Johnson's work is before the public, and they will judge of it for themselves.—Eds.

The Rev. Mr. Phelps had prepared a book of this kind, to accompany the British Flora of Dr. J. E. Smith, President of the Linnæan Society of London, which was well received. His method was adopted by Miss Johnson, with some amendments. The Botanical Teacher gives Lindley's concise generic descriptions of the genera, without abbreviations; but the specific descriptions are given by abbreviations. By using but one set of words, a general system of North American plants is compassed in a small volume of 268 pages.

This treatise is universally approved by all correct teachers of botany, who have seen it. On a hasty view, the abbreviation plan may appear forbidding. But by a card properly adjusted, the reader sees every abbreviation at one glance of the eye, without opening the book.

Being prepared by an experienced teacher for the use of her own pupils, and for the general extension of the science among young scholars, (for whom she considers botany as better adapted in early youth than any other study,) nothing is charged on the work for authorship. Therefore a class of a dozen pupils can be furnished for about half as many dollars.

As it is fitted for the vest pocket, and contains all North American plants, (excepting some recent discoveries in California and other distant regions,) it is most perfectly adapted to the wants of experienced botanists, who collect plants in fields and forests.

Errors, misprints, and omissions are to be found in it as in all books. But considering the great care and labor required in reducing a general system of the botany of a continent to a book of a hand's breadth and thickness, the errors are very few.

9. *Monographie d'Echinodermes vivans et fossiles, par L. Agassiz.* 2d livraison, contenant les Scutelles.

*M. Agassiz's Monograph of the Echinodermata, living and fossil.* 2d livraison, comprising the family Scutella, (Linn.) 4to. pp. 131, and 27 plates. Neuchatel, July, 1841.

In Vol. XXXVII, p. 369, of this Journal, we announced the appearance of the first livraison of this work, and gave an abstract of its contents. That part, it will be remembered, was devoted to the family of the Saleniarii, and a conspectus of the genera and species of that family will be found in the notice alluded to. The present livraison embraces that part of the family of the Clypeastroides containing the Scutellarii. It is prefaced by an interesting chapter on the history, different divisions, general form, structure, relations to other Clypeastroides, and geological and geographical distribution of this family.

In twenty seven elaborate plates, in part colored, we are presented with about two hundred and thirty distinct figures, including enlarged parts, and the descriptive text is full, and accompanied with a copious synonymy and references to other authors. We regret that our present limits do not permit giving a full conspectus of the genera and species of this group; but we must content ourselves with giving only the genera and the number of the species under each.

I. Rotula, (Klein,) 2 species. II. Runa, (Agass.,) 2 species. III. Millita, (Klein,) 5 species. IV. Encope, (Agass.,) 11 species. V. Lobophora, (Agass.,) 4 species. VI. Amphiope, (Agass.,) 2 species. VII. Scutella, (Lam.,) 12 species. VIII. Echinarachinus, 4 species. IX. Arachnoides, (Klein,) 1 species. X. Scutelleria, (Agass.,) 5 species. XI. Laganum, (Klein,) 14 species. XII. Echinocyamus, (Agass.,) 11 species. XIII. Moulinia, (Agass.,) 1 species.

Like all the works of this distinguished author, the present livraison is marked by its great fidelity and the beauty of its mechanical execution; and our constant wonder is, how Prof. Agassiz can carry on at once so many great works as we know he has in hand, and yet devote to each a measure of labor which few other naturalists can command for a single object.

We beg again to call the attention of American naturalists to the request of M. Agassiz, that all who are so disposed, will send him specimens of the Echinodermata of America, for which due acknowledgment may be expected.

10. *Boston Journal of Natural History. Published by direction of the Boston Society of Natural History.* Boston: Little & Brown, 1842. Vol. IV, Part I. pp. 136, with 7 plates.—This part contains the following papers:

Art. I. Dissection of two adult dromedaries, a male and a female, by J. B. S. Jackson, M. D. II. Descriptions of the Fishes of the Ohio river and its tributaries, by J. P. Kirtland, M. D. III. Observations on the genus Scalops, (Shrew moles,) with descriptions of the species found in North America, by J. Bachman, D. D., Charleston, S. C. IV. On the occurrence of the Phosphate of Uranium in the Tourmaline locality at Chesterfield, by J. E. Teschemacher. V. Descriptions of twenty four species of the Shells of New England, by J. W. Mighels, M. D., of Portland, Me., and Prof. C. B. Adams, of Middlebury College, Vt. VI. Descriptions and figures of the Araneides of the United States, by Nicholas Marcellus Hentz. VII. Descriptions of two new species of Fishes, by D. Humphreys Storer, M. D. VIII. On a new species of Rafflesia from Manilla, by J. E. Teschemacher. IX. Remarks upon Coral Formations in the Pacific, with suggestions as to the causes of their absence in the same parallels of latitude on the coast of South America, by Joseph P. Couthouy. X. Niagara Falls—their physical changes, and the geology and topography of the surrounding country, by James Hall. XI. Note to the editors respecting Fossil Bones from Oregon, by Henry C. Perkins.

A glance at this list will show that the present number of this Journal is more than usually rich in subjects of important and general interest to all naturalists. It speaks alike of the thrift of the Society of which it is the organ, and of the zeal and ability of its members.

11. *Report on the Insects of Massachusetts, injurious to Vegetation. By* Thaddeus William Harris, M. D. *Published agreeably to an order of the Legislature, by the Commissioners on the Zoological and Botanical Survey of the State.* Cambridge, **1841**, 8vo.—We have not yet had an opportunity to examine this important work, but from our knowledge of the eminent qualifications of the author, we are confident that the book is one of great value, alike to the intelligent agriculturist and to the scientific inquirer. The commonwealth of Massachusetts has earned for herself much honor, throughout the learned world, by her liberal patronage of science ; besides which she will doubtless receive in the increased resources of her own people, an abundant pecuniary recompense. We hope to be able to speak more particularly of Dr. Harris's Report, at some future day.

12. *Publication of Rogers's Letters on the Manufacture of Iron ;* by J. H. Alexander, Esq., with an Appendix.—Will shortly be published, under the editorship of Mr. J. H. Alexander, of Baltimore, "Letters on the Manufacture of Iron," by Samuel Rogers, of Monmouthshire, South Wales.

Of this book, a notice appeared in 1829, in the preface to the Manuel Complet du Maître de Forges, by M. Landriu, of Paris, in the following words :—

"C'est dans cet état de la question,"—namely, after M. Landriu, having completed the list of metallurgic writers anterior to the reformation of the phlogistic theory, has farther illustrated the subject by reference to the systematic and learned labors of Hafrenfratz, the immense scientific and practical knowledge of M. Karsten, and the supplementary critical memoirs of M. Müller,—"que Samuel Roger de Risca, métallurgiste aussi éclairé que modeste, rédigeait en Angleterre son Traité du Fer (an Elementary Treatise on Iron-making, 1819) dans les usines mêmes où il ne craignait par de manier le doli du puddleur. Il y exposait avec clarté et simplicité les principes scientifiques de la Sidérurgie ; montrait qu'on pouvait extraire le fer à l'état de pureté de toutes les matières dans lesquelles il était combiné, avec tous les combustibles qui avaient le carbone pour principal élément ; et faisait voir à quelles substances le fer devait sa propriété de devenir cassant," etc. etc.

"Cet ouvrage devait faire la matière de trente lettres in folio, dont Roger fit imprimer les deux premières afin de se procurer des souscripteurs. A l'annonce de cette publication et à la lecture de l'introduction dans laquelle le plan en était savamment developpé, la terreur s'empara des maîtres de forges Anglais : ils craignirent que le savant chimiste ne portât la lumière dans une carrière où ils avaient soin d'entretenir l'obscurité ; ils résolurent d'étouffer ce beau génie et accoururent en foule dans le Monmouthshire pour racheter au prix de l'or un monopole qui allait leur échapper. Roger eut la faiblesse de céder aux offres de ces avides Bretons et ses élucubrations restèrent enfouies dans les cabinets de trente personnes intéressées à les cacher de tous les yeux."—*Landriu, tom.* I, pp. 11 and 12.

With less of the somewhat theatrical pomp under which M. Landriu saw fit to introduce his notice, another, grounded upon the careful perusal of the said thirty letters and personal enquiries among those under and with whom Rogers had worked, was made by Mr. Alexander, in his Report on the Manufacture of Iron, noticed in Vol. XLI, No. 2, of this Journal.

Under these concurring testimonies there is reasonable ground for believing that the book will be found to contain matter of importance for all who are interested in the subject.

Mr. Alexander stands in no other light with regard to the publication than that of friendly editor, as we are informed; adding nothing of his own except a review of the experiments on the expansibility and point of fusion of this metal, and the results of his own experiments on the fusibility of different earthy and metallic silicates which are found in or may advantageously enter into the composition of the furnace cinder or slag.

The design of Mr. Alexander in taking the trouble of this publication was, as well to aid the family of Rogers—some of whom are understood to be struggling in obscure poverty somewhere in Wales—as in furtherance of a *corpus* of treatises on the subject, which he proposed to publish in the interest of this most important branch of American manufactures, under the general title of "Contributions to the History of the Manufacture of Iron;" to which his Report, &c. before mentioned, was meant to serve for introduction.

In the introduction to that report he mentions Rogers and his work in the following terms:

"In 1819, Samuel Rogers, a working hand about one of the establishments in Monmouthshire, but in many regards an extraordinary person, had yet, by some means, acquired a very judicious comprehension of the aim and application of the science of chemistry; and several of the remarkable discoveries of the last fifteen years in this manufacture, are to be found, either in germ or more distinctly brought out, in certain letters, which, during the year mentioned, he wrote and proposed to publish. There was reason to suppose that the effect of his views, if adopted, would have tended to equalize the proportionate products of establishments of different sizes, and possessing different natural advantages; but the interest of the large and favorably situated manufactories was not to encourage this equalization, or, as they thought it, rivalry; and by temptations of whatever kind, Rogers was induced to give no more than his first three letters to the public. But, a few copies of this work as he prepared it, still exist in manuscript, and one of them is now in my possession. Upon a careful perusal, I cannot but think that the iron-masters overrated the influence which the entire publication would have had; and Rogers was, perhaps, acute enough to come to the same conclusion. However, it would have been unjust in any treatment of the same subject, to have withheld the honorable mention of himself and his work, which I have thought proper here to make."

In Vol. XLI, p. 376, we inserted a brief notice of the labors of Mr. Alexander for the diffusion of correct information, both historical and practical, upon the manufacture and uses of iron, and we then gave an outline of his Report to the Governor of Maryland, upon this most important subject.

The publication named at the head of these remarks, forms a second step in the series of elucidations which we are authorized to expect, and for which Mr. Alexander, (an *unpaid* laborer in these important researches,) will impose upon his country a large debt of gratitude. No person in these states has undertaken such a labor, and all who are able, in consequence either of their scientific or practical knowledge, to contribute to the great result, will we trust be forward to sustain an enterprise of such magnitude, and connected with so widely diversified and momentous interests. We rejoice that the work has fallen into the hands of a gentleman so well qualified and so zealously disposed for its effectual performance. We understand, that in the current season, Mr. Alexander will lay before the Legislature, a statistical account of the manufacture of iron, as it now exists in Maryland; giving, as nearly as can be ascertained, particulars relating separately to high furnaces, foundery cupolas, and establishments for bar and plate iron; showing also how many of each are in activity, the fuel and raw material required by each, the number of men employed, the amount expressed in the scale of some unit of calculation of steam and water power, the quantity and value of the products of each, &c. &c. It is extremely desirable to have similar results obtained in all the Northern and Eastern States, and especially in Massachusetts and Connecticut, in which states not only much of the coarser forms of iron, but of cutlery also, is manufactured. We are given to understand that Mr. Alexander's third number in his series on iron is in progress, and that it will present the exposition of his microscopic researches into the crystallography of crude iron.

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## MISCELLANIES.

### FOREIGN AND DOMESTIC.

### 1. *Protest of Mr. Charles V. Walker.*

*Editorial Remarks.*—It is with much reluctance that we give publicity to the remarks of Mr. Walker, as it is extremely desirable, in matters of science, to avoid personal controversy, and we are not sure, that in the present case, the blame is not in part our own. The truth is, we were in doubt whether the letters of Mr. Sturgeon, referred to by Mr. Walker, were intended for publication or not. The subject-matter seemed to justify if not to require it, and we were ignorant of any personal claims that intérfered. Still, the letters were retained in hand, in the hope of hearing farther from Mr. Sturgeon, and they were at last published so late, that it seemed as if an apology was due for their delay.

If we have exposed Mr. Sturgeon to criticism, by publishing what was intended to be private, we sincerely regret it; and on the other hand, Mr. Walker may feel that he has cause to complain that his remonstrance has not appeared sooner. Being friends of peace, we have been hoping to hear from Mr. Sturgeon or Mr. Walker, that the claims of all parties were satisfactorily arranged; but as we have no such information, we cannot act impartially (as it appears to us after much consideration) without giving Mr. Walker's own statement of the case—and we are not sure, after all, that we have not taken the course that will fail to give satisfaction to any of those concerned or to the public.

TO THE EDITORS OF THE AMERICAN JOURNAL OF SCIENCE.

Kennington Grammar School, Feb. 1, 1841.

*Gentlemen*—In this Journal, Vol. XXXIX, pp. 28–36, is an article relative to some experiments made with an extended series of the constant battery, containing extracts from two letters addressed to you by Mr. William Sturgeon, in the latter of which that gentleman has labored hard to connect himself, to the exclusion of those who experimented with him, with a certain important experiment—the heating of the positive electrode beyond the circuit. Had he confined his observations to that periodical of which he is the editor and proprietor, (the Annals of Electricity,) they might have rested undisturbed on my part; but when he publishes this new version of the affair in another quarter of the globe, selecting as a vehicle a journal of such established reputation as yours, whose pages are read wherever science is cultivated, and urges as a reason for publishing this new version, the want of clearness with which my account (as read before the London Electrical Society) was drawn out, I feel that I should be wanting in justice to myself and those who were with me, if I suffered it to pass unnoticed. With respect, first, to his charge against me of want of clearness; I shall not attempt to confute this, but refer your readers to his description on page 31, and mine (which you have copied verbatim) in pages 33, 34; and if a comparison is drawn between these, and it should appear that mine is deficient, though I confess I am at a loss to discover in what, be it so: *palmam ferat qui meruit.* There is one thing most assuredly conspicuous in *his*, which, he may think—though he should have thought so before, when he corrected the manuscript and the proof sheets, for they were all submitted to his inspection—is not recognized in mine; I allude to the frequent recurrence of the pronoun *I.* The account I drew up was descriptive of a series of experiments, carried on by Messrs. Gassiot, Mason, Sturgeon, and myself, at the house of Mr. Gassiot, and at his SOLE expense. The sole object was to advance the interests of science, through the medium of the London Electrical Society, and not to found individual claims to individual experiments, when each by agreement was contributing his own share to the common stock; you may judge, therefore, of the surprise with which I saw the experiment in question, not only claimed by Mr. Sturgeon as his, but also as being undertaken from certain views which he had long entertained. If he had entertained these views, he had a marvelous manner of concealing the experiments he had based on them; we, in our innocence of what good things were in store, were plodding on through that extended series of experiments on decomposition, with such a battery as had *never* been excited before, and yet our chief man (for he was the only scientific man by profession among us) is unable to avail himself of the first opportunity that *ever* occurred to him of bringing his views to the test. Only a *few* of his experiments were attempted, he says. If you, gentlemen, were personally acquainted with Mr. Gassiot, and had seen, I will not say the *liberality* only, but the *ardor* with which he encourages every attempt at experimental demonstration, you would wonder what change could have come over him, that he should have left Mr. Sturgeon's experiments *last* on the list. But granting that this experiment was peculiarly his, surely it was strange to leave it unadopted for so many months; he did not claim it at the very outset, neither did he when I sent the manuscripts for his revision,—it passed as a portion of the *joint* stock when the whole was laid before the Society, and he allowed it to pass through the press and be published without asserting any claim. Nor am I aware that he attempted to appropriate it, until M. De la Rive drew attention to its importance, by endeavoring to repeat it. The want of success which attended M. De la Rive's endeavors, Mr. Sturgeon attributes to my faulty description, and this affords him a plausible pretext to lay his own version before the American public, lest they also should fail from a like cause. I would gladly know what there is in my description which prevented M. De la Rive from producing the same results. Surely that philosopher is not to be charged with deficiency of intellect and want of skill in manipulation; it requires very little of the former to comprehend the description I have given, and no large share of the latter to follow it. If you will refer to the Proceedings of the London Electrical Society, (a copy of which is forwarded to you by the order of the committee,) you will find on page 167, an abstract of a translation of M. De la Rive's experiments, and will see from that, that he perfectly comprehends me, but fails on account of the battery he used.

From this you will see that the motives assigned by Mr. Sturgeon are merely *imaginary*, but if *real*, they little became *him*—they should never have fallen from *his* pen, because, after the experiments were finished, the notes were offered him to prepare, but he declined them; and when I, at the request of the others, undertook the task, I sent the prepared manuscripts to Mr. Sturgeon, as well as to the rest, for his corrections or observations, if he had any to make; and they were returned from him with some emendations, but with no remark in connection with this experiment. Surely when he tells you that on account of the lateness of the hour many of his experiments were not entered into, he might have said that the battery was charged *three* different times, at each of which he was present, and on each of which there must have been opportunity. I am surprised that in a joint undertaking like this, he should talk of *his* experiments, as distinct from those of the rest, but still more so, when these were kept secret from us.

With regard to the experiment in question, it appears to have resulted, like many others in all the sciences, from merely fortuitous circumstances. He and Mr. Mason were amusing themselves with the wires, and observing the length of the arc of flame, and the phenomenon of the heated electrode presented itself; but neither knew which electrode it was until they had examined. And this, I think, you may gather from Mr. Sturgeon's own words in his first letter, dated October 9, 1838, where he says—"the wires were made to change poles, *still* the same thing occurred." Why were the wires changed, unless with the impression that a particular something, connected with the nature of the wire, might be concerned in producing the effect? I cannot pass over the letter from which I take that extract, without remarking on the great want of courtesy on Mr. Sturgeon's part in sending you an account of experiments made for the Electrical Society, the date of his communication being a *week* antecedent to the day when they were read before the Society.

In conclusion, I would advert to a *slight* error into which Mr. Sturgeon must have fallen in his over-anxiety to be *correct:* he tells you the zinc was *amalgamated;* lest your readers should, in preparing a battery of this kind, be led to incur the trouble and expense of this, I would remind them that the zinc was in the condition in which we received it from the workmen.

With every apology for trespassing so much on your time and valued pages, believe me, gentlemen, your obedient servant,

CHARLES V. WALKER.

2. *Mineralogical Notices, by Dr. Lewis Feuchtwanger.*—The indefatigable mineralogist, Breithaupt, has, according to Berzelius's annual report for 1839, discovered eight new minerals: viz.

1. Trombolite, (ϑρομβος, numb, stiff,) a phosphate of copper resembling an opal from Retzbanja, Hungary, of a sp. gr. = 3.38 to 3.4; is of green color, opaque, and conchoidal, vitreous fracture; according to Plattner's analysis, it appears to have the formula $Cu^2\dddot{P}+16\dot{H}$.

2. Allomorphite, a sulphate of barytes, containing 2 per cent. of sulphate of lime, of papillary form, and found in an ochre mine near Unterwirbach, Duchy of Schwarzburg.

3. Anauxite, (αναυξης, not growing larger,) from the highlands of Bilin, of volcanic formation, resembles in appearance the Pyrophyllite, but on heating does not swell but peels off; is translucent on the edges, dark greenish white, fine granular, foliated fracture, sp. gr. 2.264 to 2.267. Contains silica 55.7, and water 11.5; the balance is alumina, calcia, and protoxide of iron.

4. Polyhydrite, a silicate of oxide of iron from Breitenbrun, Saxony, is of a hepatic color, vitreous lustre and opaque, sp. gr. 2.1 to 2.142; contains 29.2 per cent. of water.

5. Serbian or Miloschin, forms a protruding layer in a mountain in Servia. Serbian is blue or bluish green, acquires a lustre on rubbing, opaque, conchoidal fracture, and sp. gr. 2.131; it crumbles by water with a noise; it contains principally alumina, less silica, oxide of chrome, a trace of magnesia, and 22.8 water.

6. Violan, a silicate of alumina, magnesia, lime, much protoxide of iron and soda, and occurring at Piedmont with manganesian epidote; has waxy lustre, deep violet blue color, nearly conchoidal fracture, amorphous, opaque, uneven, brittle, sp. gr. 3.233, does not change on heating, but may be brought by a higher temperature to a clear bead.

7. Tombacite, an arsenical nickel ore, with a little sulphur, and small trace of iron or cobalt, occurring near Lobenstein in Voigtland; in color it resembles the magnetical iron, sometimes with a greenish brown hue; its streak is black, appears to belong to the hexahedral system, is brittle, non-magnetic, sp. gr. 6.637.

8. Hepatic blende, a mineral mostly wax-yellow, from Saxony, in the mine Hochmuth near Geier, Himmelreich-Erbstollen, between Marienberg and Wolkenstein, and also from Cornwall. The color varies from pea yellow to pink brown, transparent; the streak is either colorless or yellowish gray, forms botryolitic and reniform conglomerates, fracture conchoidal, and a sp. gr. 3.7 to 3.78, and, according to Plattner's experiments, is said to be a sulphocarbonate of zinc, it containing zinc, sulphur, and carbon. It decrepitates on heating, yielding water and a little sulphur, smells like sulphuretted hydrogen, and then like coal tar, and then becomes gray; it is decomposed by hydrochloric acid, disengaging sulphuretted hydrogen; the gray substance remaining from before is soluble in nitric acid, leaving sulphur and carbon, the first of which may be sublimed and separated.

It may be inferred from the experiments of Plattner, that this mineral consists of sulphuret of zinc formed by water, and intensely mixed with bitumen or other carbonaceous compound; for it is not to be presumed to contain any carburet of sulphur, which would in those instances distil over unchanged, unlike the above.

Hess has described a new mineral, which he calls *Volborthite*, consisting of vanadiate of copper, of yet undetermined degree of combination. It forms crystalline needles of olive green color, papillary; is translucent in splinters, has a yellowish green streak, and a sp. gr. 3.55; on heating grows black, yields a little water; it melts before the blowpipe, and by increased heat yields a slag like graphite, extending upon the charcoal with some metallic copper; by soda the copper is reduced instantly, and vanadious soda is formed.

*Gigantolite*,* by Nordenskiöld, from Tammela, Finland. One of the crystals of that mineral measured two and a half inches in diameter. This mineral resembles the Fahlunite, and all the harder varieties of

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* What name could we give to our gigantic crystals of beryl, topaz, apatite, tourmalines, zircon, rhomb-spar, lead, fluor-spar; the four latter from the State of New York, some of which measure twelve to fifteen inches in diameter?

talc; it has been described and analyzed by the Count Trolle Wachtmeister; its color is steel gray to brownish, yields on heating, water with some ammonia; it contains silica 46.27, alumina 25.10, oxide of iron 15.60, magnesia 3.80, protoxide of manganese 0.89, potassa 2.70, soda 1.20, water 6.00, and a trace of fluor, and has a formula of $\dot{R}\dddot{Si}+\dddot{Al}\dddot{Si}+\dot{H}^4$.

3. *Infusorial Animals.*—Baron Von Humboldt presented to the Academy, from M. Ehrenberg, of Berlin, specimens of the argillaceous and peaty formation found beneath the city of Berlin, at twenty feet under the surface. It was full of small infusorial animals, all alive, with living ovaries, and capable of reproduction. He had discovered similar formations in other parts of Prussia; and he mentioned as a curious fact, that of 1,728,000 cubic feet of matter taken out of the port of Swinemunde, on the Baltic, in 1840, one half of it was composed of microscopic beings. The sandy plains of the Lamburg contained strata of fossil infusoria twenty eight feet thick.—*Literary Gazette, Nov.* 13.

## 4. *Coal Mines in Cuba.*

To the Editors of the American Journal of Science and Arts.

*Gentlemen*—In the belief that no account has appeared in any American publication, of the extensive coal mine which has been discovered in Cuba, the progress made in the examination of which I have for a year or two past watched with much interest, I send herewith a notice published by *M. Castáles* in the "*Diario de la Habana*," of the 7th of August. The mine is situated in the Partido de San Miguel, about six miles from Havanna, and is particularly interesting on account of its locality and the quality of the mineral.

The coal is of two kinds, one of which, denominated "*chapapote*," is the most abundant. One hundred parts of this yielded fifty parts of volatile matter, and afforded by analysis,

| | |
|---|---|
| Carbon, | 71.84 |
| Oxygen, | 6.22 |
| Hydrogen, | 8.40 |
| Ashes composed of silica, ox. iron, and sulph. lime, | 13.51 |
| | 99.97 |

I remain, gentlemen, with great esteem and respect, your friend and servant.

John H. Blake.

Boston, October 7, 1841.

"The abundance and good quality of the coal are the two particulars embraced in this article to which we should like most assuredly to give a greater extension. Almost at the lower extremity of a hill whose inclination is not very steep, they have opened a rectangular well of four yards in superficies, and eighteen in depth, and at one yard excavation they met the coal, which continues to the above mentioned depth, the quality of the ground being, as well at this point as in the others, a calcareous and ferruginous layer. At the distance of forty five yards up the declivity, they have opened another well, three yards wide, two broad and forty deep: in this place, the coal was found at the depth of seven yards, and continues to the bottom, at which point and in the center of it, they made a bore of fifteen yards, always meeting with coal. At the four sides of the bottom, they have opened a straight gallery, thirty yards in length, in which the vein continues horizontally without any interruption. In this well, terminates another gallery, which opening from the bottom of the other, communicates with this, the drain being obtained by means of oxen.

"On the road to Tapaste, and on the summit of the hill, at a distance of four hundred yards from the preceding well, they have opened another, the vein of coal beginning at the depth of fourteen yards. It results then, that in the small space above mentioned, is found a vein of coal of forty eight yards perpendicular, and more than sixty in surface, in the part bored up to the month of April last, interrupted with layers of stone, and some spots of chalk, though of small extent and rare. The bed of coal is almost horizontal; the difference of the depth at which it is found, is one yard in the first well, seven in the second, and fourteen in the third, depending upon the variation of the surface of the declivity of the hill.

"The mine Prosperidad was examined by Mr. San Richard, an English engineer, who came to Cuba for this purpose: he wrote to the Society the following, which we take from a copy now under our eyes:—'Descending into the well, I became astonished at seeing such a vein of of coal; never have I seen or heard till now, that there is in other places a similar vein, and I believe that I should not be mistaken in saying that there are few persons who have seen another so extraordinary as this. The coal from the surface, to the depth of a few yards, appeared to me to be charged with bitumen, and a coal of very good quality for coke; that which I have seen made with it, is, in my opinion, of superior quality. From the above mentioned distance to that of forty or fifty yards that I descended, the quality of the coal changed much to its advantage; it is less bituminous, contains a greater quantity of oxygen, and is much more compact. I saw at the bottom of the well galleries opened to the four winds, to the length of twenty or thirty yards, and it is all around full of coal. There is also at the east, a gallery a few yards from the bottom, to the extent of forty or fifty yards, all surrounded with coal, so that they see nothing else on all sides.' "

5. *Encouragement for the Fine Arts.*—George Combe, Esq. under date of March 16, 1841, writes to the senior editor of this Journal:

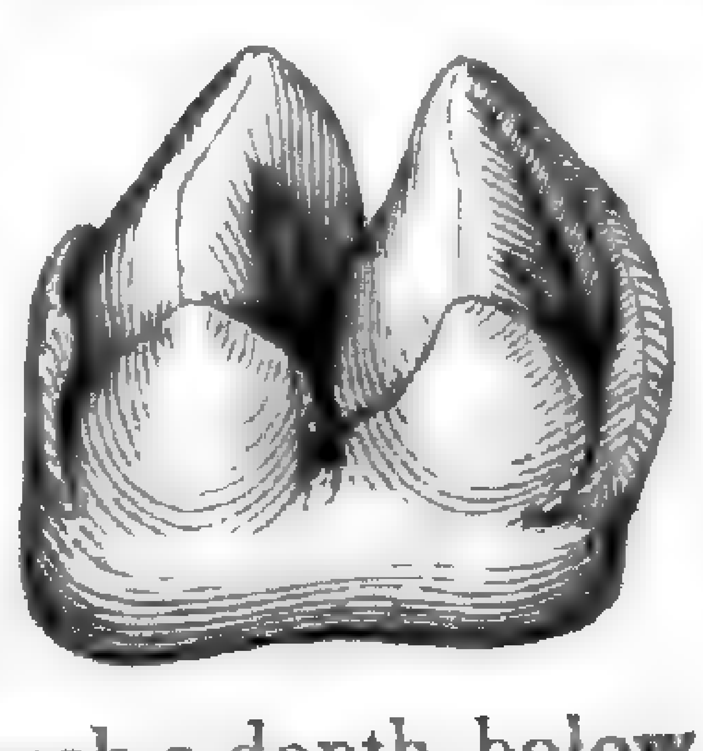
"I am glad to hear that Mr. Ives (sculptor and modeller in statuary) has obtained so much patronage among you. It appeared to me that there is no lack of genius for art in the United States; all that is needed is encouragement. Scotland was too poor to encourage artists by buying their works, until we formed an association, to which any one who chooses subscribes five dollars; we buy pictures with the funds, (last year they amounted to £3,000,) and draw lots for them. The annual exhibition has recently opened, and it is very creditable to the country. The improvement in art, within my recollection, is very great, and the public taste is improving in proportion. Such a scheme is what your country wants."

We hope that the valuable suggestion of Mr. Combe may be favorably regarded, both in the revival of institutions already existing for the improvement of the arts, and in the creation of new and effective associations.

Twelve months have passed since the above remarks were written, and they have lain among our unpublished miscellanies until we can have it in our power to confirm their justness and propriety.

6. *Geological Survey of Louisiana.*—We are happy to learn from Prof. Wm. M. Carpenter, of Jackson College, Louisiana, that he has for some time past been engaged in making, by direction of the legislature, a geological examination preliminary to a complete survey of that state. Prof. Carpenter is well known to the readers of this Journal by various interesting geological papers in our previous volumes, and we rejoice that the legislature of Louisiana have had the wisdom to select, from her own sons, one so able to answer their liberal views. From Prof. Carpenter's letter we extract the following.

*Notice of an interesting Fossil.*—The sketch represents the crown of a molar tooth, which was taken from a jaw bone found at the depth of forty five feet below the surface, in digging a well in a prairie twenty or thirty miles from the town of Opelousas, in the western part of this state. When taken up, the jaw bone is said to have been nearly entire, but was fragile, and soon crumbled, and as the discoverers saw nothing remarkable in the jaw except the circumstance of its being found at such a depth below



the surface, it was thrown away, and this crown was all that was saved. Description :—horizontal section of body quadrilateral, with the angles rounded and the sides slightly curved. The crown has two transverse ridges, the summit lines of which are slightly curved; between the extremities of the ridges on each side is a small tubercular elevation, and a slight elevation borders the anterior and posterior extremities of the crown.

Size of body, { length, 0.94 of an inch.
breadth, 0.76 " "

Length of the summit of the ridges, 0.55 of an inch. Distance of the summits of ridges from each other, 0.42 of an inch. Height of ridges, 0.36 of an inch.

It is without doubt the fifth molar of the left lower jaw of a Tapir, which appears to me to be very near to the one now inhabiting South America, as the form and size of the tooth is nearly the same as in that animal.

**Jackson, La., October 19, 1841.**

7. *Preparation of Freshwater Shells for the Cabinet.*—We make the following extract from the letter of a distinguished correspondent, whose shells have been in much demand among collectors, and whose mode of preparing them is the result of observation and experience.

" It is well known that these shells are composed of animal matter and carbonate of lime, thinly laminated. Many of them are more or less covered with mucus, lime, clay and oxide of iron, sometimes indurated, so as to require a steel instrument to remove it. Hence the first operation is to remove this extraneous matter by hand-brushes, and then with dilute muriatic acid to remove the free lime and accidental colors; then, after a thorough rinsing, and as soon as the water has dried from the surface, saturate the shells with the finest spermaceti oil, which should be left on them for several months if convenient, but wiped from them as clean as possible with a woolen cloth before putting them in the cabinet. They will then feel like steatite, and exhibit a transparency and beauty which I could not obtain in any other way. Shells which have once been exposed to the air, without the animal, and have become thoroughly dry, can never be restored to their primitive beauty, because the water of the animal matter in them has evaporated. They become opake, and a slow decomposition, like that of salts, takes place, by the evaporation of the water of crystallization; but the oil taking the place of the water, as the latter evaporates, increases the transparency of the shell, as it does that of paper, and the superfluous oil may be so effectually removed at the proper time, that the shells will not soil the fingers or smell unpleasantly; but any considerable exposure to the air and light will soon injure their appearance."

### 8. *Bones of the Orycterotherium.*

*Dear Sir*—Dr. Perkins is under the erroneous notion that my remarks on the "Orycterotherium," in the Journal of proceedings of the American Philosophical Society, is a *description* of the new genus, whereas it is only intended as a scientific notice. My memoir before the Society, of twenty one pages letter paper, with numerous figures, is now in progress of publication.

The "*protuberance*" on the humerus referred to by Dr. P. is there noticed, together with numerous other details not now mentioned, and all of which leave no reason to believe Dr. P.'s bones to have belonged to a distinct species. He is certainly premature in giving the specific title of "*Oregonensis*" to his remains. R. Harlan.

Philadelphia, Feb. 1, 1842.

9. *Note on Mr. H. C. Lea's paper in the last number of this Journal.*—Among some interesting additions to the known species of our native shells in the last number of your Journal, I find a shell described under the name of *Pasithea sordida*, which has been known to me for several years, and had been regarded as a variety of *Actæon trifidus, Totten.* A re-examination of numerous specimens confirms this opinion. The species presents the following varieties, the type being characterized by three well impressed and several indistinct revolving lines.

*Odostomia trifida*, Gould. Invert. of Mass., p. 274, fig. 179.

*Actæon trifidus*, Tott. Am. Journ. Science, XXVI, 368, pl. 1, fig. 4.

*Var. a.* With two well impressed lines.

" *b.* With one well impressed line.

" *c.* With all the lines obsolete.

" *d.* With one well impressed line, and the columellar fold indistinct.

" *e.* With the lines obsolete and the fold indistinct.

*Pasithea sordida*, H. C. Lea. Am. Journ. Science, XLII, 110, pl. 1, fig. 6.

Varieties *a* and *b* are most common in the vicinity of New Bedford. In most of the individuals, which would, at first, be referred to varieties *d* and *e*, the fold will usually be seen far within the aperture. But occasionally it is wanting, and a roughness of the columella indicates this to be the result of disease or accident. Without the intermediate varieties, *e* might be supposed quite distinct from the type, and many species have been proposed with much less reason. But having a large number of the shells referred to by Mr. Lea, among which are *all* the above varieties, I cannot regard it as entitled to specific rank.

Mr. Lea is in error in supposing that his shell and the *Cerithium Sayii*, Menke, (*C. reticulatum*, Totten,) among which it was found, are from Boston. Although in Col. Totten's description of the latter species, Boston harbor is mentioned as its habitat, it has not probably been found north of or within Cape Cod, its extreme limit being Provincetown, where it was found by Dr. Gould. The shells in question were obtained in Dartmouth, Mass., where they were clinging to the *Zostera marina* below low-water mark. Very respectfully,

C. B. Adams.

Middlebury, Vt., Feb. 15, 1842.

10. *Notice of some facts connected with a stroke of lightning, in a letter from Rev.* James H. Linsley,* *dated Stratford, Conn., Sept.* 9, 1841.

Prof. Silliman—*Dear Sir:* Early in June, 1821, four men, who had been engaged in fishing, were cleaning shad upon a plank ten or twelve feet in length, one end of which was resting upon the edge of a stump, and the other upon an empty flour barrel, the latter being towards the river. A large pile of the offals of shad was lying around the stump; a steel pointed pitchfork was standing by the plank, which, as well as the prongs of the pitchfork, was smeared with the fish-oil. A heavy shower had commenced, and the men took shelter in a shed about twenty five or thirty five feet off, when the lightning struck the stump, splitting it to pieces, until it came down to the fishes' entrails and heads that were piled around it. Below them it did not affect the stump or the ground, nor injure the plank, or the pitchfork by it on the barrel; but took the ground at the lower end of the barrel, and thence ploughed a furrow until it came to a rock about five feet in length or two or three feet horizontal thickness, weighing several tons, through which it passed, leaving one side broken in several pieces, and the other side unbroken, with a square face, as if sawed through. The rock is thinly laminated, but the lightning did not separate the laminæ; it cut across nearly at right angles, i. e. varying only twelve degrees, the laminæ being nearly perpendicular to the horizon. From the rock, the lightning passed to the water and disappeared. In a few moments, however, many dead fishes of various species rose upon the surface of the river; they appeared to come up "as they do when the ice over them in winter is struck by an axe." The effect upon the men in the shed was singular: one was seen from the dwelling house (about five rods distant) to stoop down as though picking up something with both

* The facts were communicated to Mr. Linsley by Mr. S. Crowfut, the owner of the place where the event occurred.

hands; he would then rise and extend both hands high in air, and then stoop down again as before; this action he repeated several times; at length he called to those in the house, saying, that "the lightning is so thick upon the ground that you can pick up corn-baskets full of it." His mind was evidently for a short time injured by the shock. Two of the other men, who had just sat down as the shock came, were found leaning back against the wall, stunned, as if asleep. The fourth received little or no injury.

The persons in the house, (Mr. C. believes about a dozen,)—most of whom had naked feet—said that at the moment of the shock their feet felt as though some person had tossed a chip of wood on them, while those with shoes on did not perceive this sensation.

In addition to this, an empty boat lay a short distance from the rock struck, and when the shower was over, the men who came there in the boat attempted to return in it, but on entering it immediately filled and sank. On examination it was found that every nail in the boat had started, and that the leaks were thus caused.

The points which I conceive of any importance in this transaction, are, 1st. The good evidence furnished, or the corroboration of a long known fact, that *oil is a powerful non-electric*, as the fluid passed over or under the whole length of the plank covered with the refuse of shad. 2d. The sensation given to all the *bare feet* of persons five rods distant, without affecting the hands and face, was uncommon. Is it not probable that the skin of the feet, being usually covered, was more delicate and therefore more sensible to the shock? The floor of the house where these persons were, is several feet higher than any point touched by the lightning. 3d. Did the electric fluid reach the fishes in the river? or were they killed by the mere shock in the air acting upon the water? 4th. Is it possible the nails in the boat could have been started out by the shock, and if so, in what manner? Was the concussion of air so great upon the plank of the boat, that the nails were thus drawn by the plank? or was this result produced by the electric fluid acting upon the nails? 5th. Is it possible to explain or show cause why the lightning should leave so smooth a surface through the rock which it severed, especially when acting not *with* nor directly *at* right angles to the natural cleavage or laminæ of the rock and not separating any laminæ?

Some person a short distance further up the river, who saw the column of electric fluid descend on this occasion, remarked, that "it appeared to be about the size of a common bar-post."

### 11. *Separation of silver or gold from lead.*

Prof. SILLIMAN—*Sir:* In looking over a former number of your Journal, (Vol. xxxv, No. 2, January, 1839,) I find on page 321 an article on cupellation, where the writer proposes to separate silver or gold from lead by oxidizing the alloy in the external flame of the blowpipe on a slip of mica. This process is undoubtedly original with him, but a much better one has been practiced by me more than thirteen years, when I first learned it from Prof. H. Rose of Berlin.

Take a few grains of bone ash, make it into a paste with a little saliva, spread it about one line thick on a piece of charcoal, and make a shallow impression in it, to receive the globule of metal. Expose it to the heat of the blowpipe, so as to burn it white and hard, and then melt the globule of the alloy on it, and keep it in a constant red heat, till the lead is all oxidized.

The advantages of the bone ash over the mica are manifold. 1. It is easier to be obtained, and every where the operator can prepare a little if he should not be supplied with it. 2. The metal will remain in the concavity of the bone ash paste, and not be liable to run down and be lost, as on the mica. 3. It is never necessary to change the material; the bone ash absorbs the litharge which collects on the mica, and impedes the process, so that the remaining metallic globule has to be transferred to a fresh slip of mica. 4. The color of the paste, after the operation is finished, gives an indication as to the nature of some impurities of the metal; lead alone makes it appear yellow; a small proportion of copper changes this yellow color to greenish. Respectfully, your obedient servant, GEORGE ENGELMANN, M. D.

St. Louis, Jan. 22, 1842.

12. *Suggested observations relating to the total solar eclipse of July, 1842, visible in Europe.*—The sun is supposed to belong to the class of nebulous stars. The nebula that surrounds him is however, at ordinary times, very incompletely visible, being hidden by the effulgence which his reflected beams pour upon the eye from the atmosphere, and from the whole assemblage of terrestrial objects in the field of vision. It is only when this effulgence is withdrawn, and evening is far advanced, or the morning yet distant or scarcely beginning to glimmer, that this nebula may be observed in its remoter parts, lifting itself above the twilight, and forming the celestial phenomenon known commonly as the "*Zodiacal Light.*" At such times, however, the central body and the brighter regions of the nebula are concealed beneath the horizon.

Our only opportunity, therefore, for a complete observation of the zodiacal light, in its brightness near the sun, in the gradations of brightness as it recedes from that orb, and in the relative visual extensions estimated *along* the zodiac and *across* it, would seem to be on those rare occasions when one may stand, during a total solar eclipse, quite within the path of total obscuration. I suppose, however, that no such occasion has yet been distinctly improved, for the purpose above indicated; nor—however probably that circumstance may be the result of a too limited information on my part—have I seen reason to expect that the one just at hand is likely to be so improved, otherwise than incidentally and very imperfectly. It will be impossible for the astronomers, intent as they must be upon telescopic observations, to do full justice to the phenomenon in question, and almost equally impossible for any other man who shall not have anticipated in his reflections the specific aspects to which the attention ought to be essentially devoted.

Before quitting this topic, may I be indulged in making an inquiry that naturally grows out of it? Is not the light which, in a total eclipse of the moon, makes her dark face visible to us, derived, in a greater measure, from this equatorial nebula of the sun, than from the refractive effect of the earth's atmosphere? If the intensity and extent of the zodiacal effulgence shall be detected at the occurrence of the coming eclipse, or by any other means, it may be possible to reply very satisfactorily to this inquiry. I would not unhesitatingly assume that a reply *substantially* satisfactory might not be derived from facts already well known. I must own that, hitherto, I have not even undertaken to speculate concerning the amount of illumination, at the moon's surface, due to the terrestrial atmosphere,—a question which would seem, at first view, to be of moderate difficulty, if only the dispersive and refractive powers of common air are exactly ascertained.

But I pass on to some suggestions respecting a phenomenon of a different class. To observers just within the path of total obscuration, —and perhaps, *very transiently*, to those situated deeply within it,— the telescope will probably reveal a fine thread of light, edging some part of that dark limb of the moon which is in near proximity to the sun's corresponding limb. I infer this probability from a similar aspect,—which may indeed have been observed at other times, and recorded, although I have no knowledge that it has been,—that was witnessed by myself, through an excellent instrument, from the station of New York, on the occasion of the annular eclipse of 1838,—or rather the eclipse which *just failed* to be annular, at that station, on account, possibly, of an irregularity in the moon's outline. In any event, it must be rare that the phenomenon under consideration can be exhibited so strikingly as it was on the occasion alluded to, from the very circumstance of my station being at or near the limiting boundary, upon the earth's surface, of the annular aspects. On that occasion I noticed, several minutes before the time of nearest completion of the ring, the fine cusps of the sun's unobscured crescent prolonged by a hair-breadth line of brightness, totally diverse, in color and intensity, from the sun's disc. As the cusps approached, the line or thread of light in advance of each, shot round the moon's edge, between them, rapidly, till, at a certain time, the threads from the two met and joined in one,—thus uniting the cusps. At a certain time following the instant of nearest formation of the ring the thread became again disunited, and the reverse phenomena of those just mentioned took place.

In meditating, at the time and occasionally at subsequent times, upon this, to me, surprising phenomenon, I could obtain no glimpse of a solution respecting the probable cause, unless by supposing the existence of a *lunar atmosphere.* It is, I admit, only in one point of view that I can be held excusable for offering these phenomena as proof upon this high and much questioned topic, antecedently to having myself demonstrated by a rigid process the mode in which a lunar atmosphere implies and accounts for just those appearances which I witnessed. But, although I am not without my reasonings to fortify the conjecture above presented, those are not to my present purpose. An excuse for my boldness, if I need one, may be found in the nature of my present object, which is simply to invite attention to expected and interesting phenomena, on the part of observers among my countrymen who may be favorably situated abroad for devoting to them the requisite attention, as well as on the part of any others to whom these unpretending thoughts may find way and whom they may concern. A. C. T.

13. *Meteors of April* 18–20, 1841.—About 8 P. M. on the 18th of April, 1841, at Vidalia, Louisiana, Prof. Forshey noticed an unusual number of meteors in different parts of the heavens, and on tracing their paths backwards, found that they traversed the constellation *Virgo.* Having commenced precise observations at half past eight, and continued them for three hours, he saw in two hours and a quarter, (forty five minutes being lost in recording,) sixty meteors, of which, all but five, passed within 10° from the common radiant point. These meteors were very unlike those of the August shower; being chiefly without trains, and of a reddish color, few of them of the first magnitude, and the greater number of the third and inferior magnitudes. Their velocities were remarkably equal and gentle; their paths short, and their light first increasing and then waning. Prof. F. determined their radiant point to be in a line drawn from Spica to $\theta$ Virginis, somewhat nearer to Spica, about R. A. 198°, S. decl. 8°. The convergent point was therefore in longitude 19°.6, and lat. N. 0°.3, while the observer's motion was towards a point of the ecliptic, in long. 299°. This gives a deflection of the path of the meteors, relatively to the true path of the observer, of 80°.6; and hence their true velocity cannot have been much less than that of the observer, or about sixteen geographical miles per second. This observation of the convergent point of these meteors, Mr. Walker regards

as strongly confirmatory of the cosmical theory of shooting stars, inasmuch as it seems to demonstrate the existence in this group, of a planetary velocity, like that of the December group observed in 1838, (see this Journal, Vol. xxxv, p. 361, and Vol. xxxvi, p. 355,) in a direction normal to the observer's motion, and incapable of resulting from it.—*Proc. Am. Phil. Soc.* ii : 67.

*Observations at New Haven.*—From 11h. to 12h. P. M. of April 19, 1841, Messrs. F. Bradley, A. B. Haile, and myself, watched in the S. W. quadrant only, in concert with Mr. S. C. Walker and others, at Philadelphia. During this hour, we saw *thirteen* shooting stars, whose paths we recorded on the star-chart. Of these, two exceeded the first magnitude ; two equaled the first magnitude ; three were of the second ; five of the third, and one of the fourth. The average time of visible flight was one third of a second. No definite radiant was observable, but only a general westward tendency. At 0h. 30m. (20th) we began to watch in the sky at large. Clouds soon came over from the west, and by one o'clock A. M. the sky was so much obscured that we were compelled to desist. In this half hour, we saw three meteors in the N ; two in the E., and two in the S. No very definite radiant could be determined, but it appeared that the radiant region was then east of the meridian, and about 70° or 80° in altitude. For five nights following, the sky was wholly overcast. It may be worthy of mention that there was a moderate display of the Aurora Borealis on the nights of the 19th and 20th. E. C. H.

14. *Shooting Stars of Dec.* 7, 1838.*—In a paper communicated January 8, 1839, to the Meteorological Society of London, by J. H. Maverly, Esq. of Gosport, he states the following observations :—" On the day after this storm, (of Dec. 2, 1838,) there were showers of hail and rain, two double rainbows, and one lunar rainbow at 6½ P. M. On the night of the 7th, between 7½ and 10, he noticed *ninety seven meteors*, viz. *fifty six* eastward of the meridian, and *forty one* westward of it." * * So great was the display, that Mr. M. says, " had this phenomenon occurred between the 12th and 15th of November, those who maintain the opinion of the annual appearance of *showers of meteors*, would have pronounced this extraordinary appearance to have been their diurnal periodical return."—*Proc. Meteor. Soc. Lond.* i : 9.

In the *Institut* for October 14, 1841, M. Colla states, that at *Parma*, in Italy, on the night of December 7, 1838, during three hours, he ob-

* For observations made in this country and elsewhere, see this Journal, Vol. xxxv, p. 361, and Vol. xxxvi, p. 355.

served *one hundred and fourteen* shooting stars. This fact was announced in his Astronomical Annual for 1840, p. 91.

15. *Determination of Longitude by Shooting Stars.*—It has been stated that Dr. Maskelyne first suggested (in 1783?) the utility of corresponding observations of shooting stars and the larger fire-balls for the determination of differences of longitude. It appears, however, that George Lynn is entitled to the credit of a distinct proposal of this kind, made much earlier, in a paper entitled "*A method for determining the Geographical Longitude of Places from the appearance of the common meteors called Falling Stars*," published in the Philos. Trans. of the Royal Society of London, for 1727, No. 400, p. 351. A suggestion somewhat less comprehensive was made still earlier by Dr. Halley, in his account of a large meteor seen in England March 19, 1719, (Philos. Trans. 1719, No. 360.) He says "a considerable use might be made of these momentaneous phenomena for determining the geographical longitudes of places. For if in any places, two observers by help of pendulum clocks, duly corrected by celestial observation, exactly note at what hour, minute, and second such a meteor as this explodes, and is extinguished, the difference of the times will be the difference of longitude of the two places, as is well known."

16. *Ancient Meteorological Memoranda.*—The following notices are copied from entries made by the Rev. James Pierpont, (minister of the first church in New Haven, Conn.) on the blank leaves of an almanac for the year 1692, (by John Tulley: Cambridge, Mass.: printed by Samuel Green and Bartholomew Green, for Samuel Phillips.) The dates being in the Julian style, must of course be advanced ten days to bring them to our present reckoning. E. C. H.

1692. *Tuesday*, *February* 23. At night an unusual eastern storm of furious wind and rain began, and continued till Sabbath following. Rivers higher than ever known. Wallingford bridge carried away: Great damage through the country.

*Thursday*, *March* 3. The aforesaid storm renewed, and continued for that day.

*July* 1. Latter end of June, multitudes of caterpillars fell on corn, and did much spoil in some places, but were remarkably checkt with us.

*July* 4. Excessive hot, and a sore drought about the time.

*July* 9. Excessive hot again. About the time a severe drought. Indian corn almost spoiled: all signs of rain vanisht in drought.

*July* 11. Unexpectedly, and without foregoing signs, a long shower, which revived all things languishing before.

*July* 14. More rain, so that every thing was fully recovered to admiration.

*August* 11. A plentiful rain.

*December* 21. In the evening, two *dracones volantes*, [meteoric fireballs,] of unusual dimensions were seen; on the extinguishing of one, a noise like a great gun was heard: both light and noise were affrighting to many.

17. *Description of Russell's Planetarium, with improvements.*—This great orrery is drawing towards its completion. When finished, the zodiac will describe a circle of more than 48 feet.

The celestial sphere is about 4 feet 8 inches in diameter, and contains the Sun, Mercury, Venus, the Earth and the Moon. The superior planets are placed on the outside of the sphere; Jupiter, Saturn, and Herschel, having their satellites revolving around them in their proper order, with their inclinations to the plane of the ecliptic. Saturn has his two concentric rings, with their proper inclination and direction.

This armillary sphere is a beautiful structure, and is an important addition to the orrery first made by Mr. Russell.

The whole machine will weigh about one ton and a half, and is composed chiefly of cast and wrought iron, and brass, with but little wood. It contains about 500 cog-wheels, large and small, principally of brass.

The Earth revolves on its axis, inclined as in nature about $23\frac{1}{2}°$, and remains parallel to itself, exhibiting perfectly the manner in which the changes of the seasons are produced, and the variations in the lengths of the days and nights. The other planets also revolve on their axes duly inclined to the planes of their own orbits, so that the causes of the vicissitudes upon each planet are readily comprehended.

The Moon revolves around the Earth in an orbit duly inclined to the plane of the ecliptic; making ascending and descending nodes, the retrograde motion of which is also given, so that the circumstances under which eclipses of the Sun and Moon happen, are clearly shown. The libration of the Moon is also exhibited.

The Sun is represented by a gilt globe about 15 inches in diameter, revolving in about its proper time.

The primary planets are represented by beautiful glass globes made opake, with some attention to their relative magnitudes and telescopic appearances.

Vesta, Juno, Ceres, and Pallas, are all to be introduced in the machine; their motions and great inclinations being properly represented.

Jupiter, Saturn, and Herschel, will furnish us with their splendid little orreries, either attached or detached; making at the same time their proper revolutions while going around the Sun.

Columbus, Ohio, February, 1842.

18. *Abstract of Mr. S. C. Walker's paper entitled Researches concerning the Periodical Meteors of August and November, read before the Amer. Phil. Soc. Jan.* 1841.—This paper contains—1st, Tabular statements of the relative velocities derived from corresponding observations of the same meteor at different stations, chiefly from Quetelet's Catalogue. 2d. A catalogue of remarkable appearances of shooting stars, also from Quetelet, with additions. 3d. Bessel's position of the earth, in the ecliptic, at the date of the principal November showers. 4th. The convergent points hitherto observed for the relative paths of the meteors of August, and 5th. Of those of November. The term *periodical* is restricted to the meteors, which, at a particular season of the year, tend towards the convergent point for that season. *Sporadic* is applied to the unconformable meteors seen on the same occasions. *Extraordinary* showers of the second table are placed in the former class, and are considered as differing from periodical meteors only in numbers. The convergent point, as far as noticed for the periodical meteors, is not far from the antipode of the earth's *tangential* direction. The average relative velocities in table first, with the known convergent points, for August and November, and other parts of the year, as far as observed, afford on the cosmical theory, the most plausible estimate of the elliptic elements of the orbit of periodical meteors. The well-known formulæ for computing these elements are stated; and the differential formulæ are investigated for computing the probable errors of such elements, arising from errors of the relative velocities and directions derived from the foregoing tables. The most plausible elements of the periodical meteors, are thus found to have their perihelia inferior to that of Mercury, and hence are only seen by us when near their aphelia; the orbits being necessarily very eccentric, or flattened, and their inclinations very great. Since many millions of these bodies are annually encountered by the earth, including chiefly those which move in orbits having small parameters, analogy leads to the inference, that the planetary spaces inferior to Venus, abound in these bodies, of which only a small proportion ever reach the earth's mean distance, or become visible to us. This suggestion of a far greater aggregation of these bodies near the sun, is supported by the analogy of the resisting medium encountered by Encke's comet, which is only sensible at a distance from the sun below that of Venus. Bessel's objections to the theory of the resisting medium, that it is indicated by no other phenomenon in nature, may be in some degree obviated by this analogy; since a very thin, light body, might be sensibly resisted by a great multitude of these small meteors or asteroids, though their effect is insensible on Mercury and the other primaries, owing to their superior mass and density, and as Encke remarks, also insensible on Halley's and Biela's comets,

whose perihelion distances, respectively, correspond nearly with those of Venus and the Earth. It is only necessary to suppose that in some planes these bodies exhibit a greater tendency to the formation of clusters, or possibly of flattened rings, in order to account for anniversary periods of remarkable showers; since the earth revisiting the same plane at the same season of the year, and at the same distance from the sun, may or may not encounter one of these clusters or parts of a flattened ring. But these clusters continuing to move in the same plane, the earth must, if it meet them at all, do so at anniversary periods. On the supposition of a flattened ring, the node having the same radius vector as the earth, these displays might occur for several anniversaries, and then cease for an indefinite period, owing to the motion of the apsides of the ring; till the anomaly which has a radius vector equal to the earth's mean distance, again coincides with one of the nodes of the ring. Hence the connexion between the periods of the second table, as far as regards our knowledge of them is *accidental*, since they depend not on the orbital period of these bodies round the sun, but on the circumstance of the earth's encountering one of these clusters, or planes abounding in them, which is regulated by a law of distribution of these bodies in planetary space, that must always remain unknown, for want of data for its determinatton.

The author conjectures that the meteors termed *sporadic*, by Quetelet, which have no common convergent point, may have their perihelia superior to those of the periodical meteors, and their aphelia far superior to that of the earth. In such a case, their orbital velocity would be as great as that of the earth, or greater; and as they move in all varieties of direction, the earth's tangential motion does not cause them to tend, relatively towards a convergent point, in nearly an opposite direction, as it does with meteors moving very slowly in their orbits, whatever may be their true directions in space.

A brief history of the opinions and theories of writers on this subject is given; and an oversight pointed out in Prof. Erman's paper, quoted by the author in an oral communication of August 21st, 1840. This relates to Prof. Erman's minimum relative velocity of the meteors, which, instead of being 0.83, of that of the earth, may be indefinitely small, and therefore in his formulæ [Artronomische Nachrichten, No. 385, p. 9,] may give a motion of the convergent point indefinitely great. The author also remarks, that the quantities neglected in Prof. Erman's formulæ for this motion, may produce an important effect on the result, and even change its direction from a retrograde motion, as found by Prof. Erman, to a direct motion as observed by Mr. Fitch, at New Haven, and as indicated by Prof. Forshey's observed positions of this point at two different dates on the night of the 10th of August last.—*Proceedings of the American Philosophical Society, Feb.* 1841.

19. *Barometric Minima of February* 16–19, 1842.—During the violent gale, which swept along the coast of the United States between the 15th and 20th of February last, the oscillations of the barometer, were very extraordinary and perhaps unprecedented. In Boston, the following were the observed altitudes of the mercury in that instrument, reduced to the temperature 50°, to the mean level of the sea, and to the true level of the cistern.

| | | | | |
|---|---|---|---|---|
| Feb. | 15, | 10*h*. | 30.36 | |
| " | 16, | 13 | 28.47 | fall 1.89 in 27 hours. |
| " | 17, | 19 | 30.39 | rise 1.92 in 30 " |
| " | 18, | 2 | 30.39 | stationary 5 hours. |
| " | 19, | 2 | 29.46 | fall 0.93 in 24 hours. |
| " | 20, | 2 | 30.43 | rise 0.97 " " |

Amount of oscillations 5.71 inches in 4 days 11 hours.

The least height I had ever previously noticed in Boston, occurred Jan. 1st, 1827, viz. 28.62, and the greatest on Jan. 1st, 1839, 31.11. From the above, it appears that the extreme range in Boston, in the course of many years is 2.64 inches, nearly three quarters of which were *twice* experienced in 57 hours between Feb. 15th and 17th last.

Boston, March 7, 1842. R. T. P.

At New Haven, Conn., the barometric minimum occurred Feb. 16th, 10*h*. P.M., the column, when reduced as above, standing at 28.69 inches. During the day the gale blew from S. 62° E.; on the 17th, from N. 88° W.—Eds.

20. *Meteorite of Château-Renard.*—A fragment of the meteorite which fell near Château-Renard, in France, June 12, 1841, has been examined by M. Dufrénoy. The meteorite appears to have burst, at an elevation which cannot be determined, into several pieces, of which two only were seen to fall on the earth, about forty paces apart. One of these pieces falling on a rock was broken into a multitude of small fragments; the other buried itself to a depth of about 20 centimetres, (8 inches,) and has separated into but a few fragments, of which the largest is 35 centimetres (14 inches) long, and 11 centimetres (4½ inches) wide.

The exterior of this stone is covered with the black crust which is observed on all meteorites. Its fracture is granular. A small vein traverses the whole mass. Externally this meteorite resembles trachyte; it is of a clear gray, and is composed entirely of crystalline portions, which cross each other as in the volcanic porphyries. However, the spherules of metallic iron, which are scattered with much uniformity, throughout the mass of the stone, indicate a different nature from that of any terrestrial product, for iron is not found here in a metallic state:

at least its discovery has been alleged, and that in a doubtful manner, in but three or four localities. This aerolite resembles, on the contrary, in a remarkable manner, some of the slags of the furnace. Examined with a strong magnifier, two distinct minerals are recognized: one imperfectly lamellar, presents in some parts bands analogous to those which characterize the hemitropic masses of albite or labradorite: the other, of a vitreous fracture, might be taken for quartz, if we did not know from numerous observations, that this mineral is not found in true volcanic rocks, nor in those of meteoric origin. Besides these two minerals, the eye detects small black glassy globules, analogous to perlite. These are evidently the product of fusion, and their gray interior, which is like the general texture of the stone, has not been altered by the heat. Finally, there are to be detected small shining black plates, which are particularly collected about the veins which traverse the stone. These small plates resemble the scales of graphite which exist in some varieties of gneiss. The gravity of the stone is 3.56: that of the grains of metallic iron, extracted by the magnet, is 6.48.

Before the blowpipe, a fragment is immediately reduced to a black hollow scoria, like that of the exterior crust of the stone. This proves that the crust is the result of the fusion of the exterior parts, which are oxidized to a very high degree by their contact, when at an elevated temperature, with the atmosphere.

M. Dufrenoy gives the following as the result of three analyses which he made.

| | |
|---|---|
| Silica, | 38.13 |
| Magnesia, | 17.67 |
| Protoxide of iron, | 29.44 |
| Protoxide of manganese, | a trace. |
| Alumina, | 3.82 |
| Lime, | .14 |
| Metallic iron, | 7.70 |
| Nickel, | 1.55 |
| Sulphur, | .39 |
| Potassa, | .27 |
| Soda, | .86--99.97 |

Or, grouping together the elements which are combined:

| | |
|---|---|
| Alloy of iron and nickel, | 9.25 |
| Pyrites, | .67 |
| Ferruginous peridote, soluble in acids, | 51.62 |
| Matter insoluble in acids, and not related to any known mineral, | 38.17--99.71 |

*L'Institut, July* 22, 1841, *No.* 395.

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THE TELLURIUM.

*An Astronomical Machine by Edwin C. Leedom, M.D. Plymouth, Pa.*


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THE

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OF

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CONDUCTED BY

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OF YALE COLLEGE.

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