THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and For. Mem. Geol. Soc., London; Mem. Geol. Soc., Paris; Mem. Roy. Min. Soc., Dresden; Nat. Hist. Soc., Halle; Imp. Agric. Soc., Moscow; Hon. Mem. Lin. Soc., Paris; Nat. Hist. Soc., Belfast, Ire.; Phil. and Lit. Soc., Bristol, Eng.; Hon. Mem. Roy. Sussex Inst., Brighton, Eng.; Lit. and Hist. Soc., Quebec; Mem. of various Lit. and Scien. Soc. in America.

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MISCELLANIES.

ERRATA.

Page 70, l. 12 fr. top, for *Lebois* read *Seboois*.—P. 72, l. 5 fr. bot. for *Kennebunk* read *Kennebeck*.—P. 204, l. 9 fr. top, for *Siberian*, read *Silurian*.—In a part of the impression, the drawing on p. 206 was accidentally inverted.

The writer of the article, "extracted from the Diary of a Naturalist," and published in the October number of the Journal for 1836, has since discovered several mistakes, which he wishes to correct. On page 1 it is stated, that the "first steamboat built on the western waters was the Washington"—he has since ascertained that a small boat was built some years before at Brownsville, and went down the river, but did not return: the Washington was built at Wheeling, Va. On page 64 it is stated, that Cols. Williamson and Crawford were engaged in the massacre of the Christian Indians at Gnadenhutten, which is a mistake as regards Col. Crawford, and probably arose from the fact of his being engaged with Col. Williamson in the affair at Sandusky plains in May following, where he lost his life. Colonel Crawford was a humane and excellent man, and abhorred that wicked transaction. The "legend of Brady's hill," at page 20, he is sorry to say, he fears has been confounded with some other adventure, as Capt. Brady's descendants affirm that he was never a prisoner to the Indians.

Feb. 2, 1838.

NOTICE.

TO OUR READERS AND FRIENDS.

SINCE the name of my son now appears for the first time, as assistant Editor of this Journal, I beg leave to mention him in that character, while I indulge a hope that he will endeavor, in that relation, as well as all others, to recommend himself to the confidence of the wise and good. More it is not necessary to say; and it remains to be seen, how far he will honor the trust thus reposed in him, in reference to the editorial and professional duties to which he is now devoted.

B. SILLIMAN.

New Haven, April, 1838.

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 and pamphlets 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, as now, in part, retrospective.—*Eds.*

DOMESTIC.

Remarks of Mr. Calhoun in Senate U. States on the bill authorizing an issue of Treasury Notes, Sept. 19, 1837. From Hon. J. C. Calhoun.

Speech of Hon. John C. Calhoun on the separation of the Government from the Banks, in Senate, October 3, 1837. Hon. J. C. Calhoun.

Catalogue of Poughkeepsie Collegiate School, with a figure of a Trilobite. From George L. Le Row.

Jewett's Advertiser, Medical and Scientific, No. 4. Vol. III. Oct. 1837. From the Editor.

Introductory Lecture at the opening of the Lancaster Conservatory, by and from Rev. C. Fr. Cruse.

Notice of the Indian copy of the Hebrew Pentateuch.

Letter No. X. to Am. Teachers on the Lyceum System of Education. Josiah Holbrook.

Dr. Barber's Elocutionist.

The Elements of Biblical Interpretation, by Rev. L. A. Sawyer.

Memoirs of Miss Mary Lyon. The three last from A. H. Maltby, the publisher.

Catalogue of the Library of the Linonian Society of Yale College. From L. T. Downing.

The Spirit's Life, a Poem. From the Author, Rev. Ray Palmer.

A Monograph of the Helices of the United States, by Amos Binney, M. D., M. B. N. H. Soc. &c. From the Author.

Ogdensburgh Meteorological Notice, in a newspaper of Oct. 17, 1837.

Reports and other documents relating to the State Lunatic Asylum at Worcester, Mass. with a print, pp. 200; printed by order of the Senate. From the Superintendant, Dr. S. B. Woodward. Two copies.

Historical Collections of New Hampshire, part 5. From Concord, N. H. 1837. From J. B. Moore, Librarian of the Society. Two copies, one for Y. Col. Library.

Documents relating to an attack by a British Squadron, upon the armed Brig General Armstrong, in the Island of Fayal, Sept. 26, 1814. From her late commander, S. C. Reid. Troy Budget, Oct. 31, 1837.

American Association for the supply of Teachers, 1837. From Jos. H. Dulles. Six copies.

Report on the Auburn and Rochester Rail Road, by Robert Higham, Engineer. From Henry Tracy, Canandaigua.

Scioto Gazette, Oct. 26, 1837, with notice of very large bones of a Mastodon. J. Hughes, Jackson C. H., Oct. 21, 1837.

Courier and Enquirer, of New York, Nov. 13, 1837—State Election Returns.

Portsmouth Times, Nov. 16, 1837—Aurora.

Am. Soc. for Diffusion of Useful Knowledge, Pros. for Am. Lib. for Schools and Families.

Buffalo Daily Com. Advertiser, several in Nov., containing Notices of Meteoric Phenomena. From R. W. Haskins.

Catalogue of the Golden Branch of Phillips' Exeter Academy, 1837. From the Society.

Poughkeepsie Telegraph, Nov. 22, 1837, with notice and drawing of a Trilobite. From G. L. Le Row.

An Address delivered before the Springfield High School, Ohio, Sept. 1837, by and from John H. James.

Introductory Letter, delivered before the Medical Class of the University of Maryland, Nov. 1837, by Sam. G. Baker, M. D. From the Author.

Annual Announcement of the Trustees and Faculty of the Medical College of South Carolina, for the session of 1837–38. From Prof. C. U. Shepard.

Extracts from Correspondence of the American Bible Society, Nov. 1837.

An Address delivered before the Mass. Charitable Mechanics' Association, Sept. 20, 1837, by his Ex. Gov. Ed. Everett. From the Author.

Portsmouth (Va.) Times, Dec. 2, 1837—Notice of an Aurora. Hd. Rodriguez.

Papers on the Wyoming Claims on the United States Government. J. W. Robinson.

Pennsylvania Intelligencer, Dec. 7, with the Governor's Message. J. W. Robinson.

Cheiroptera of the United States, by Wm. Cooper, with a plate, from the Annals of the Lyceum of Natural History. From the Author.

Journal of the American Temperance Union, Dec. 1837.

Catalogue of Princeton Theol. Seminary, for 1837–8. From E. P. Rogers.

Report of the State Treasurer of Pennsylvania, 1837. From J. W. Robinson.

Catalogue of Plants near Newbern, N. C.—with Remarks and Synonyms, by the late H. B. Croom, Esq., posthumous. From the Editor, Prof. John Torrey.

Twelfth Annual Report of the Board of Managers of Prison Discipline Society, Boston, 1837.

An Essay on the Veterinary Art, by Peter O. Browne, LL. D. 1837. From the Author.

Annals of the Lyceum of Nat. History, Vol. IV. Nos. 1, 2, 3 and 4, Nov. 1837.

Catalogue of French Medical, Mathematical, &c. Books, for sale, Dec. 16, 1837. Boston.

Report on the Strength of Materials, by the Franklin Institute. Part II. 1837. Hon. J. J. Whittelsey, M. C.

Farmer's Register, Dec. 1, et seq. 1837. Petersburgh, Va.

Speech on behalf of the University of Nashville, Oct. 4, 1837, at the public commencement, by President Lindsley.

Rev. Thomas Smyth's Sermon on the loss of the Steam Packet Home, with a Narrative.

New York Daily Whig. Several Nos.

Franklin Farmer, Frankfort, Ky. Several Nos.

Clinical Lecture on the Primary Treatment of Injuries, by Dr. Alex. H. Stevens.

Ordnung des taglichen Morgen Gebetes, &c. New York.

Circular of the College of Physicians and Surgeons of the Univ. of New York. 1837.

Colonization Herald and General Register, Vol. I. No. 1 and 2. Jan. 3 and 10.

Catalogue of Catlin's Indian Gallery of Portraits, Landscapes, Manners and Customs, &c. New York, 1837. From Mr. Catlin.

Catalogue of the Western Reserve College, 1836–7.

Literary Advertiser of the American Stationers' Company, Boston. July, 1837.

Daily Commercial Bulletin of Pittsburgh. Jan. 1838. From Linton Rogers.

Tract Magazine. Jan. 1838. From O. Eastman.

South Western Journal, Vol. I. No. 1. quarto, 16 pages, et seq.

Geological Reconnaissance of the State of Indiana in 1837, by D. D. Owen, State Geologist. From Prof. Dunn.

Report of the Commissioner of Patents for 1837. From the Superintendent, H. W. Ellsworth, Esq.

Prof. Cunningham's Inaugural Address, Easton, Penn. Jan. 1, 1838.

Report on the Medical College of Ohio, Dec. 1837. Dr. J. P. Kirtland.

Buffalo Daily Advertiser, Jan. 30, 1838. R. W. Haskins.

Rev. President Day on the Self-determining Power of the Will and Contingent Volition. From the Author.

Four Years in Great Britain, by Rev. Calvin Colton. From the Author.

Report of the Committee on Colleges, Academies and Common Schools, on the Memorial of William G. Griffin and others. From B. D. Silliman, Esq.

Proceedings of the Annual Convention of Professional Teachers and others, Columbus, Ohio, Dec. 1837. From M. G. Williams.

Fourth Geological Report to the Legislature of Tennessee, Oct. 1837, by Prof. G. Troost, M. D., Geologist to the State, &c. &c. From the Author.

Notice of the Academy of Natural Sciences of Philadelphia. 1837. p. 24. Dr. S. G. Morton. With one for the Yale Nat. Hist. Soc.

Penn. Inquirer, Feb. 24, 1838, with the Address of Hon. J. S. Buckingham on Temperance.

Buffalo Commercial Advertiser, No. 971; Do. No. 55, with notice of Falling Stars. R. W. Haskins.

Report to the Legislature of Ohio, Dec. 10, 1837, on Elementary Public Instruction in Europe, by Prof. C. E. Stowe. From the Author.

Considerations on a States' National Bank, by John L. Sullivan, A. M. From the Author.

Prospectus of the Missouri Iron Company, with the Acts of Incorporation. Rev. Giles Pease.

Boston Daily Advertiser, March 13, 1838, with a Memoir of the late Dr. N. Bowditch.

Buffalo Newspapers, with a list of Scientific Memoranda, translated from the Proceedings of the French Academy, by R. W. Haskins.

Discourse on the recent Duel in Washington, by Rev. Henry Ware, Jr.

On the same, by Rev. W. B. Sprague, D. D. Albany.

An Address on the Utility of Astronomy, delivered before the Young Men's Society of Lynchburgh, Va., by Prof. Landon C. Garland, of Randolph Macon College.

First Annual Report on the Geological Survey of the State of Ohio, by W. W. Mather, and the several Assistants. Columbus, 1838. Two copies from the corps; one copy from Mr. Seabury Ford.

Sixth Annual Report of the New England Institution for the Education of the Blind. From Dr. Saml. G. Howe.

Fifth Annual Report of the Trustees of the State Lunatic Hospital at Worcester, Dec. 1837. From the Superintendant, Doctor Samuel B. Woodward.

Second Report of the Executive Committee of Young Men's Association of the City of Buffalo. R. W. Haskins.

Macon Messenger, March 8, 1838, with a notice of the Thundering Spring.

Prospectus of the W. Virginia Iron Mining and Manufacturing Co. F. Shepherd.

Address delivered before the Bellefonte Lyceum, Feb. 1838.

Colonization Herald, Vol. I. No. 2. March 14, 1838. Philadelphia. 5 copies, 1 from Mr. Elliot Cresson.

Report of the State Geologist to Gov. Mason of Michigan, on the Geological Survey of that State.

Outlines of Geology, prepared for the Junior Class in Columbia College, by Prof. Jas. Renwick, LL. D.

Second Annual Report on the Geological Exploration of the State of Pennsylvania, by Prof. Henry D. Rogers. From Mr. Ritner. Another copy from Prof. H. D. Rogers; another from an unknown hand; another from E. Miner, Esq.

A Discourse on the Traffic in Spirituous Liquors, Feb. 1838. By Rev. Leonard Bacon, New Haven.

Statistical Tables of certain branches of Industry in Massachusetts, for 1837 to April 1. From John P. Bigelow, Esq., Secretary of the Commonwealth.

Report of the Committee on the Judiciary in the Legislature of New York. March 18, 1838. From B. D. Silliman, Esq.

Cleaveland Gazette, March 3, 1838, notice of ice.

Wiley and Putnam's notice of new books.

Temperance Circular, March 22, 1838.

Prof. White's and John T. Norton's Sermon on the occasion of the decease of John Nitchie, Esq. New York, 1838. From the Secretaries of the A. H. M. S.

Picture of Young Ladies, from the Society Seminary at Bethlehem, Penn. From G. Grunewald, by Col. Trumbull.

Catalogue of Bacon Academy, 1837. From M. N. Morris.

Dr. Geddings' Introductory Lecture, Medical College of South Carolina. Charleston, Nov. 1837. From H. H. Bacot.

Journal of American Temperance Union, vol. ii. No. 1.

Buffalo Patriot, &c., Jan. 10, 1837, with a Map of Navy Island, Niagara River, &c. From G. L. Marvin.

Boston Atlas, Aug. 2, 1837.

Annual Report of the Commissioners of Indian Affairs for 1837–8. Transmitted at the opening of the 2d session of the 25th Congress. Washington. From Charles E. Mix.

New Hampshire Patriot, &c., Aug. 2, 1837.

Medical Examiner, Philadelphia, No. 1, Vol. 1. Jan. 3, 1838. J. B. Biddle, M. D. and M. Clymer, M. D.

Seventeenth Annual Report of the Mercantile Library Association. Clinton Hall, New York, 1837.

Extracts from the Correspondence of the American Bible Society, Nos. 21 and 22. March, 1838.

First Report on the Agriculture of Massachusetts. By H. Colman, Commissioner. Boston, 1838. The Author.

Treatise on Bone Manure. By Henry Colman, Commissioner for the Agricultural Survey of Massachusetts. Boston, 1838. The Author.

On the Culture of Spring Wheat. By the same. From the Author.

FOREIGN.

Liverpool Mercury, Sept. 15, 1837, containing an account of the doings of the British Association for the promotion of Science. From Rev. S. Wood.

Notice of the Scientific Congress at Metz, Sept. 3, 1837.

Circular of Louis and Andrè Breton, Mathematical and Philosophical Instrument Makers, Rue Servandoni, No. 4, pres St. Sulpice, Paris.

Liverpool Standard, Sept. 15, 1837 ; with an account of the doings of the British Association for the advancement of Science. From Rev. S. Wood. The same from Mr. St. John, late a tutor in Yale College.

Report on the Present State of our Knowledge with respect to Mineral and Thermal Waters, by and from Prof. Charles Daubeny, of the University of Oxford, England. 1837.

On the action of Light upon Plants, and of Plants upon the Atmosphere. Id. 1836.

Some account of the Eruption of Vesuvius, which occurred in Aug. 1834. Id. 1835.

On the quantity and quality of the gases disengaged from the Thermal Spring, which supplies the King's Bath, in the city of Bath. Id. 1834.

Catalogue of Philosophical Apparatus, by Wilkins & Hall. London, No. 5, Charing Cross. From J. H.

Remarks upon the Aristotelian and Platonic Ethics, as a branch of the studies of the University of Oxford, by Frederick Oakley, M. A., Fellow of Baliol College.

The study of Morals vindicated and recommended, in a sermon preached before the University of Oxford, Feb. 5, 1837, by Henry Arthur Woodhouse, B. D., Fellow of St. John's College. The two preceding from Mr. Charles Fox.

List of Works by American authors, on sale by Jas. S. Hodson, 112, Fleet street, London. From J. S. H.

Memorials of Oxford, England, No. 39, with Plates. From Prof. Daubeny.

Proceedings of the Geological Society of London. Nos. 50 and 51. From the Society.

Prospectus of the Polytechnic University, London. John Isaac Hawkins.

Foreign Scientific Memoirs—notice of a republication of a selection of, by Richard Taylor, F. S. A.

Catalogue of British Plants, arranged according to the natural system, &c. &c., by Rev. Prof. J. S. Henslow, M. A., of Cambridge University, England. From the Author.

Researches into the Causes of Voltaic Electricity, by Mons. Aug. de la Rive, of Geneva. From the Author.

Icones Filicum, or Figures and Descriptions of Ferns, principally of such as have been altogether unnoticed by Botanists, or have not yet been correctly figured. By William Jackson Hooker, LL. D. and Robert Kaye Greville, LL. D. In two volumes folio. Londini, 1831.

British Jaugermauniae ; being a history and description, with colored figures, of each species of the Genus, and Microscopical Analyses of the parts. By William Jackson Hooker, LL. D. London, 1816. Quarto, 88 Plates.

Musci Exotici, containing figures and descriptions of new or little known Foreign Mosses, and other Cryptogamic subjects. By William Jackson Hooker, F. R. A., LL. D., &c. &c. London, 1818. 2 vols. 8vo.

Icones Plantarum, or figures and descriptions of new or rare Plants, selected from the Author's Herbarium. By Sir William Jackson Hooker, K. B., LL. D., &c. &c. 3 Parts, octavo, each containing 50 Plates. London, 1836–7.

Journal of Botany, by Sir William J. Hooker, LL. D., &c. &c. London, 1834. 4 Parts.

Companion to the Botanical Magazine. London. Nos. 1 to 20. By Sir W. J. Hooker, LL. D., &c. This and the five preceding it are from the Author.

Edinburgh Evening Courant, of Dec. 25, 1837, with a notice of the presentation of a silver vase to John Wood, Esq., Advocate, on account of his exertions in the cause of education.

Sussex Advertiser, England, Jan. 8, 1838. Brighton Herald, Jan. 20, 1838. Dr. Mantell.

British Annual, and Epitome of the Progress of Science, for 1838. From the Editor, Dr. Robert D. Thompson, London.

Notice of the University of Durham, Eng. From an English Newspaper.

List of the Geological Society of London. April, 1837.

Letters from Rev. Samuel Wood on the United States. Nos. 1 and 2. London, Nov. 1837. From the Author.

MINERALS.

A box, containing chiefly chalk fossils, echini, bivalve and univalve shells, sharks' teeth and palates, and other remains of fishes, sponges, alcyonia, fuci, coprolites, belemnites, &c. From the Wealden—emys, iguanodon bones, &c. &c. From the tertiary—bones and teeth of the horse. From the diluvial—bog iron ore. Wood, from the peat bogs of Ireland—the submerged forests, coal plants. From Dr. G. Mantell, Brighton, Eng.

Very perfect and beautiful terebratulites and fossil corals—shore of Lake Erie, fifteen miles from Buffalo. G. E. Hayes.

Specimens of marl from New Jersey. From J. M. Ely, Esq., New York.

Fossil equisetum, in sandstone—large and distinct, from the excavations for the Walhouding and Mohican Canal, at Roscoe, Ohio. From J. S. Peters, Esq.

Specimens of bituminous coal, from New Lisbon, Ohio—remarkably filled with vegetable remains in flattened masses, having a distinctly fibrous structure. From Wm. E. Russell, Esq.

Lignite of remarkable beauty, from New Jersey. Dr. L. D. Gale, New York University.

CONTENTS.

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B. Silliman.

New Haven, April, 1838.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Seventh Meeting of the British Association for the Advancement of Science.*

[Concluded from Vol. xxxiii. p. 296.]

Waves.—Mr. Russell had made in September, 1836, a series of observations on the River Dee, below Chester, where that river has a form and dimensions admirably suited to the purpose. It appears, that for more than five miles in length, the banks of the Dee are perfectly straight, quite parallel to one another, while the depth of the channel at low water is nearly uniform throughout the whole of that length. Now, in this river there is a tidal wave of from six to fifteen feet, forming, in fact, a tidal canal of large dimensions. On this part of the river the first series of observations was made; a second was made upon the River Clyde; and a third on the waves at the surface of the sea: and the series has been terminated by a course of experiments made in artificial channels of different forms, for the purpose of determining the nature of the mechanism of the generation and propagation of waves, so as to determine the identity of their nature with the tidal wave.

It appears that there exists a species of wave different from all the others, and which Mr. Russell calls "The Great Primary Wave of Translation," which is generated whenever an addition is made to the volume of a quiescent fluid, in such a manner as to affect simultaneously the whole depth of the fluid, and this species of wave is exactly of the same nature as the tide wave. In a rectangular channel this primary wave moves with the velocity which a heavy body would acquire in falling through half the depth of the fluid, so that

In a channel about 4 inches deep, the velocity of the wave is nearly 2 miles an hour.

—	12	——	——	4	—
—	2 feet deep		——	$5\frac{1}{2}$	—
—	3	——	——	$6\frac{1}{2}$	—
—	4	——	——	$7\frac{2}{3}$	—
—	5	——	——	$8\frac{2}{3}$	—
—	6	——	——	$9\frac{1}{3}$	—
—	7	——	——	10 1-5th	—
—	8	——	——	11	—
—	9	——	——	$11\frac{1}{2}$	—
—	10	——	——	12 1-5th	—
—	15	——	——	15	—
—	30	——	——	20	—
	&c.			&c.	

It also appears that the breadth of the channel, when the depth is given, does not at all affect the velocity or form of the wave; and Mr. Russell then proceeded to assign a general rule, by means of which the velocity of the wave might be assigned *à priori* for a channel of any form, however irregular.

The manner in which the wave was observed, was by successive reflections from opposite surfaces, so as to make it pass and repass a given station of observation, the interval being noted by an accurate chronometer; and it was stated, that in many cases, above sixty transits of the same wave had been observed, so as to give a high degree of accuracy to the observations. The instant of the wave's transit had been observed by the reflection of a luminous image, thrown down by a series of mirrors, so as to cross micrometer wires with perfect precision. For a mode of determining the length of the wave, Mr. Russell acknowledged himself indebted to Prof. Stevelly, of Belfast.

These observations, having determined the laws of the propagation of waves on a small experimental scale, were then extended to the analogous phenomena of the great tidal wave. In his observations on the River Dee, Mr. Russell found that the tide wave followed precisely the same laws as those in his experimental channel; that its velocity was exactly proportioned to the square root of the depth of the fluid, that its form changed in the same manner, and the existence of the same law was sufficient to account for the different rate of propagation of different tides between two given places, because a tide of fifteen feet deep would travel from one place to another at the rate of fifteen miles an hour, while one of ten feet deep would proceed at the rate of only twelve miles an hour; so that if the places were thirty miles apart, the one would receive the former tide two hours later, and the latter tide two and a half hours later than the other. The creation of a tidal Bore in some places was also accounted for on the same principles; and it was evident, that the means of improving the navigation of tidal rivers might be satisfactorily deduced from these principles.

Similar observations had been made on the tidal wave of the River Clyde, which was found to move in strict conformity with the laws of the great wave of translation, as determined by Mr. Russell's previous experiments.

Magnetical Observatory at Dublin.—The Magnetical Observatory now in progress at Dublin, is situated in an open space in the gardens of Trinity College, and sufficiently remote from all disturbing influences. The building is forty feet in length, by thirty in depth. It is constructed of the dark-colored argillaceous limestone, which abounds in the valley of Dublin, and which has been ascertained to be perfectly devoid of any influence on the needle. This is faced with Portland stone; and within, the walls are to be *studded*, to protect from cold and damp. No iron whatever will be used throughout the building. With reference to the materials, Prof. Lloyd mentioned, that in the course of the arrangements now making for the erection of a Magnetical Observatory at Greenwich, Mr. Airy had rejected bricks in the construction of the building, finding that they were in all cases magnetic, and sometimes even polar. Mr. Lloyd has since confirmed this observation, by the examination of specimens of bricks from various localities; and though there appeared to be great diversity in the amount of their action on the needle, he met with none entirely free from such influence.

The building consists of one principal room, and two smaller rooms,—one of which serves as a vestibule. The principal room is thirty-six feet in length, by sixteen in breadth, and has projections in its longer sides, which increase the breadth of the central part to twenty feet. This room will contain four principal instruments, suitably supported on stone pillars: viz. a transit instrument, a theodolite, a variation instrument, and a dipping circle. The transit instrument (four feet in focal length,) will be stationed close to the southern window of the room. In this position it will serve for the determination of the time; and a small trap-door in the ceiling will enable the observer to adjust it to the meridian. The theodolite will be situated toward the other end of the room, and its centre will be on the meridian line of the transit. The limb of the theodolite is twelve inches in diameter, and is read off by three verniers to ten seconds. Its telescope has a focal length of twenty inches, and is furnished with a micrometer reading to a single second, for the purpose of observing the *diurnal variation.*

The variation instrument will be placed in the magnetic meridian, with respect to the theodolite, the distance between these instruments being about seven feet. The needle is a rectangular bar, twelve inches long, suspended by parallel silk fibres, and inclosed in a box to protect it from the agitation of the air. The magnetic bar is furnished with an achromatic lens at one end, and a cross of wires at the other, after the principle of the collimator. This will be observed with the telescope of the theodolite, in the usual manner; and the deviation of the line of collimation of the collimator from the magnetic axis will be ascertained by reversal. The direction of the *magnetic* meridian being thus found, that of the true meridian will be given by the transit. It is only necessary to turn over the transit telescope, and, using it also as a collimator, to make a similar reading of its central wire, by the telescope of the theodolite. The angle read off on the limb of the theodolite is obviously the supplement of the variation. This use of the transit has been suggested by Dr. Robinson; and it is anticipated that much advantage will result from the circumstance, that the two extremities of the arc are observed by precisely the same instrumental means. With this apparatus it is intended to make observations of the *absolute variation* twice each day, as is done in the observatory of Prof. Gauss, at Göttingen,—the course of the *diurnal variation*, and the hours of maxima and minima, having been ascertained by a series of preliminary observations with the same instrument.

A dipping circle constructed by Gambey, will be placed on a pillar at the remote end of the room; and will be furnished with a needle, whose axis is formed into a knife-edge, for the purpose of observing the diurnal variations of the dip. Gauss's large apparatus will also be set up in the same room, and will be used occasionally, especially in observations of the *absolute intensity*, made according to the method proposed by that distinguished philosopher. The bars are too large to be employed in conjunction with other magnetical apparatus.

It is intended to combine a regular series of meteorological observations, with those on the direction and intensity of the terrestrial magnetic force just spoken of; and every care and precaution has been adopted in the construction of the instruments.

In conclusion, Mr. Lloyd said, that he felt it a duty to allude to the liberality and zeal in the cause of science, which had been evinced by the Board of Trinity College on this occasion. The probable expense of the building and instruments is estimated at 1000*l.*; and that sum was immediately allocated to the purpose, when it appeared that the interests of science were likely to be benefited by the outlay.

Mr. Peacock congratulated the Section upon the prospect held out to the scientific world, of having fixed magnetical observatories erected in such places as would afford the surest promise of successful co-operation, particularly when they would be placed under the superintendence of gentlemen so eminently qualified for the task as Prof. Lloyd. He informed the Section, that an observatory for magnetical observations had been erected at Greenwich, and that little doubt need be entertained of the rapid advances which the interesting investigations connected with this important science would now receive.—Mr. Ettrick conceived, that bricks would be a very improper material for the construction of a magnetical observatory. He considered the use of metals in any part of the building as highly objectionable; even copper, as fastenings, or hinges to doors, would not be free from injurious effect. He made some inquiries as to the mode of reading off, proposed by Prof. Lloyd.—Prof. Stevelly said, that Mr. Ettrick was unquestionably right in the objection urged against the use of bricks, but Prof. Lloyd had distinctly stated, that bricks were not to be used, and that experiments had been made to ascertain the precise magnetical influence, if any there was, of the kind of stone which it was proposed to use. It was well, however, that Mr. Ettrick's observations should go abroad, for the guidance of persons not conversant with these subjects. Bricks, when built into large edifices, such as the chimneys of factories, were well known to have acquired magnetic polarity: the material from which they were made must be largely impregnated with iron: the mud of rivers was the detritus from hills, whose rocks were often highly magnetic. The engineers employed on the trigonometrical survey of Ireland, had erected a mound of stones composed of basalt, to sustain the signal-staff which they had erected on the highest hill, near Belfast: the effect of that heap of stones on the magnetic needle was so great, that in walking round it, the needle would veer round to every point of the compass.

Electro-Magnetic Currents.—M. de la Rive then read a paper 'On the Interference of the Electro-magnetic Currents.' This distinguished foreigner addressed the Section in the French language. After a brief *résumé* of the known properties of electro-magnetic currents, he adverted to some new results at which he had arrived in studying them. He remarked, that in chemical decomposition effected by these currents, the *individual* force of each was greater the more rapidly they succeeded each other; so that, to decompose a given quantity of water, it becomes necessary to have a number of these currents, so much the greater as the succession is less rapid. There is, however, a limit, beyond which the force of the currents is not augmented by any further augmentation of the rapidity of the succession. When plates of platina are employed, instead of wires, in the decomposition of water, the decomposition ceases to take place when the surface of contact of the metal with the liquid surpasses a certain limit. Nevertheless, the current, far from diminishing in intensity, becomes, on the contrary, more intense,—as is shown by the indications of a metallic thermometer,—the helix of which, placed in the current, furnishes a measure of its calorific energy. As soon as the surfaces of contact are of such magnitude that decomposition is no longer effected, the thermometer reaches a maximum, which it does not pass, even when the surfaces of contact are augmented. This fact seems to prove, that chemical decomposition produced by electrical currents takes place only when these currents undergo a certain resistance in their passage from the metal into the liquid; and that, when this resistance does not exist, decomposition ceases. When we employ wires of platina to transmit the magneto-electric currents into a solution of any kind, whether acid, saline, or alkaline, we, at first, observe an abundant evolution of gas; then this disengagement diminishes, and at the end of fifteen or twenty minutes it altogether disappears. When we examine these metallic wires, we find them covered with a very fine powder, composed of platina in the metallic state, but extremely divided. The same phenomenon takes place with gold, palladium, silver, &c. All these metals are covered, in the same manner, with a very fine coating of the metal itself, in a state of extreme subdivision. The author has assured himself that this powder was composed of the metal itself, and not an oxide or a suboxide. He inquired whether this effect is the result of the mechanical shocks that the molecules of the metal undergo by the action of these currents, which are discontinuous, and alternately in opposite directions; and whether it would not be augmented by the succession of oxidations and deoxidations, which would occur on the surface of the wires. He concluded by stating, that he had observed that the armatures of soft iron (about which the metallic wires are coiled, in which the currents are developed by induction,) cease to be attracted by the poles of the magnets, before which they pass when the two ends of the wire in which the current is developed are united by one good metallic conductor; a fact which would seem to prove that Magnetism and Dynamical Electricity are, in these cases, but two different forms of the same force, one of which disappears when the other becomes apparent; and he insisted on the advantage that we might derive from this property in the production of motion by electro-magnets.

Clearness of the Air.—Prof. Lloyd said that the distinctness and vividness with which distant objects were seen in some states of the atmosphere was quite astonishing: on one occasion he had seen from the neighborhood of Dublin the Welsh hills from their very bases, and brought so near, apparently, that he could absolutely see the larger inequalities of the surface upon the sides of the mountains. That the atmosphere was at the time very much loaded with vapor in a highly transparent state, was obvious from the fact, that immediately after a very heavy fall of rain took place, and continued for a considerable time.—Prof. Stevelly wished to confirm what had fallen from Prof. Lloyd and M. de la Rive by stating that whenever the Scotch hills appeared with peculiar vividness and distinctness, from the Lough of Belfast, the fishermen always looked upon it as a sure precursor of heavy rain and wind. A friend had informed him that on one occasion he had noticed this appearance while standing on the beach at Hollywood, and pointed it out to an old fisherman; the old man immediately gave notice to all his friends to whom he had access, who instantly set about drawing up their boats and placing their small craft in more secure places; early the next morning a violent storm came on, which did much damage upon the coast, to those who had not been similarly forewarned. It might perhaps be accounted for by supposing that on these occasions the intervening air became actually converted into a large magnifying lens.

Magnetic Intensity.—Determinations of the value of the terrestrial intensity have been obtained at between forty and fifty widely scattered stations, principally in the southern hemisphere, where such determinations had been previously a great desideratum.

The number of separate determinations collected in this Report exceeds six hundred, and the number of stations falls a little short of five hundred. They are the work of twenty-one observers, and of these the observations of seven have been hitherto unpublished.

Beer.—Mr. Black communicated a paper 'On the Influence of Electricity on the processes of Brewing.' According to his statements, a thunder-storm not only checks the fermentation of worts, but even raises the gravity of the saccharine fluid, and developes in it an acid. This effect is witnessed principally when the fermenting tun is sunk in moist earth, and may be obviated by placing it upon baked wooden bearers, resting upon dry bricks or wooden piers, so as to effect its insulation. Mr. Black also stated, that during the prevalence of highly-electrified clouds, the fabrication of cast iron does not succeed so well as in other states of the atmosphere.

Electrical Relations.—Dr. Faraday cautioned chemists against considering electrical relations as affording, in every instance, conclusive proofs of what is a base and what is an acid.

Electrical Protection.—A letter was next read, addressed by Mr. Locke to Mr. W. W. Currie, of Liverpool, in which the latter was requested to propose as a question, to the philosophers assembled, whether, in the case of a monument one hundred and forty feet in height, erected on the summit of a mountain fourteen hundred feet high, augmented safety or danger would be the consequence of attaching to it a conductor or paratonnerre. The column is sandstone, the mountain conglomerate, and in the vicinity of the latter there is a mountain of still greater elevation. It was resolved, that this letter should be, *pro formâ*, put into the hands of Mr. Snow Harris, though no doubt whatever was felt as to the answer which it would be proper to give to such an inquiry. The efficacy of the protectors of Franklin in every possible situation, provided they be constructed upon proper principles, and mounted in a suitable manner, is now universally admitted.

Mining.—Mr. Tarlor, jun., stated, that, in the course of his experience in practical mining, he had observed certain conditions necessary for the profitable working of metals. In the oldest, or scar limestone, he had observed that the miner was not remunerated; but in newer lead measures he had a better chance of success, as in grits and shales. The best chance was in altered rocks. In Cardiganshire he had observed a remarkable case in a slaty rock: where very schistose, the workings were poor; but where the rock was *diced*, as the workmen call it, they were certain to be rich: the strike of the altered rock being N. and S., and that of the veins E. and W. He had seen remarkable proofs of the mechanical theory in North Carolina, especially in the rich veins of iron ore in that country. Mr. Sedgwick remarked, that fissures caused by crystallization were, in general, very small; and that joints seldom coincided with rents;—that in districts where granite approaches slate rocks, we may be certain of finding the richest metalliferous deposits.

Catastrophe in a Mine.—Mr. Sedgwick requested the attention of the meeting to an account, which he was about to submit, of the late unfortunate accident at the Workington Colleries. He pointed out, on the geological map, the rocks which occur in that neighborhood, and stated some of the phenomena of the stratification of the coal measures, which are there very much disturbed. There is an anticlinal line, on the opposite sides of which the strata dip differently, so that, in one place, very important beds of coal crop out under the sea. Workings, quite submarine, have accordingly been carried on for some time: in the Isabella pit, a depth of one hundred and thirty-five fathoms under high water has been reached. A culpable want of caution has been shown by the managers of late, as they have caused the workings to reach too near the sea—even within fourteen fathoms of it; and the pillars and roof of the older works had been taken away, by which the danger was greatly increased. There had been repeated warnings from the shrinking of the ground, and from an old work having become filled with water;—also in the new workings—although the pumping brought up one thousand gallons per minute, the miners were in such danger of being drowned, that several left the employment. In the latter end of July, the sea at length broke in, filling the mine in all its parts, in little more than two hours, and destroying twenty miles of railway. On one side of the Camperdown dyke, which ranges through the mine, not a soul was saved, but several escaped from other parts; and one individual, an Irishman, called Brennagh, had not only a remarkable escape himself, but saved three others by his intrepidity. Prof. Sedgwick related to the Section this man's story, which was so singular, and told with such a mixture of the serious and ludicrous—often in the language of the man himself—that it is impossible to convey to the reader an idea of the effect produced on the audience. A remarkable fact in the escape of one of the individuals rescued by Brennagh was, that he was actually *blown up* the last open shaft of the mine by the enormous force of the air, the noise of which was heard at a considerable distance in the country. The first notice to Brennagh of the accident, was an unusual undulation of air in the galleries, which made him suspect that all was not right, and he took the precaution of moving near to an air passage in the dyke, which he had been permitted to use: he was thus enabled to save himself and his companions. At the suggestion of the Professor, a subscription was made in the Section for Brennagh, which amounted to 34*l.*

Intestinal Worms.—Dr. Richardson communicated a paper from Dr. Bellingham, on the frequency of the occurrence of *Trichocephalus dispar* in the alimentary canal. The author alluded to the difficulty of accounting for the origin of animalculæ in the human body. To say that they were secreted or not secreted by the tissues of the body, was premature, as we knew so little of secretion itself. Although in some instances parasitic animals produced injurious consequences to the animal they infested, yet in many others no injury was experienced. The Trichocephalus was found in the majority of human beings, but produced no ill consequences. The genus belonged to the division *Nematoidea* of Rudolphi, and contained eight species. The *Trichocephalus dispar* was mostly found in the cæcum, but sometimes occupied the colon and small intestines. It had been found at Göttingen in those who died of fever, and at Naples in those who died of cholera; and was there supposed to be the cause of that frightful disease. Baillie and Bostock had stated it to be rare, whilst French and German anatomists had pronounced it frequent in the generality of the human species. The author states, from his own experience, that out of twenty-eight individuals he had opened, who had died of various diseases, and varied in age and sex—the youngest being fourteen—he had found the *Trichocephalus dispar* in twenty-five. Dr. Richardson added, that in the lower mammalia and in fish, the cæca were frequently found filled, in some literally crammed with Botryocephali, ranging from a yard to a yard and a half in length; and what was remarkable, the animals appeared to be as healthy and vigorous as if they were not infested.

Plants growing under Glass.—In April last, Dr. Daubeny introduced into globular glass vessels, their aperture being covered with bladders, three several sets of plants. In the first were *Sedum*, *Lobelia*, &c.; in the second, *Primula*, *Alchemilla*, &c.; in the third, *Armeria*, *Sempervivum*, &c. At the end of ten days the plants were healthy, and had grown. The air in the jars was examined, when it was found that the first had four per cent. more oxygen than the atmosphere, the second also four per cent. more, and the third one per cent. more. This was the result of examination during the day, but at night the excess of oxygen had disappeared. On the eleventh day, the first jar contained two per cent., the second and third one per cent. excess of oxygen. At night there was less oxygen than in the atmosphere. On the 20th of June the following results were obtained: in first jar, two and a half per cent., in second jar, three and a quarter per cent., and in third jar, four per cent. less oxygen than in atmospheric air. Some experiments were then made to determine the rate of access of air to the plants through the bladder, and it was found that when the jars were filled with oxygen, the average rate at which it escaped till the internal air was like that of the atmosphere, was eleven per cent. daily.

Prof. Lindley then read a paper by Mr. Ward on the same subject. The Professor observed, that Mr. Ward, of Wellclose Square, London, had made many experiments on the subject of keeping plants in unventilated vessels, and was the original proposer of the plan for preserving plants in this manner. The discovery of their being able to be thus preserved, was of great practical importance, as it enabled us to bring plants from foreign climates, that could in no other way be introduced into this country. The paper commenced, "Consider the lilies *how* they grow." The attention of the author was first directed to this point by accident. He had placed under an inverted jar a chrysalis, and on looking at it some time after, he found a fern and a blade or two of grass had grown under the jar, the sides of which appeared to be covered with moisture. Taking the hint, he introduced some plants of Hymenophyllum under a jar, which grew and flourished in this situation. The Messrs. Loddige then enabled him to perform some experiments on a larger scale. The plants were enclosed in glass cases, or small green-houses, made tight with paint and putty, but, of course, not hermetically sealed, and were watered once in five or six weeks. From his experiments, the author came to the following conclusions:—First, that confining the air secured a mere equable temperature for plants, as its expansion and contraction by change of external temperature, by its relation to heat in those states, prevented any great or sudden change. This was remarkably exemplified in some plants that were brought from India, which were in the course of three months successively exposed to 20°, 120°, and 40° of Fahrenheit. The enclosed plants were very frequently found surrounded by a temperature higher than the external atmosphere. Secondly, that vascular plants required to be grown in a greater quantity of air than cellular. Thirdly, that light must be freely admitted. Fourthly, that the enclosed air must be kept humid. This can be done by occasional watering, provided any means of escape for the water is allowed, but is not necessary where the water has no means of escape. Besides the advantage of enabling us to bring plants from abroad, it would also furnish to the physiological botanist the means of observing those operations of nature in his study, for which, before, he had been obliged to resort to the forest and the plain. As an instance, the author had been enabled to observe the rapid growth of a *Phallus fœtidus*, by merely devoting to it a few hours of the night. The writer concluded by suggesting that this mode of preserving tropical productions might be extended from the vegetable to the animal kingdom.

Prof. Lindley also read a letter from the Messrs. Loddige to Mr. Ward, stating that in every case in which his instructions had been attended to, foreign plants had arrived in a state of safety.

The Rev. J. Yates read a paper on the same subject. Wishing, he observed, to make an experiment, on a large scale, which might be exhibited at the meeting of the British Association in Liverpool, a green-house, nine feet by eighteen in dimensions, and with a southern aspect, had been erected in the yard of the Mechanics' Institute, in Mount-street. It was stocked with foreign plants of all kinds, to the number of about eighty species. A list of the plants, and observations on their condition and progress, accompanied the report. The general result of the experiment was, that the plants had flourished perfectly well, being in a vigorous and healthy state, without any extraordinary growth. Many of them had flowered, and Canna and some Ferns had ripened seed. The green-house had no flue, and no provision for any artificial heat. It was judged best to construct it without a flue, both as least expensive, and for the purpose of trying, by a fair experiment, to what extent plants might in this state be kept alive, even during the severity of winter, which would certainly die if fresh air were more freely admitted. It was also to be observed, that nothing had been done to prevent the water from escaping through the yellow sandstone rock, on which the green-house was erected, and hence it had been necessary to give the plants occasionally a fresh supply of water. Mr. Yates further stated, that he had also grown plants under glass in London, where no plant could be made to flourish without such a protection. Nearly a year ago he planted *Lycopodium denticulatum* in a chemical preparation glass, with a ground stopper. During that time the bottle has never been opened; yet the Lycopodium continues perfectly healthy, and has grown very much, although, for want of space, the form of the plant is distorted. Seeds which happened to be in the soil have germinated, and Marchantia has grown of itself within the glass. He also obtained a hollow glass globe of eighteen inches diameter, and with an aperture sufficient to admit the hand for planting the specimens. A variety of Ferns and Lycopodiums were then set in the soil, which was properly moistened with water. This having been done, the aperture was covered with sheet India-rubber, its attachment to the glass being made perfectly air-tight. No change of air could take place, except by percolation through the India-rubber, which was every day forced either outwards, as the air within the glass was heated and expanded, or inwards in the reverse circumstance; these Ferns grew probably as well as they would have done in a green-house or hot-house. They were all foreign, and some of them requiring a great heat. Several had ripened seed.

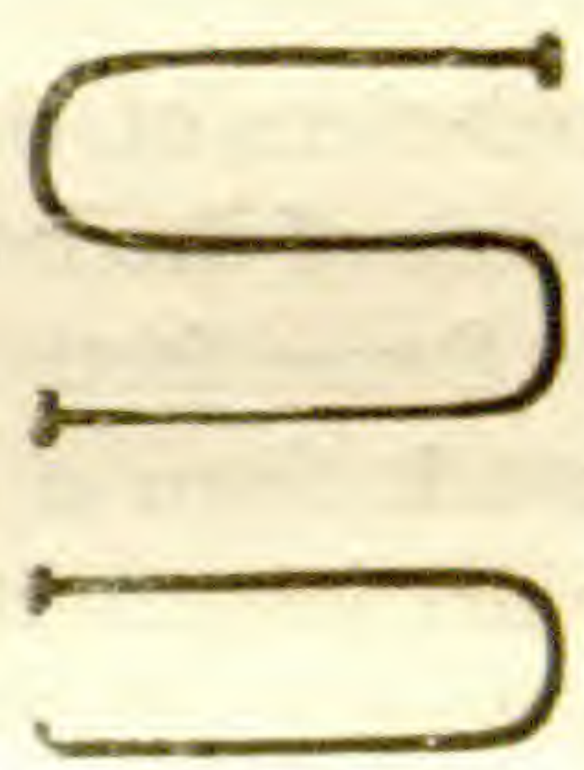
Mr. Gray stated, that he had grown Droseras under glass jars; one circumstance with regard to them he thought worthy of remark, their leaves did not turn red, as is usual when exposed to the atmosphere. Prof. Graham observed, that although in Mr. Ward's experiments atmospheric air had been admitted, he did not think it essential to the welfare of the plant. Plants grown in this manner only required a glass large enough to contain a sufficient quantity of air, to permit of the absorption of oxygen without deteriorating the air of the vessel to such an extent as to injure the plant. The want of red in the leaves of Drosera, he thought, depended on the presence of moisture. A singular point was, that plants growing naturally in arid soils and climates, flourished in the humid and confined atmosphere of the closed jars. He had placed under jars completely closed some plants of Cacti, which had flourished more than those not so situated. He did not think that animals could be sustained in the same manner, as they consumed all the oxygen which they inspired.—Dr. Travers remarked, that he had seen common mould, which was a species of fungus, in a tube which had been heated and hermetically sealed for two years.—Mr. Bowman had observed at the Duke of Devonshire's, Chatsworth, that Droseras did not under the jars change the color of their leaves as in open air. He wished to know of Dr. Graham, how long his Cacti had lived in a moist atmosphere; they were naturally at certain seasons of the year exposed to heavy rains. He thought it was very possible for plants and animals to live together.—Mr. Duncan inquired if plants were healthy, and fit to be transplanted to the open air when treated in this manner.—Professor Graham stated, that the Cacti had lived without access to air eighteen months. He believed that plants and animals might live together, provided the vessel in which they were inclosed was sufficiently large to enable the plants to absorb the carbonic acid gas expired by the animals. This would be a representation in miniature of what takes place in our own world.—Prof. Lindley, in reply to Mr. Bowman's question, stated, that plants suffered little when confined in carefully closed vessels. From improper treatment they may become debilitated, but he had seen them arrive from foreign countries, when treated in this manner, in the most perfect state of health. Want of skill in the management of those brought from abroad was the most frequent cause of injury. Too much water was frequently given to plants when just packed. They had better be placed in too dry, than in too moist an atmosphere. He had seen this illustrated in plants from India; plants exposed to too much moisture rotted very soon. He thought the change of color in the leaves of plants depended on their free exposure to light; the Droseras mentioned had not been exposed to the free access of light; this was certainly the case with the Droseras at Chatsworth and of Mr. Gray. The discovery of Mr. Ward was not only important in enabling us to import foreign plants, but it also rendered the ventilation of green-houses less necessary, and would enable gardeners to manage the artificial climate of their hot-houses with less difficulty. The fact that cellular plants grow best under this mode of treatment, was well established.—In answer to a question from Prof. Lindley, Mr. Gray and Mr. Yates stated, that plants had both flowered and fruited under this plan of treatment.—Prof. Graham stated that the order in which he had found plants to grow best, was, 1. Lycopodiums; 2. Grasses; and 3. Begonias.

Railway Iron.—Mr. Mushet made some observations on Railway Iron, founded on experiments carried on for forty years. He expressed himself much surprised, that hitherto, in contracts for iron for railway purposes, fibre and hardness were not stipulated for, but were left to the chapter of accidents. Both these qualities might be attained by his method, the principal characteristic of which consisted in doing away with the refining process now in general practice, and the preventing the severe decarbonization to which the iron was at present exposed. Several specimens of iron, of extremely fine fibre and hardness, were laid before the Section, and afterwards removed to the Model Room. The great object of his process was, to obviate the evil of lamination. On some railroads they had been obliged to lay the iron two or three times; but he had little doubt, that it would soon be possible to obtain a solid rail without any exfoliation.

Mr. Cottam mentioned, that he had known a piece of iron six inches thick, and considerably bent, to be quite straightened by blows, but, at the same time, to be greatly weakened; and that he attributed this to some of its constituent crystals being driven into it, by the force of the blows, like so many wedges, thereby weakening the strength of the iron.

Electricity.—Prof. Henry then made a communication respecting the Lateral Discharge in common Electricity.

The primary object of these investigations was to detect, if possible, an inductive action in common electricity, analogous to that discovered in a current of galvanism. For this purpose an analysis was instituted, of the phenomena known in ordinary electricity by the name of the lateral discharge. Prof. Henry was induced to commence with this from some remarks by Dr. Roget on the subject. The method of studying the lateral spark consisted in catching it on the knob of a small Leyden phial, and presenting this to an electrometer. The result of the analyses was in accordance with an opinion of Biot, that the lateral discharge is due only to the escape of the small quantity of redundant electricity which always exists on one or the other side of a jar, and not to the whole discharge. The Professor then stated several consequences which would flow from this; namely, that we could increase or diminish the lateral action, by the several means which would affect the quantity of redundant, or as it may be called, free electricity, such as an increase of the thickness of the glass, or by substituting for the small knob of the jar a large ball. But the arrangement which produces the greatest effect, is that of a long fine copper wire insulated, parallel to the horizon, and terminated at each end by a small ball. When sparks are thrown on this from a globe of about a foot in diameter, the wire, at each discharge, becomes beautifully luminous from one end to the other, even if it be a hundred feet long; rays are given off on all sides perpendicular to the axis of the wire. In this arrangement the electricity of the globe may be considered nearly all as free electricity; and as the insulated wire contains its natural quantity, the whole spark is thrown off in the form of a lateral discharge. But to explain this phenomenon more fully, Prof. Henry remarked, that it appeared necessary to add an additional postulate to our theory of the principle of electricity,—namely, a kind of momentum, or inertia, without weight; by this he would only be understood to express the classification or generalization of a number of facts, which would otherwise be insulated. To illustrate this, he stated that the same quantity of electricity could be made to remain on the wire if gradually communicated; but when thrown on in the form of a spark, it is dissipated as before described. Other facts of the same kind were mentioned; and also, that we could take advantage of the principle to produce a greater effect in the decomposition of water by ordinary electricity. The fact of a wire becoming luminous by a spark, was noticed by the celebrated Van Marum more than fifty years ago, but he ascribed it to the immense power of the great Haarlem machine. The effect, however, can be produced, as before described, by a cylinder of Nairn's construction, of seven inches in diameter, a globe of a foot in diameter being placed in connexion with the prime conductor to increase its capacity.



Some experiments were next described, in reference to the induction of the lateral action of different discharges on each other. When the long wire is arranged in two parallel, but continuous lines, by bending the wire, the outer side of each wire only becomes luminous; when formed into three parallel lines by a double bend, the middle portion of the wire does not become luminous, the outer sides only of the outer lines of wire exhibit the rays. When the wire is formed into a flat spiral, the outer spiral alone exhibits the lateral discharge, but the light in this case is very brilliant; the inner spirals appear to increase the effect by induction.

Prof. Henry then stated, that a metallic conductor, intimately connected with the earth at one end, does not silently conduct the electricity, thrown in sparks, on the other end. In one experiment described, a copper wire, ⅛th of an inch in diameter, was plunged at its lower end into the water of a deep well, so as to form as perfect a connexion with the earth as possible; a small ball being attached to the upper end, and sparks passed on to this from the globe before mentioned, a lateral spark could be drawn from any part of the wire, and a pistol of Volta fired, even near the surface of the water. This effect was rendered still more striking, by attaching a ball to the middle of the perpendicular part of a lightning rod, put up according to the directions given by Gay-Lussac, when sparks of about an inch and a half in length were thrown on the ball; corresponding lateral sparks could be drawn not only from the parts of the rod between the ground and the ball, but, from the part above, even to the top of the rod.

Some remarks were then made on the theory of thunder-storms, as given by the French writers, in which the cloud is considered as analogous in action to one coating of a charged glass, the earth the other coating, and the air between as the non-conducting glass. One very material circumstance has been overlooked in this theory,—namely, the great thickness of the intervening stratum, and the consequent great quantity of free or redundant electricity in the cloud. This must modify the nature of the discharge from the thunder-cloud, and lead to doubt, if it be perfectly analogous to the discharge from an ordinary Leyden jar, since the great quantity of redundant electricity must produce a comparatively greater lateral action; and hence, possibly, the ramifications of the flash, and other similar phenomena, may be but cases of the lateral discharge.

Some facts were then mentioned, on the phenomena of the spark from a long wire charged with common or atmospheric electricity. It is well known that the spark in this case is very pungent, resembling a shock from a Leyden jar. The effect does not appear to be produced, as is generally supposed, by the high intensity of the electricity at the ends of the wire by mere distribution, since this is incompatible with the shortness of the spark. In one experiment, fifteen persons joining hands received a severe shock, while standing on the grass, from a long wire, one of the number only touched the conductor; the spark in this case was not more than a quarter of an inch long.

Mr. Sturgeon was confident a well-constructed thunder rod would never be struck by lightning, as, upon the approach of an electrical cloud, it would silently discharge it into the earth.—Mr. Stevelly said, that unquestionably when the discharge was made directly upon the thunder rod, if well constructed, it would perform its office silently; but if a lateral discharge took place near it, the effect, as Prof. Henry showed, might be flashes of light and heat from the entire length of it, capable, when on a great scale, of setting fire to buildings, firing gunpowder, and other effects hitherto unexpected.—Mr. Snow Harris expressed his regret, that he had not been in the room during the early part of Prof. Henry's communication. In his opinion, the pressure of the air was an element in the phenomena not sufficiently attended to. He had produced beautiful illuminating effects by discharging electricity along a wire enclosed in an exhausted glass receiver.—Mr. Adams confirmed the statements made by Prof. Henry as to the illuminating effects of the lateral discharge; he had once seen upon the discharge of a large electrical battery, a wire splendidly illuminated by the lateral discharge, and exhibiting the coruscations spoken of by Prof. Henry.

Aurora in Summer.—Prof. Christie then made a communication 'on the occurrence of the Aurora Borealis in summer.'

The occurrence of an aurora borealis in England, in the middle of summer, was, he believed, a phenomenon hitherto unrecorded. He then gave an account of several very striking exhibitions of this phenomenon, which he had observed during the last summer. One, on the 19th of May, 1837, presenting two bands of arches, radiating from the magnetic west, and extending nearly to the opposite horizon, was unaccompanied by streamers. Another, on the 24th June, exhibited the usual appearance of coruscation from the northern horizon, but no arches were visible. This aurora, which was the most singular from being observed in the very middle of summer, lasted from 11h. 46m. until 12h. 20m. P. M. Other auroras were observed on the 1st, 2nd, and 7th of July, and 25th of August. On the last occasion, the author noticed a singular phenomenon, which he had, on one occasion many years previous, observed, namely, that the darkness usually attending an aurora appeared to break into the light above it. He noticed that, on the former occasion, he observed the darkness to rush through, and finally break up, two well-defined arches of white light; and recalled to the Section, that Capt. Back had described a very striking exhibition of a similar phenomenon, which he witnessed during his wintering at Fort Reliance. He particularly called attention to these and other phenomena, of the darkness exhibited in the aurora borealis, in connexion with the arches of light and the more brilliant coruscations. After recurring to other auroras which he had observed during the last summer, he inferred that it was probable that the aurora borealis was as frequently in activity in summer as during other seasons, though it might be less frequently visible. The author further stated, that during the last twelve months, no period of a month had elapsed without the exhibition, in the south of England, of one or more auroras; and pointed out the importance of inquiring into the cause of the now so frequent occurrence of a phenomenon, which some years back had been very rare. He concluded by expressing a hope, that observations of the highly interesting phenomena of the aurora would be entered upon by members of the British Association, who might have more time at their command than his own avocations allowed him for such observations.

Mr. Stevelly stated, that the dark cloudy appearance during the aurora was so characteristic, that on one or two occasions, having seen, just before sunset, these scattered black clouds, he was led to anticipate that an aurora would ensue, which accordingly manifested itself when it grew dark; and a friend, since he came to Liverpool, had boasted that he could unfailingly predict an aurora on the evening of the night on which it was to occur. He had mentioned this to Prof. Christie, who said that his own experience had been precisely similar.—Sir David Brewster said, that, by an analysis of the light of the aurora borealis, he had proved that it was direct light, and had never suffered either reflection or refraction.—Sir. W. Hamilton inquired, whether Mr. Christie had taken any notice of the very remarkable aurora which occurred on the 18th of last February.—Prof. Christie said he had observed it. The object, however, of his present communication, was to turn attention to the occurrence of the aurora in summer.—Mr. Snow Harris trusted that a wide line of distinction would be drawn between electrified luminous clouds and the true aurora. He also wished attention to be turned to the difference between magnetic needles when suspended in vacuo and in the open air. He had exhausted a very tall glass receiver, and by electrifying it, caused a very brilliant display resembling the aurora. This notably affected a needle suspended near it in the open air; but a needle suspended in vacuo was not at all effected.—Mr. Abram had no doubt whatever, but that the aurora was a magneto-electrical effect; and described an apparatus which he had contrived in order to illustrate this.

Mean temperature at Plymouth, England.—The mean temperature of two years, from 17,520 observations, is 52.90; that of five years, from 43,800 observations, is 52.45.

New property of Light.—Sir David Brewster then gave an account of a new property of light discovered by him. He observed, that his attention had lately been drawn to a very curious, and, to him, entirely inexplicable property of light. While examining the solar spectrum formed in the focus of an achromatic telescope, after the manner of Frauenhofer, he placed a thin plate of glass before his eye, in such a manner as to intercept and retard one half of the pencil, which was entering his eye, by placing it before one half of the pupil. He was then surprised to find, that when the edge of the retarding glass plate was turned towards the red end of the spectrum, intensely black lines made their appearance, as might be expected, at such regular intervals, as to represent the most exact micrometrical arrangement of wires; but upon turning the plate of glass half round, (still keeping its plane perpendicular to the axis of the eye,) so as to present the edge, past which the rays entered the eye, to the violet end of the spectrum, every one of those dark bands entirely disappeared. In the intermediate positions of that edge they appeared more or less distinct, according as the edge was more presented to the red, or to the violet end of the spectrum. A glass plate, one-thirtieth of an inch thick, gave these lines; but the thinner the glass, the more intense was the blackness, and the more distinct the lines. They were formed in any part of the spectrum; but they were best seen when the rays were intercepted which lay between the two fixed lines A and D, of Frauenhofer. An examination of these lines afforded the very best means of determining the dispersive powers of substances, for their distance from one another increases or diminishes, exactly as the entire length of the spectrum is increased or diminished; and the number of them in the same part of two spectra is always the same.

Comparative Composition of Cast Iron prepared with the hot and the cold blast.—Dr. Thomson observed, that the specimens of cast iron examined, were all from iron smelted from the iron-stone in the Glasgow coal-field. This iron-stone is a carbonate of iron, more or less pure. The richest is known by the name of *Mushet's black band*, which occurs in the neighborhood of Airdrie; its specific gravity is 3.0553, and it is composed of

Carbonate of iron, - - -	85.44
" of lime, - - -	5.94
" of magnesia, - -	3.71
Silica, - - - - -	1.40
Alumina, - - - - -	0.63
Peroxide of iron, - - -	0.23
Coal, - - - - -	3.03
	100.38

In the poorest specimens of iron-stone, the carbonate of iron, amounts to only 29 per cent., but such specimens are rejected by the iron-masters. The ore is roasted to drive off the carbonic acid; this, at an average, reduces the weight about 31 per cent.; it is then mixed with limestone and coal, and smelted.

When the Clyde iron-works were established, above forty years ago, ten tons of coal were requisite to produce one ton of iron. This coal was previously coked, by which rather more than half its weight was driven off under the form of gas, &c. By various improvements, the quantity of coal requisite was diminished from ten tons to seven tons thirteen cwt., and the quantity of limestone requisite for smelting one ton of iron was ten and a half cwt. When hot air (or air heated to above 607°,) was blown into the furnace instead of cold air, it was found that coal could be used without being coked, and the quantity requisite to smelt a ton of iron was reduced to two tons nineteen cwt.; the lime was reduced to seven cwt., and the produce of iron in a given time from a furnace was more than doubled. The reason of this superiority of hot air over cold seems to be, that when the hot air enters the furnace it is immediately united to the coal, and is all consumed; whereas, the cold air partly passes up through the materials, and produces, as it ascends, a scattered and useless combustion. Hence, when hot air is introduced, the heat at the point of combustion is greater than when cold air is used, and hence, the smaller quantity of limestone requisite, and the greater produce in iron in a given time. The specific gravity of cold blast iron is lower than that of hot blast, the average of the former being 6.7034, and that of the latter 7.0623.

The following table shows the composition of six specimens of cold blast iron from different localities:—

	Muirkirk.	Do.	Do.	Pyrites.	Carron.	Clyde.	Mean.
Iron, . . .	90.98	90.29	91.38	89.442	94.010	90.824	91.154
Copper, . .	. .	. .	. .	0.288	. .	. .	. .
Manganese,	. .	7.14	2.00	. .	0.626	2.458	2.037
Sulphur, .	. .	. .	. .	. .	. .	0.045	. .
Carbon, . .	7.40	1.706	4.88	3.600	3.086	2.458	3.855
Silicon, . .	0.46	0.830	1.10	3.220	1.006	0.450	1.177
Aluminium,	0.48	0.016	. .	3.776	1.022	4.602	1.651
Calcium, .	. .	0.018	0.20	. .	. .	. .	. .
Magnesium,	. .	. .	. .	. .	. .	0.340	. .

The constant constituents were iron, carbon, silicon, and aluminium; and manganese was a pretty frequent ingredient. The average proportions were

$3\frac{1}{2}$ atoms of iron and manganese,
1 do. of carbon, silicon, and aluminium.

The atomic proportions of the carbon, silicon, and aluminium, were 4, 1, 1, so that cold blast cast iron may be considered as composed of 21 atoms iron and manganese,
4 do. carbon,
1 do. silicon,
1 do. aluminium.

The following table exhibits the composition of hot blast cast iron, No. 1:—

	Clyde.	Carron.	Carron.	Clyde.	Clyde.	Mean.
Iron, ...	97.096	95.422	96.09	94.966	94.345	95.58
Manganese, . . .	0.332	0.336	0.41	0.160	3.120	0.87
Carbon, ...	2.460	2.400	2.48	1.560	1.416	2.099
Silicon, ...	0.280	1.820	1.49	1.322	0.520	1.086
Aluminium, . . .	0.385	0.488	0.26	1.374	0.599	0.422
Magnesium, . . .	. .	. .	. .	0.792	. .	. .

These constituents are in the proportion of

$6\frac{1}{2}$ atoms iron and manganese,
1 do. carbon, silicon, and aluminium.

	Iron.		Carbon, &c.
In the cold blast we have	$3\frac{1}{2}$ atoms	+	1 atom.
In the hot blast	$6\frac{1}{3}$ atoms	+	1 atom.

Thus, it appears, that hot blast iron contains only about half the foreign matter that exists in cold blast iron.

Cast steel made from the best Dannemora iron, had a specific gravity of 7.8125. Its constituents were

Iron, - - - - - -	99.288
Manganese, - - - - -	0.190
Carbon, - - - - - -	0.388
	99.866

or it contained 55.7 atoms iron,
1 atom carbon.

In reply to questions, Dr. Thomson stated, that he had made no experiments on the comparative composition of bar iron from pigs made with the cold and hot blast, and that he had not found any phosphorus in the specimens of cast iron whose analysis he he had detailed.—Mr. Tennant stated, that the bar iron by the hot blast was equally tough, both hot and cold.—Mr. Guest inquired of Mr. Tennant, whether in the puddling, hot blast iron did not lose more than the cold blast iron: but to this no satisfactory answer was given.—Dr. Clarke contended, that as the impurities of cold blast iron are about double those of hot blast iron, it was impossible that, as suggested by Mr. Guest, this latter should undergo a greater waste in the process of refining. If such should be proved, he would consider it a chemical miracle. In continuation, Dr. Clarke observed, that manufacturers were too much in the habit of working by what he called the Rule of Thumb, and that, in particular, as the difference of the quantity of pig iron depended materially upon the heat employed, by not attending to this essential condition, iron-masters were liable to fall into erroneous conclusions as to the value of any particular improvement. Mr. Guest being called on by the President to speak to this point, stated distinctly, that he found the hot blast iron to lose more in puddling than the cold; and he had the impression that it was of inferior quality.—Dr. Thomson asked, whether the iron referred to by Mr. Guest was, or was not, made from cinder; to which Mr. Guest replied, that in some cases it was, but that his observation in reference to the greater loss experienced by hot blast iron in the refining surface was applicable to varieties in the manufacture of which cinder was not employed. —Professor Johnston expressed his surprise at the absence of phosphoric acid from the Glasgow iron, the more especially, as in the Newcastle coal-field phosphoric acid is abundant, and the nodules of clay iron-stone, which may be considered as coprolites, always, as is well known, include phosphoric acid. He also stated, that as specimens of hot and cold iron have frequently the same physical properties, it is very difficult to pronounce upon the relative value of these processes. The white and black cast iron also may have the very same composition, and therefore the quality of iron must be referred to something totally extraneous to chemical constitution. In fact, quick or slow cooling will determine the pig to be of the one or the other color.—The President observed, that, though generally speaking, black iron may be considered as yielding the best malleable iron, this could not, with any probability, be predicated of black cast iron got by the rapid cooling of the white variety, as suggested by Prof. Johnston.—Dr. Thomson stated, that cinder is a mixture of silicates of iron ; and subsequently expressed his conviction, that the quality of iron, notwithstanding what had been alleged to the contrary, is chiefly dependent on its composition, and that if phosphorus, for example, or sulphur, were present, the metal could not be good. The same gentleman, in conclusion, decried the doctrine, which would place what was called the Rule of Thumb above what he considered a much more valuable guide—the Rule of Science.

The action of Water upon Lead.—Mr. Pearsall brought under consideration the action of water upon lead. He commenced by a reference to the researches of Col. Yorke and Prof. Christison, which demonstrate the corrosion of lead by pure water, though saline water does not dissolve it. (This fact was first noticed by Guyton Morveau.) The great object of his communication was to show, that rain water collected in leaden cisterns will dissolve the metal in considerable quantity, probably as hydrated oxide, but that, if such water be passed through a filter, or agitated with carbonaceous matter, it is altogether removed. This point he established in the course of some investigations having a reference to certain disastrous cases of poisoning which have occurred recently at Hull.

Mr. Mallet stated, that, according to his experience, lead alone is corroded which contains copper. This opinion was combated on the ground, that all the lead of commerce includes copper. Col. Yorke also stated, on the other hand, that he had established that perfectly pure lead is corroded by water when it contains air; that the calx is of a crystalline nature, and composed, according to his experiments, of carbonate united to oxide of lead. A gentleman, whose name we could not learn, stated, that the following experiment was instituted some years ago, and is still in progress. Into three bottles, filled, the first with Thames water, the second with distilled water containing air, and the third with distilled water deprived of air, three slips of lead were introduced, and the bottles hermetically sealed. The lead in the first has been acted upon ; that in the second has been still more extensively corroded ; but that in the third continues perfectly bright

The oxidation of the lead is therefore, he concluded, obviously due to the oxygen of the air.

Fossils with Coal.—Mr. Williamson explained drawings of sections of the Lancashire coal district. He exhibited a number of beautiful drawings of organic remains, some of which are very singular; including vegetable fossils, and teeth of sauroid fish; but the most interesting were of fossil fish, which Mr. Williamson conceived to have a close resemblance to the recent salmon. In mentioning the coal strata of Wigan, he pointed out a remarkable seam of impure cannel under the Smith's coal, which seam contains fresh-water shells. Some of his drawings represented *Goniatites* and *Pecten papyraceus*. He thought it very likely, along with some other geologists, that the different coal basins of England are parts of a great whole. He showed drawings of fish scales found in the coal strata. These have a close resemblance to the scales of recent fresh-water fish, and form an additional argument in favor of the formation of coal beds originally in fresh-water lakes or estuaries—perhaps the latter, as he found also some shells, evidently marine.

Mr. Sedgwick having stated that he would now receive the observations of any one present upon these several papers on the coal strata, Mr. Phillips came forward, and spoke of the regularity of the fibrous structure of coal as forming an important cause of its cleavage—this regularity of cleavage enabling the practical miner to work it with more facility.—Sir Philip Egerton was requested by the President to give his opinion respecting the fish, supposed by Mr. Williamson to resemble the recent salmon; Sir Philip referred to the arrangement of fish proposed by M. Agassiz, and to their geological distribution. The salmon is ranged by that eminent naturalist, under the division of Cycloidal fish, and remains of these have not been discovered in any system below that of the chalk. The fish delineated by Mr. Williamson might be referred to the genus Colopticus, and the teeth to *Diplodus gibbosus*. Dr. W. Smith remarked, that the specimens of coal exhibited by Mr. Pease would point out a mode by which coals could be touched without dirtying the fingers—what are technically called the top and bottom being the soiling sides, but the cross cleft is clean. The President said, it was a thin layer of mineral charcoal that caused the soiling.

Changes of Level.—Mr. Smith, of Jordan Hill, made some observations on the changes of level of land and sea, that have last taken place, instanced by the occurrence of recent marine shells and gravel at various elevations. He mentioned the shores of the Solway Frith, and of Ayrshire, the neighborhood of Paisley: also Portrush in the northern part of Ireland, and the late observations of Mr. Lyell, in Sweden. The alluvial clay of the Forth is elevated sixty feet, that of Essea one hundred and fifty feet; indeed, recent shells have been found by Mr. Gilbertson in some places at an elevation of three hundred feet. On the shores of the Clyde, over a deposit of erratic blocks, is a stratum of shells, which contains fourteen new species not now found in the river; this is a singular occurrence, as in other parts of Great Britain the erratic blocks overlie the newer Pleiocene strata, to which Mr. Smith refers this stratum.

Silica in Plants.—Prof. Henslow stated, that he believed the object of the author was to prove, that all plants contained more or less silica; that the silica left after burning assumed different forms, according to the species of plants, and that this process might probably be applied to the investigation of the species of fossil plants.

Goliathus Magnus.—A specimen of the Goliathus magnus, was also exhibited. This is the largest species of insect known, measuring three or four inches in length, and one and a half in breadth. It is also very rare, only three specimens existing at the present time in the cabinets of Europe. It was one of the rarest insects known. It had been offered for sale at the price of fifty guineas, and he had himself offered twenty guineas for a specimen. It belonged to the extensive family of the Cetonidæ. This family was one of the most extensive and best known groups of insects that we possessed, and afforded the best opportunities for acquiring ideas of general arrangement. It contained six hundred species, only six of which were British. The family *Buprestidæ*, perbaps equalled them in numbers.

Wood in the Sea.—The President then exhibited some wood from the new pier at Southampton, that had been attacked by the *Limnoria terebrans.* He had been applied to, by Capt. Du Cane, mayor of Southampton, for his opinion as to what was the best course to be pursued, as the existence of the pier was threatened by these devastating animals. He had recommended, that stone be substituted in the pier for wood. He believed that this was the only plan, for wherever wood was exposed to the *gentle action* of salt water, these crustaceous animals attacked it. They never attacked wood exposed to the more violent action of the waves of the sea.

The Rev. F. W. Hope stated, that a memoir had been published on this subject, in the last volume of the Transactions of the Entomological Society. He had recommended gas tar to be applied over the wood, but as this would require renewing, it would in the end be as expensive as covering the wood with iron, he should therefore prefer the latter plan. He had heard, that Kyanized wood was not attacked by white ants, and he thought it might be applied to prevent the attacks of these terebrating animals. These remarks led to a general conversation on the subject of preserving wood from the attacks of insects and crustacea, as well as the bottoms of vessels from the adhesion of plants. The President observed, that he had seen vessels with tons of algæ, polypiferæ, and other plants and animals, attached to their bottoms. Experiments were related, and observations made by Messrs. Francis, Hope, and Gray, and Prof. Henslow ; and Mr. Francis was requested by the President to draw up a paper on this important subject, to present to the Association at their next annual meeting. Mr. Francis stated, that sap-wood, exposed to the action of chloride of mercury, became as durable and fit for use as the heart-wood.

Respiration.—Dr. Holland replied, that he had made repeated experiments, and had invariably found that a series of deep inspirations did always bring to the lungs a larger quantity of blood than previously existed. The pulse, which before had only been seventy or seventy-five, became eighty-five, and in some cases ninety, and was proportionably debilitated. Setting aside all theory, two effects followed—change in the rapidity of the pulse, and in its force. He brought forward a theory to account for these effects. But, letting his own theory alone, it was quite clear that inspiration must have an effect on the circulation. Dr. Carson had also stated that air passed directly into the blood. He had never heard this opinion before. All they were acquainted with was, that air was so inspired that a certain change was effected by it in the blood. By chemical investigation they found that the carbonic acid gas, which was exhaled, existed as carbon profusely in the blood, and united with the oxygen inspired; hence they had carbonic acid. Dr. Carson had stated still further, that sighing improved the circulation. He had paid considerable attention to this, and he could not say that it improved it except in one way, and that was, it occasionally gave freer play to the lungs. They saw persons after being interested in any story almost suspend their breath, or, in other words, forget to breathe; and as soon as the interest of the story terminated there was a very deep inspiration, which relieved the blood in the chest. But he was satisfied, that a series of inspirations did not invigorate the system. Dr. Carson had also stated that the blood was not facilitated in its return by inspiration. Experiments had frequently been performed which proved this.

Dust in the Lungs.—Dr. Macintosh read a communication from a medical student, on a disease of the lungs caused by the deposition of particles of dust. It would contribute, he observed, towards the elucidation of that class of diseases affecting artisans, which had, in a more systematic form, been treated by Mr. Thackrah. In the neighborhood of Edinburgh were many stone-quarries, and the workers in which not unfrequently died from consumption. A mason, a worker in the Craigleith-quarry, was ill; he was bled and treated for a common cold, recovered, and returned to his work. A short time afterwards he was again taken ill, and, two years after the first attack, he died. During his illness percussion afforded a dull sound; on the right side the stethoscope indicated no respiratory murmur; on the left a puerile râle. After death, the lungs presented a black appearance; 20 oz. of fluid were found in the right side, and 4 oz. in the left; there was no membrane, the pleura being fibrous, which was rare. Dr. Alison stated he had only seen this state once, being on the pleura and cardiac portion of this kind of membrane; both lungs were completely studded with black tubercles, as if they were melanotic, and cut like cartilage. Similar projections were on the pleura, and the bronchial glands were long and hard, grating when cut with the scalpel, owing to a cretaceous secretion like bone. The analysis of this cretaceous matter showed it to be principally the carbonate of lime. In the bronchial glands were carbonate of lime, silica, and alumina. He directed particular attention to this analysis, for Dr. William Gregory has published an account of the Craigleith-quarry stone, and the analysis of this stone gave the same ingredients as those found in the lungs of the workman. Dr. Gregory found in the stone carbonate of lime, silica, and alumina. The deduction must necessarily be, that this (pointing to a preparation of the lungs which he exhibited) must be an absolute deposition of the Craigleith-quarry stone, from small particles taken into the lungs during respiration, producing consumption and death. Dr. Macartney had seen many black glands at the root of the lungs, and dispersed through its substance, but they were not hard. It was stated that fibrous concretions in the chest were rare; this did not accord with his observations. In his museum, at Trinity College, he had placed many examples of this disease. The inflammation gave, first, condensed lymph, changed it into fibrinous, converted it into cartilage, and finally into bone. Dr. Macintosh replied in the negative, to the question if any other part of the body contained stone.

Variations of Pressure on the Human Body.—Sir James Murray presented to the Section an apparatus for the purpose of withdrawing atmospheric pressure from the surface of the body, partially or wholly. He presented his reasons and observations to the Dublin Medical Section of the British Association, but they were not well understood, for want of apparatus and drawings. These he had now got, which, besides much labor and time, had cost upwards of 100*l.*; and he trusted, since he was becoming old, some of the Members would perfect them. The first machine was for the whole body, and resembled in form a slipper-bath, with the addition of a separate part to cover the upper portion of the body, the head only being free. The upper portion was luted to the lower, by means of a composition (used in making printers' rollers for inking the types,) and fixed in a groove; and, if necessary, the patient's face and head could be contained in a glass case, luted to the machine in the same manner, and respiration carried on by a tube. The air from the machine was removed by means of an exhausting syringe, screwed on towards the bottom part of this apparatus. He had tried this machine in the collapsed cases of cholera, and exhausted the air from the body, taking off one ton of atmospheric pressure. The consequence was, that the vessels became full and turgid, and the body, previously shrunk, was rounded and red. He had tried it repeatedly, and the same results followed. The process might be reversed, and pressure of air made on the body, even to the amount of

100 tons, without damage; but beyond this it would not be safe. He had tried it repeatedly in asthma. The principle was applicable topically, and parts of the body could be submitted to the action of the machine, modified so as to be suitable to them. He exhibited a contrivance, of a long tin tube, made air-tight, and with a piece of wet bladder round one end, which was open; at the other end, which was closed up, a small exhausting air-pump was placed. A patient, with a paralytic wrist, put his arm into this; the wet bladder was tied round his arm at the top, to make it air-tight, and the atmosphere was then pumped out of the tube. The atmospheric pressure being taken off, the limb became turgid, the circulation was increased, and the part affected was soon cured. There was another adaptation of the same contrivance to the limbs, to draw off the effect of congestion of the brain; and one to stop hæmorrhage in an injured hand, limb, or other extremity. An exhausting pump was fixed to the end of a bladder, the limb was put into the bladder, and the neck then tied round to make it air-tight. The air was then completely exhausted by means of the pump, which compressed the bladder so close to the skin as effectually to stop even the pores of the skin. The same contrivance of a bladder and exhausting pump was also applied for the cure of ulcerated legs, by preventing evaporation of the ulcers, by exhausting the air, and making the collapsed bladder adhere tightly all round. For irregular surfaces he thought the instruments of particular value, since no dry-cupping could be used there. If this plan had been known when those melancholy deaths from dissection cuts took place in Dublin, and dry-cupping could not be had recourse to, it would have been fortunate. The machine would be particularly advantageous in withdrawing blood from particular parts to others more remote. Thus, in cases of congestion of blood in the head, where bleeding had been carried to such an extent that it would not be safe to carry it further, owing to the great general loss in the circulation, blood might be made to accumulate in other parts, as in the legs. The case of a well-known brewer in Dublin was treated on this principle, and recovered. Sir James then enumerated the kinds of cases where the apparatus might be used,—asthma, defective external circulation, aneurism, tumors, paralysis, &c.

Structure of the Brain.—Mr. Carlile further adverted to the particulars of several dissections of the brain in his possession, but which were too much in detail for perusal before the Section. The conclusion to be drawn from these dissections is, that in the brain of idiots the internal structure is always defective, and, in many instances, more so than the size or external form; and that in the brains of persons not idiotic, but possessing various degrees of intellectual power, very marked differences in internal structure may be observed by those who dissect the brain in the manner first proposed by Dr. Macartney, in a paper read by him before the British Association, and published in their Transactions for 1833. It is a most reasonable supposition, from the facts just mentioned, and from observation of the structure of the brain in animals, that the intellectual and moral character is much influenced by peculiarities in the organization of the various plexuses or ganglia, of which the brain essentially consists. Phrenologists have wholly neglected the internal structure of the brain, and have confined their attention to the size of certain portions at the surface; a method which is calculated to mislead,—amongst other reasons, because the surface of the brain is not the only part essential to the exercise of the intellectual and moral qualities, and size is a very inadequate measure of power, unless the structure of the part be also taken into consideration. As an example of an erroneous method of investigation, Mr. Carlile quoted an elaborate paper, by the celebrated Tiedemann, in the Philosophical Transactions, in which he concludes, from measurements of the size of the cranial cavity in Negroes and in Europeans, that the faculties of both are alike; whereas, it is well known to those who have opportunities of observing the children of Negroes and of Europeans educated together at the same school, that, as long as the perceptive faculties chiefly are employed, equal progress is made by both classes of children; but that as soon as the reflecting and comparing powers are required, as in the learning of mathematical or other inductive sciences, the inferiority of the Negro is almost uniformly made manifest. Mr. Carlile concluded, by inviting the attention of physiologists to the examination of the minute structure of the brain, and stated his conviction, that by a comparison of its peculiarities with the differences of mental capacity observed during life, much light would be thrown on the functions of different parts of this organ.

The Plague.—Mr. Urquhart read a paper, 'On the Localities of the Plague in Constantinople.' He stated, as the result of three years' observation, that this disease, if it did not originate in localities close to cemeteries, was greatly aggravated by the proximity of burial-grounds, especially when the towns and villages stood on a lower level than the neighboring cemeteries. It was known, that the Turks, from religious prejudices, made their graves hollow, and placed a very shallow covering of earth over the dead. The mephitic vapors arising from the putrescent bodies, tainted and polluted the surrounding atmosphere: and that this disease was connected with atmospheric influences, was a fact known to the Turks themselves; among whom it was commonly said, that birds abandoned the localities where plague prevailed, and fruits became more abundant. Mr. Urquhart declared, that these observations were confirmed by his own experience: he regretted that he had no statistical data to offer to the Section, and hoped that, attention being now directed to the subject, it would lead to the prosecution of a more regular inquiry.

Mr. Wyse said, that his personal experience in Syria, Turkey, and Egypt, enabled him to corroborate Mr. Urquhart's statements: he had never passed the large cemetery, near the gate of Adrianople, without a distinct perception of noisome effluvia, which in humid weather were peculiarly offensive. He trusted that the attention of government would be directed to the subject, and a series of questions addressed to the consular agents in the Levant. —Dr. Bryce said, that he had long directed his attention to the subject of plague, and made numerous observations during his residence at Constantinople; but scarcely had he formed an hypothesis, when it was contradicted by some new facts. Mr. Urquhart's remarks had first given him a ray of light to guide investigation, and from many circumstances which now occurred to his mind, he was led to place considerable reliance on Mr. Urquhart's account.—Col. Briggs stated, that the plague was unknown in India, which he attributed to the custom of burning the dead. It was anciently unknown in Egypt, where the dead were embalmed; among the Parsis, who expose their dead in a walled cemetery, to be devoured by the birds of the air, plague rarely or never occurs. In the countries which now constituted Turkey, pestilential diseases were very rare in the classical ages.

Statistics of Crime in Liverpool.—"The report gave, as the result of rigid inquiry, a criminal population to this town of 4,200 females, and 4,520 males, 2,270 of the latter being professional thieves, and the remainder occasional thieves, living by a combination of labor and plunder; and the whole was set down at upwards of 700,000*l.* This does, at first sight, appear incredible; but an investigation, pursued with much labor, and not unattended with obloquy, convinced me the statement contained no exaggeration.

"A more recent inquiry, carried on by better means, afforded by a more experienced police force, not only confirms these details, but leaves an impression that the number of criminals was underrated. In an inquiry of this kind, an approximation to accuracy is all that can be expected; and all I purpose to do is to furnish the society with the most accurate data which are accessible.

"I hold in my hand two or three returns, about the correctness of which there can be no doubt. They contain the number of persons brought before the magistrates, and the number committed; the number of felons apprehended, and the number committed; they also give the age of the juvenile felons. In the year 1835, there were taken into custody 13,506 persons, of whom 2,138 were committed. In 1836, there were taken into custody 16,830, of whom 3,343 were committed. Up to the 13th of the present month, the number taken into custody in eight months, was 12,709, of whom 2,849 were committed. From July, 1835 to July, 1836, the number of juvenile thieves, under eighteen years of age, apprehended was 924, of whom 378 were committed. From July, 1836, up to the present day, the number of juvenile thieves taken into custody was 2,339, of whom 1,096 were committed. There were in custody, during the same period, upwards of 1,500 well-known adult thieves.

"In our report, juvenile thieves were set down at 1,270: it now seems that the number was very greatly underrated, for the most expert officer does not pretend to say that one-half were taken into custody.

"In the returns made by the old watchmen, the number of houses of ill-fame was set down at 300; but this return referred only to the *notorious* ones. A full and complete return has since been made, and the real number is 655, exclusive of private houses in which girls of the town reside. In all the houses of ill-fame, females reside; and, allowing an average of four to each house, the number residing in such places only would be 2,620.

"This return is further confirmed by the fact, that in the year preceding the inquiry, there were apprehended 1,000 females of a particular description.

"Another return has been placed before me, which, though not absolutely bearing on the subject, is not without interest. Of 419 individuals now in the gaol, 216 profess the religious creed of Church Protestants, 174 Roman Catholics, 8 are Methodists, 17 are Presbyterians, 2 are Unitarians, 1 Baptist, and 1 Independent. 141 can neither read nor write, 59 read imperfectly, 38 read well, 127 read and write imperfectly, and 56 read and write well." Amount of property stolen, about one million sterling annually.

Keels of Ships.—Mr. Lang addressed the Section on his improvements in Ship-building. He fills up the floor perfectly solid, puts in a kelson and a keel in the usual way, bolting them well together, and caulking all up. On each side of this keel he fixes another broad and flat one, and over these another, all secured in a peculiar way, by dovetailing, but so as one may come off without bringing off the other, and the whole without damaging the floor; over all he puts a false keel. The depth from the inside of the floor to the bottom of the false keel is about twice the depth of the kelson, and the breadth of the three keels under the floor a little more than the depth from the top of the kelson to the bottom of the false keel. He caulks with Borrodaile's felt, observing that, when the seam is caulked in the usual way, outside and inside, the oakum does not reach the centre, but leaves a hollow, where damp lodges, to the destruction of the timbers. This plan has, it appeared, been adopted by the English and by foreign governments. It was, Mr. Lang admitted, rather more expensive than that usually adopted in building merchant-ships.

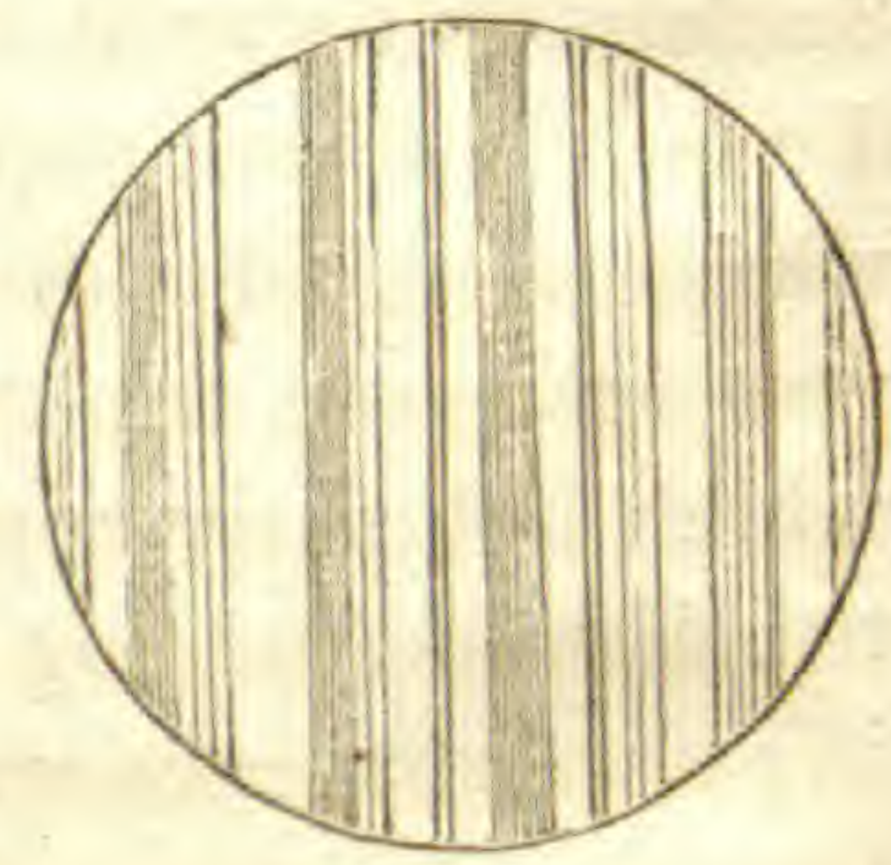
Safety of Steam Vessels.—Mr. Williams then offered some observations, as a practical man merely, on a method for preventing accidents from the collision of steam vessels, which was in practice in the vessels belonging to the city of Dublin Steam Packet Company. The danger at present arose from this,—that a local injury, as in the late instance of the *Apollo*, admitted the water through the whole body of the vessel. The improvement would confine the water to the section in which the injury took place. It consisted in dividing the vessel into five water-tight compartments, by iron divisions or bulk-heads, the only objection with respect to which arose from the difficulty of fixing them in a timber frame. This was obviated by making the side of the vessel solid for twelve inches before and aft the bulk-head, and closing up the interstices with felt. As to the number of these compartments, he had found, after several trials, four bulk-heads, forming five sections, unexceptionable. The length of these sections was arbitrary; Mr. Williams made the centre one enclose the machinery, and those at the stem and stern of comparatively small length. He had, two days before, tried several experiments with the *Royal Adelaide*, having admitted the water by boring holes, first into the foremost section, next into the second, and afterwards into the third; and in each instance very little depression had been produced in the stem, never exceding twelve inches, while there was no disturbance to the men at work. In cases of fire, too, there was a double advantage from this arrangement; the fire could not extend far under deck, so that the men could work easily in extinguishing it,—there would be no current of air throughout, and the water might, if necessary, be admitted to the section attacked by the fire, without any general inconvenience, and without any danger. Mr. Williams intimated, in conclusion, that a vessel would be placed by the Company at the disposal of members of the Association returning to Ireland, as it had been to transport them to Liverpool.—The President then closed the meetings of the Section, by a few remarks on the successive development of power apparent in it. Though originally only an offset from another Section, it now rivalled, if it did not exceed any of the others, in the variety and interest of the topics discussed, the attendance of members, and the ability of the papers laid before it. He, as its original proposer, felt especially interested in its progress, and hoped to see it still more distinguished.

Heat of the Earth.—The sun's heat was found to extend to variable depths at various places, and with many alternations of increase and diminution; and it was in general necessary to descend from one to two hundred feet before the effect of this cause disappeared; from thence downwards, the evidence of an increasing temperature seemed to be quite satisfactory. At a colliery at Wigan, where the surface mean temperature was 50°, at 50 yards deep the temperature was constantly 53°; at 150 yards deep the temperature was 56.75°; at 250 yards 63°. From this set of observations, it appeared that a descent of 100 yards was accompanied by an increase of temperature of about 6.25°, or about one degree for sixteen yards; the result of the observations made in France giving one degree for about each fifteen yards of descent.

Magnetism.—Mr. Fox drew attention to the advantages conferred on this branch of science by Lieut. Burns. He exhibited charts drawn by him, in which the dip and variation were laid down, with extreme accuracy, in several parts of the world. He gave a curious instance of the value of a knowledge on these subjects; as the ship drew near a promontory of the Cape de Verd Islands, the action of the rocks became perceptible to this accurate observer, who was thereby warned of the neighborhood of land. He also was frequently able to guess at the nature of the rocks at the bottom of the sea from similar indications.—Major Sabine explained, that the Report now laid before the Section, related exclusively to observations made in Great Britain; hence he had not alluded to any of these subjects, nor to other general results which many members had urged him to bring forward.—Prof. Phillips said, that the dip changed frequently in the course of a day; in some observations which he had made at several stations between Ryde and York, he had found the dip to vary so much as six or seven minutes in the course of the day.

Diamond.—Sir D. Brewster now read a notice of a new structure in the diamond.

Sir David said, that having communicated to the Geological Society an account of certain peculiarities in the structure of the diamond, which confirm the theory of its vegetable origin, he was desirous of submitting to the consideration of this Section a new structure which he had recently detected in that gem, and which indirectly supported the same views. In consequence of the diamond having been used as the fittest substance for forming single microscopes of high power and small spherical aberration, the attention of opticians has been drawn to the imperfections of its structure. Mr. Pritchard, who first succeeded in executing lenses of diamond, put into the hands of Sir David for examination, a plano-convex lens about the 30th of an inch in diameter, which he had found unfit for the purposes of a microscope in consequence of its giving double images of minute objects. As Sir David had previously shown, that almost all diamonds possessed an imperfect doubly refracting structure, as if they had been aggregated by irregular forces, compressed or kneaded together like a piece of soft gum or an indurated jelly, he had no doubt that the double images were owing to this structure, as there appeared, on an ordinary examination of the lens, to be no other cause to which it could be reasonably ascribed. This was also Mr. Pritchard's opinion, and the existence of such images prevented opticians from rashly cutting up diamonds which might turn out useless for optical purposes. As lenses of sapphire and ruby, which Sir David had long had occasion to use in very delicate microscopical observations, produced no duplication of the image, although the rays passed in directions in which the double refraction was much greater than in any specimen of diamond which he had examined, it occurred to him that the double images might arise from some other cause. He therefore proceeded to examine the light transmitted through the diamond, by combining it with a concave lens of the same focal length, in order to make the rays pass in parallel directions through its substance. This experiment indicated no peculiarity of structure at all capable of producing a separation of the images, and he was therefore led to examine the plane surface of the lens by reflecting from it a narrow line of light admitted into a dark room, and examining the surface with a half-inch lens. While turning round the plane surface of the diamond, he was surprised to observe the whole of its surface covered with parallel lines or veins, some of which reflected the light more powerfully than others, so as to have the appearance of a striped ribband, somewhat resembling the rude sketch here given, which shows that the plane surface of the diamond, in a space of less than *one-thirtieth* of an inch, contains many hundred veins or strata of different reflective and refractive powers, as if they had been subjected to variable pressures, or deposited under the influence of forces of aggregation of variable intensity. If, Sir David observed, the planes of these different strata had been perpendicular to the axis of the diamond lens, their difference of refractive power would produce no sensible effect injurious to the perfection of the image; but if these strata are parallel to that axis, as they are in the lens under consideration, each stratum must have a different focus, and consequently produce a series of partially overlapping images.



The results of this experiment in restoring the diamond to its value as an optical material, in so far as it enables us to cut it in a proper direction, and select proper specimens, and its connection with some delicate researches of Profs. Airy and Maccullagh, on the superficial action of diamond upon polarized light, possess considerable interest, but the fact of a mineral body consisting of layers of different refractive powers, and consequently different degrees of hardness and specific gravity, is remarkable. There were several minerals, such as *Apophyllite*, *Chabasie*, and others, in which Sir David said that he had found different degrees of extraordinary refraction in different parts of the crystal; but this variation of property depends upon a secondary law of structure; and he believed that there was no crystal, either natural or artificial, in which the properties of ordinary refraction, hardness, and specific gravity, varied throughout its mass. This peculiarity of structure, therefore, might be regarded as an indication of a peculiarity of origin; and as there are various strong arguments in favor of the opinion, that the diamond is a vegetable substance, the new structure which he had described might be considered as an additional argument in favor of that opinion. He had, in a former paper, placed it beyond a doubt, that the diamond must have been in a soft state, like amber or gum, and capable of having its structure modified by the expansive force of air or gaseous bodies imprisoned in its cavities; and therefore the fact of its being sometimes composed of strata of different degrees of induration and refractive power, was more likely to have been produced by pressures varying during the formation of the crystal, than by any change in the intensity of the forces of aggregation of its molecules. Such a change might have been supposed probable, had it been found in another crystal.

Prof. Bache on Heat.—The object of this communication is to call the attention of the Section to the researches of Prof. Bache of Pennsylvania, which seem not to have been so fully appreciated in this country as they deserve. That gentleman, at the outset of his inquiries, refers to a paper of Prof. Powell, in which the difficulties unavoidably attending any comparison of radiating effects of surfaces are pointed out from the impossibility of determining precisely in how many other respects besides those of color and polish of surface, the coatings applied may not differ. In contending for the necessity of equalizing the coatings compared, in other respects, before we can estimate the effects really due to the state of the surface, he must, of course, be understood to speak under the qualification acutely referred to by Prof. Bache, dependent on the fact noticed by Leslie, that radiation takes place not only from the surface, but from a certain minute, though sensible depth, which differs in different substances.

Taking this into account, the general meaning, as well as importance of the caution, will be manifest. In the sequel, Mr. Bache gives some very precise experimental proofs of the truth of the law just noticed, and shows, by successively adding fresh coats of the pigment, the precise limit beyond which such addition ceases to increase the radiating power,—which, in fact, there comes to a maximum, and with greater thicknesses decreases.

When this point had been ascertained carefully for each pigment, their effects were observed with great accuracy, and compared with a standard surface under similar circumstances; the observations include a considerable range of substances, differing both in color and other properties. The results exhibit no correspondence of the greatness of effect with the color. The source of heat was hot water:—the author allows fully the distinction between properties of heat of this kind, and that connected with light; in the latter case it is evident that color is an essential element; a wide field is yet open for tracing on what the effect does depend: and again, since Melloni has pointed out the existence of many kinds of heat, differing in their relations to screens, to trace also their different relations to surfaces.

Uric Acid and Urea, by Prof. Liebig.—The important part which uric acid performs in the animal economy, has for a long time attracted the attention of the most distinguished physicians and chemists. Uric acid forms in one class of animals the whole of the excrement, and in another class it is its principal constituent, and it is accompanied by urea, a never-failing constituent of the human urine. Its extraordinary production in that morbid state of the body, which we call a predisposition to gout, is well known to give origin to one of the most painful diseases to which mankind is liable. It may be affirmed with the utmost certainty, that urea and uric acid are products of the organization. We cannot discover their existence in any part of our food, nor do they constitute a part of any organ, as fibrine does of the blood; but they are chemical combinations of a peculiar nature, on which account they come more within the range of chemical investigation than any other bodies of animal origin. Prout's masterly analysis has long since removed every doubt respecting the composition of urea, and the extraordinary, and, to some extent, inexplicable, production of this substance without the assistance of the vital functions, for which we are indebted to Wöhler, must be considered one of the discoveries with which a new era in science has commenced. Wöhler observed, that when cyanic acid is made to combine with ammonia, the product is urea; and he and I have, in a set of experiments which we made together, proved that these two bodies, when first combined, form cyanate of ammonia, a salt analogous to every other ammoniac salt; that is to say, the base can be replaced by other bases, and the acid by other acids: but that, a few minutes after the combination has taken place, all these properties disappear. We can no longer detect either ammonia or cyanic acid. A new substance has been formed, entirely different from every other chemical compound. To follow out the characters of urea, would here be quite out of place: it was, however, necessary to allude to it from its intimate relation to nitric acid.

The elementary composition of uric acid has also been established beyond a doubt. We are certain that it may be expressed by the formula $C_{10} N_4 H_4 O_6$. We know also that this acid combines with the different bases, and forms salts. Inorganic Chemistry is satisfied with the determination of these properties, but it must be evident that this formula can give us no idea of the manner in which the elements are united together to form this substance. If we admit the principle, that no ternary or quaternary compound can be formed, except by the union of a binary compound with an element, or of two binary compounds with one another, it is clear that any further investigation of uric acid must be carried on with the intention of discovering the compound elements into which it may be resolved.

This investigation, which promised to yield the most important results, both for Medicine and Chemistry, Prof. Wöhler and I determined to undertake together. In Medicine, it was evident that we might have some new method of destroying calculi in the human bladder, without the application of external force. In Chemistry, the most interesting discoveries were also to be expected, as we had not the slightest doubt that urea, xanthic oxide, cystic oxide, oxalic acid, (which last substance is well known to constitute frequently an ingredient in unary calculi,)—that all these bodies are produced by the decomposition of one single substance, and that substance uric acid.

Our analytical investigations of these various bodies have not yet made sufficient progress to enable me to communicate them here. My intention at present is, to point out the plan which we followed in our attempts to decompose uric acid into its proximate elements, and the singular results which we obtained. But, before proceeding to do so, I should like to notice a very remarkable compound, which will, I think, serve greatly to illustrate the subject we are at present occupied with.

Winkler found, that when the distilled water of bitter almonds was mixed with muriatic acid, a new acid is obtained. The distilled water of bitter almonds, in a pure state, contains nothing but prussic acid and oil of bitter almonds, (hydret of benzoyl.) When treated with muriatic acid, we obtain sal ammoniac and the new acid, and nothing else. It is evident from this, and the conclusion is corroborated by the ultimate analysis of the new acid, that the hydro-cyanic acid of the liquid is decomposed by the action of the muriatic acid into ammonia and formic acid; that the ammonia combines with the muriatic acid, and that the formic acid, in the nascent state, unites with the oil of bitter almonds, to form a compound acid, in which the power of saturation of the formic acid is not changed. This acid performs, in every respect, the part of a simple acid; and its existence has rendered probable the supposition, that the same views respecting other acids are not without foundation. Another interesting fact respecting this acid is, that when heated with hyperoxides, it is decomposed in a particular manner, only one of its proximate constituents being oxidized, while the other suffers no change. The products obtained are carbonic acid and oil of bitter almonds.

Now, I think it must be evident to every one, that uric acid must possess a composition similar to that of the acid just mentioned; and, therefore, that its oxidation in the same manner would, in all probability, lead to interesting results. We obtained, in fact, results which corresponded to our expectations. Uric acid may be considered as a compound of urea, with a peculiar acid—that is, we may view it as analogous to nitrate of urea.

This acid contains the radical of oxalic acid, combined with cyanogen. I have attempted to show, in some former researches, that carbonic oxide, and not carbon, constitutes the radical of carbonic acid, and of oxalic acid, and that phosgene gas might be considered as containing the same radical in combination with chlorine. If we indicate carbonic oxide by R, these compounds will be as follows:—

1. Phosgene gas R+Cl. 2. Carbonic acid R+O. 3. Oxalic acid 2 R+O.

Now, the acid which combines with urea to form uric acid, may be expressed by the formula R+Cy. Viewed in this manner, the composition of uric acid will be 4 (R+Cy)+Ur.

Uric acid, when heated with brown hyperoxide of lead, was decomposed into three different products, oxalic acid, urea, and a peculiar substance, which we may view as a compound of cyanogen and water, and which is identical with a body long known, called allantoic acid, from having been first found in the allantoic fluid, but which it would be better to call allantoin, as it is capable of acting equally as an acid and a base.

One atom of uric acid, decomposed by the action of two atoms of hyperoxide of lead, is converted (supposing three atoms of water to be present) into two atoms of oxalate of lead, one atom of allantoin, and one atom of urea.

1 atom uric acid + 2 atoms hyperoxide of lead

$$(C_{10} N_4 H_4 O_6) + Pb_2. O_4$$

gives

$(R_4 + O_2)$ oxalic acid (+2 Pb. O) oxalate of lead 2 atoms

(4 Cy + 3 Aq.) allainton

1 atom urea.

Allantoin is the second body belonging to the animal organization, which we can form artificially in the laboratory. This substance can also be directly produced by the decomposition of cyanogen and water. It yields, when decomposed by other bodies, all the products which, from its formula, might be expected. Thus, with alkalies, it yields oxalic acid and ammonia, with strong sulphuric acid, carbonic acid, and carbonic oxide.

There are many bodies similar to urea and allantoin, all of which will probably, at a future period, be produced by artificial means; but, in order to arrive at this, the final object of investigations in organic chemistry, a great deal of labor, and that labor of a combined nature, will be required. I am certain that this object will be obtained. Organic chemistry has made its first step, and already its field has been extended to a very surprising degree. We meet every day with new and unexpected discoveries. It is, however, remarkable, that in the country in which I now am, whose hospitality I shall never cease to remember, organic chemistry is only commencing to take root. We live in a time when the slightest exertion leads to valuable results ; and, if we consider the immense influence which organic chemistry exercises over medicine, manufactures, and over common life, we must be sensible that there is at present no problem more important to mankind than the prosecution of the objects which organic chemistry contemplates. I trust that English men of science will participate in the general movement, and unite their efforts to those of the chemists of the continent, to further the advance of a science which, when taken in connection with the researches in Physiology, both animal and vegetable, which have been so successfully prosecuted in this country, may be expected to afford us the most important and novel conclusions respecting the functions of organization.

Non-decomposition of Carbonic Acid by Plants.—Dr. Dalton communicated through a friend, a short paper 'On the Non-decomposition of Carbonic Acid by Plants.' He calculates, that in 5000 years, animals supposed to live upon the earth, would produce but .001 of carbonic acid, so that the assistance of plants to purify our atmosphere is not necessary. By experiment, he found, that a hot-house does not contain more or less carbonic acid, by night or by day, than the external air, and the results were the same in a number of repetitions of the experiments. This paper was said to have been penned during the convalescence of its illustrious author from a late attack of illness, and was listened to with the greatest attention.

Galvanic Formation of Metallic Copper.—The present is the first occasion on which native copper has been found, actually detected, as it were, in the very act of formation in the mine shaft. The Cronebane mine has been wrought for a very lengthened period, and has an additional interest as connected with the present subject, from the electro-magnetic condition of the next mine to it, the Connoree, which is part of the same vein, having been determined by Mr. Petherick, (*Philosoph. Mag.* 3*d Series*, vol. 3.) He found it deflected the galvanometer needle 18°—that the ore was negative, and the ground positive. The lode is situated in clay slate, dipping to the S. W. The mine water is strongly cupreous, and deposits a slimy sediment of iron, and organic matter, probably "Glairine." In this slime, and adhering to the timbering of the mine, the crystals of pure malleable copper were found in considerable quantity. The mine water from whence these masses were formed, has a specific gravity of 1.032, at 58° Fahr. When evaporated to dryness, it leaves a horny residue, smelling of animal matter. It contains the mixed sulphates of copper and iron.

Amongst the many forces in operation to produce this metallic aggregation, the author suggests the possibility of galvanic action, between the lode and the timbering of the mine; having found the galvanometer much affected by a small series of plates of grey copper ore, and of fir timber, saturated with solution of sulphate of copper under the air pump—the exciting fluid being the water of this mine.

Browning of Gun Barrels.—Mr. Ettrick submitted to the Section a paper on browning gun barrels. After various experiments, Mr. Ettrick discovered that the process consisted wholly in procuring a *permanent* peroxide of iron, and then coloring such oxide. He had procured not only all shades of brown, but a perfect black, by mixing 1 part of nitric acid with 100 parts of water, and applying this to the barrel with a rag moistened with it. It is material that the rag should be only so much wetted as to damp the iron, for if the fluid be allowed to stream, the oxidation will be unequally performed. It is also material that the barrel should be well smoothed and polished, and all greasiness removed by chalk before the browning commences, otherwise a bright brown is not attainable. The barrel, after being wet, should be placed for an hour or more in a window on which the sun shines, and when this process has been thrice repeated, the superfluous rust must be removed by a scratch brush consisting of a quantity of fine iron wire tied up into a bundle. This process being repeated eight or ten times, the barrel will have acquired as good a brown as it frequently receives from the common gunsmiths; but to do away with the disagreeable rusty appearance, it is necessary to proceed to color the oxide, which Mr. Ettrick accomplishes by dissolving 1 grain of nitrate of silver in 500 of water, and applying this solution like the browning liquid. The number of repetitions of the nitrate of silver water would depend on the shade of brown required, but Mr. Ettrick found from 1 to 5 or 6 amply sufficient. The barrel is to be placed in the sunshine to obtain a dark color. The last process was to apply the scratch brush freely, though lightly, and then polish the whole by bees' wax. Mr. Ettrick had, since the date of his own invention, discovered the process used by workmen generally, and long kept secret, but by the plan described a much finer brown is attainable than that gained by the trade.

Fossil Fishes—Agassiz's great work going on.—Mr. Dawson exhibited a collection of fossils from New South Wales.—Mr. Murchison communicated some information which he had lately received from M. Agassiz, who was bringing out some new livraisons of his great work on fossil fishes, and he mentioned that in order to enable that gentleman to carry on his work, a further grant of money would be recommended by the Geological Committee. The remains of fish had been found to be the most valuable of all indexes for determining the ages of rocks, as there was a plain separation of these animals in formations of different ages. Mr. Murchison showed drawings of some of these fossils, and remarked that in the lias and the older beds the fishes were characterized by a tail quite different from that belonging to those found in the newer formations, and he exhibited on a board representations of some of the peculiarities of those discovered in the Silurian rocks. He must record the names of Drs. Lloyd and Lewis as having given him material assistance in the collection of these remains. He had found remains like the shagreen or tuberculated skin of some recent fishes, also extraordinary teeth belonging to a species termed *Stogodus Priscodontus*, and fish called *Seraphim*, by the quarrymen, from their seeming to possess only head and wings, to which the name *Pterigodus* has been given; also many others which M. Agassiz would soon have described and published.

Heat in Mines.—Mr. R. W. Fox stated, that at the Bristol Meeting of the Association he had been requested to make experiments on the Electricity of Mineral Veins. He had been unable to do much since that time—he had merely to mention, that he had made experiments at Middleton Teesdale, in the county of

Durham, and found a slight electric action in lead veins running east and west, other veins crossing these at right angles: in Goldbury mine he found it very trifling in lead veins occurring in sandstone. Indeed, he had generally observed, that the electric action was much more feeble in veins situated in sandstone and limestone than in those placed in granite and killas. He remarked a singular phenomenon in a coal-mine at Cockfield Fell:—It is well known, that coal is a bad conductor, but cinders the reverse; and in this mine he found an altered coal, resembling a cinder, which would not conduct at all; but he was able to render it a good conductor, by causing it to be heated. Mr. Fox then made some observations on the temperature of mines, and detailed some experiments. He had observed, that adventitious circumstances had the effect of reducing this temperature, so that experiments must be made independent of accident. He had accordingly placed one thermometer, in various mines, at a depth of three feet *in* the ground, and another *upon* the ground of the mine, and then marked the degrees; and he uniformly found a difference of one or more degrees between the two instruments, the imbedded one rising sometimes as high as 92°. Also, in a mine having an inclined lode, he placed on the floor of a horizontal gallery a pair of thermometers, one instrument imbedded, the other not, and found that, at a distance from the lode of twenty-four fathoms, the deep one marked 85½°, and the other 84°; at ten fathoms off the lode they were respectively 86½° and 85°; in the lode itself, and upon it, 92° and 88°. Mr. Fox found the increase of temperature vary in different mines, and also in the rocks themselves, which he ascribed to the percolating water—killas being more porous, becoming sooner heated by water filtering through, than granite, which is more compact.

North American Antiquities.—Dr. Warren, of Boston, U. S., then offered remarks 'On some Crania found in the Ancient Mounds in North America.' Whatever related, he observed, to the lost nations of North America is interesting. The fate of a people which occupied the richest part of that country, for an extent of more than a thousand miles, is involved in the deepest obscurity. Nothing remains of their history, and we can gather no ideas of what they were and what they did but from the constructions existing in the territory they inhabited. These works are numerous, and scattered over the country, from the lakes of

Canada to the Gulf of Mexico. They consist of regular lines, having considerable elevations and great extent, of mounds or pyramidal eminences, and of spacious platforms of earth. These different works were adapted for fortifications, for places of worship, and for cemeteries. Within the last two years, reports, he said, had reached the Atlantic States of very extensive remains of structures indicating the existence of one or more considerable cities in the territory of Ouisconsin, formerly a northwest territory of the United States. The antiquity of some of the numerous works alluded to was great; there are circumstances which led him to refer them to a period 800 or a 1000 years back. The circular and pyramidal eminences seem to have been destined for two purposes: for places of worship and for cemeteries. Some of them contain immense heaps of bones, thrown together promiscuously, as after a bloody battle; in others the bodies are regularly arranged, and in some there are only one or two bodies: the bones in the last are usually accompanied by silver and copper ornaments, some of which are extremely well wrought. The crania found in these mounds differ from those of the existing Indians, from the Caucasian or European, and in fact from all existing nations so far as they are known. The forehead is broader and more elevated than in the North American Indian, less broad and elevated than in the European; the orbits are small and regular. The jaws sensibly prominent, less so indeed than in the Indian, more so than in the European. The palatine arch is of a rounded form, and its fossa less extensive than in the Indian or African, more than in the European, owing principally to a greater breadth of the palatine plate of the os palati. But the most remarkable appearance in these heads is an irregular flatness on the occipital region, evidently produced by artificial means. These peculiarities, with others more minute, give a character to these skulls not found in any living nations. Dr. Warren also stated that he had received other crania, which at first view he believed to be of the same race and nation, for they resembled them in all their peculiarities, more nearly than one Caucasian head resembles another; and he exhibited drawings and a cast in proof of the exactness of this resemblance; but these latter, he observed, were species of ancient Peruvian heads. Now the cemeteries of the ancient Peruvians are distant from the Ohio mounds more than 1500 miles, yet the facts stated above rendered it certain, in his opinion, that these nations were connected by blood, and rendered it probable that the northern race, being driven from their country by the ancestors of the existing race of North American Indians, retreated, after a long resistance, to South America, and gave origin to one of the nations which founded the Peruvian empire. Anatomy, also, he observed, showed that there was much resemblance between the crania spoken of and those of the modern Hindoos; and instruments, ornaments, and utensils have been discovered in the mounds, which bear a great resemblance to articles of the same description seen in Hindostan. The facts stated above lead him to the following inferences:—1. The race whose remains are discovered in the mounds were different from the existing North American Indian. 2. The ancient race of the mounds is identical with the ancient Peruvian. To these conclusions might be added others tending to support existing opinions, but which are hypothetical:—1. That the ancient North American and the Peruvian nations were derived from the southern part of Asia. 2. That America was peopled from at least two different parts of Asia, the ancient Americans having been derived from the south, and the existing Indian race from the northern part of the same continent.

Cholera.—Dr. Mackintosh then addressed the Section on cholera. He would state only facts, and show them, supported by a great number of preparations of parts taken from cholera patients soon after their death, mostly in the second stage,—collapse. He then spoke in favor of pursuing pathology, with a view of elucidating disease; but pathology, in combination with causes, symptoms, and treatment. He who did not pursue this method, was not a pathologist, but a mere morbid anatomist. He had dissected three hundred cases of cholera, in the first year of its appearance in a malignant form; two hundred and eighty of these died in the collapsed stage. It was a popular error to say, as many frequently do, that medical men know nothing of cholera. In every respect their knowledge on this subject is vast, and minute, and scientific, and practical. Their knowledge exceeds that on scarlatina, or measles, with which popular opinion thinks them well acquainted. In India the opinion is, that in cholera there is lost balance of the circulation: it was not so; there is no rigor, and never was a rigor, which there would have been, if the India opinion was true. There was a giving off of serum, and every vessel, arteries as well as veins of the body, every tissue was literally injected with black blood, which freely followed the knife on dissecting. Dr. Mackintosh now presented a great number of preparations, and paintings, and drawings, of the organs of the body afflicted with cholera. Many preparations were dried with the cholera blood in them, which was effected by submitting them, immediately on their removal from the body, to a stream of dry hot air, from apparatus constructed for that purpose. These accumulations were greater in some organs than others, often depending on the state of the patient's health previous to the attack,—if he had bronchitis, there would be the greatest accumulation. The bloodvessels were greatly distended: in a cast of a case taken from the abdomen, which he exhibited, the abdominal aorta was one inch in diameter, vena cava three-fifths, emulgent vein eight-sixteenths. The general anatomical characters, as shown by preparations of each organ, were accumulations of blood, ecchymosis, called by the French apoplexy; thus, if occurring in the lungs,—pulmonary apoplexy, petechiæ, and clots. In addition, we may mention some peculiarities in individual organs, as noticed by the lecturer. In the head, even the bones were vascular, and could not be bleached, but with great difficulty: arachnitis rare, pia mater loaded with blood and effusion, which caused many to mistake it for arachnitis; in the sinuses clots of blood and lymph, rendering in these cases recovery impossible. In the spinal marrow were, in sixty out of two hundred, deposits of bone on the theca; in the chest, pleura at first dry, as if exposed to dry air; in collapse it became unctuous; lungs very heavy, weighing 3 lb. 9 oz., to 3 lb. 11 oz.; pulmonary apoplexy frequent in consecutive fever, which fully explains the number of deaths from that fever after the cholera attack. In the abdomen, the mucous membrane ulcerated and softened, not always red, sometimes even white; the liver resembled that of dram-drinkers, the gall-bladder unusually distended with black bile; then many galls in numerous cases, in only one was the duct rendered impervious by them; the kidneys were diseased, as recorded by Bright, and from the papillæ could be pressed mucus; bladder contracted. As to the blood vessels, he wished to direct the particular attention of the Section to them; he would show, by many preparations, the diseased state of their inner coat, the organization of which was completely altered, so as to render them unfit for their functions, and this disease extended throughout the whole series of vessels, until it terminated in a kind of gelatinous pulp. Would this state of the vessels have considerable influence? and how far would it be concerned in producing that state of blood, always observed in cholera,—when the serum passes off, the blood becoming thick and black? Many of the French, and some English, thought the nerves in cholera, on its appearance, were comparatively not so vascular, and not much diseased otherwise; the par vagum, as it passes the subclavian artery, was enlarged like a ganglion. Even animals were seized with cholera, and presented the same morbid appearance as in the human subject.

Dr. Clanny could fully confirm all the observations of Dr. Mackintosh. Dr. Holland inquired, what name he would give to the affection of the bowels ushering in the cholera, and what was the nature of cholera? Dr. Mackintosh replied, watery diarrhœa; and he would have entered into the nature of the disease, if time could have been afforded him.

Bust of Mæcenas.—"It was long a cause of wonder and regret that no gem, medal, or statue of a man so illustrious, had ever been discovered. At length the Duke of Orleans, Regent of France, early in the last century, by a happy conjecture, fixed on one of the gems in his collection, an amethyst of small size, marked with the name of the engraver, Dioscorides, as being the representation of the head of Mæcenas. Another gem, bearing the name of Solon, the engraver, evidently representing the same person, was afterwards found in the Farnesian Museum; and a third of the same, a sardonyx, also engraved by Solon, has since been discovered in the collection of the Prince Ludovisi. The features given in these gems agree so well with all that has been handed down in the Roman classics, concerning the personal appearance and habits of Mæcenas, that the suggestion of the Duke of Orleans has been adopted by all subsequent antiquaries. A few years after the recognition of the head of Mæcenas on the gems of Dioscorides and Solon, both artists coeval with Augustus, an antique fresco painting was discovered in the ruins of the palace of the Cæsars on the Palatine Hill at Rome. This painting represents Augustus surrounded by his courtiers, conferring a crown on the Persian king Phraates, an event spoken of by Horace. In the front rank of the courtiers stands one, evidently the Prime Minister in the act of speaking, whose features strongly resemble those on the gems of Mæcenas above described. Next to him is Agrippa, who is readily recognized from medals, coins, and statues of him. Horace also is found in the group. A copy of this painting was bought by Dr. Mead, and brought to England by him; and an engraving of it may be seen in Turnbull's Essay on ancient Painting.

"This was the extent of antiquarian research and acquisition concerning Mæcenas during the last preceding half century, when, in the spring of 1830, a bust was found in an excavation made by Prof. Manni, at Carsoli, the ancient Carsuli, about seventy miles from Rome, on the Flaminian Way. This place is situated in what is esteemed the most beautiful and romantic district of the Roman territory, being near the cascades of the Nera, at Terni, and midway between the towns of Terni, Todi, and Spoleto.

"The bust was of colossal size, the same as that presented to the Society, of pure Parian marble, and perfect in every feature. On being cleared of its incrustation, the modelling of the work was seen to be of that masculine firmness which characterizes the style of the epoch of Augustus, excelling in what is called a broad manner,—the execution that of a master,—with the greatest severity and grandeur; the emaciation by age of the individual represented being faithfully preserved. The striking resemblance of the bust to the gems and picture of Mæcenas, was at once recognized by the most eminent antiquaries and learned men at Rome.

"It may be interesting to state, in further confirmation of the high value which has been set upon the bust, in Italy, as also because the circumstance enhances the gift of Prof. Manni, that it has been twice copied by Thorwaldsen. One copy was presented to the Grand Duke of Tuscany, and by him placed in the Hall of the Academy of Petrarch, at Arezzo, as being the presumed birth-place of Mæcenas; the other to the king of Naples, who caused it to be deposited in the Borbonico Museum at Naples."

Objects of interest in Liverpool.—In the museums, &c., of the Royal Institution, the attention is first directed to a series of ancient paintings, from the collection of the late Mr. Roscoe, illustrating the progress of the art. The department of Natural History is remarkable, and contains some rare specimens,—to which attention was drawn in the Zoological Section,—there is also a well-arranged Geological collection, particularly rich in specimens of the coal formation. The School for the Blind must also be specified as an institution on the largest scale, and admirably managed. The manufactures executed by the pupils are (some of them) exquisite for their neatness and finish. Besides these, we may mention the Botanic Gardens, recently removed from their old site in Mount Pleasant, in consequence of the rapid growth of the town; and the Zoological Gardens, or, in other words, Mr. Atkins' private menagerie, located and enriched by subsequent donations. The ground is agreeably varied, and the collection, which is extensive, contains, we believe, an unique specimen of the mule between the lion and the tiger. But the most interesting and individual things in the town, are some of the manufactories. One of them, Messrs. Fawcett & Preston's Foundry and Steam Engine Manufactory, is one of the largest establishments in the world. We saw it under favorable circumstances, for the proprietors were just completing the apparatus for a steam frigate, about to be launched by the French government. A stranger is most struck by seeing iron undergoing processes with which he is only familiar as connected with wood,—such as turning, planing, grooving, &c. An iron shaving, more than a yard in length, turned off as smooth and clear as if it were from a piece of wood, was a novelty which surprised most of the visitors. There are more than seven hundred workmen employed in this establishment; and though the labor is very severe, and would appear, from the number of metallic particles flying about, to be very unwholesome, we remarked that several of the operatives were very old men, and that none of them looked sickly. Contrary to the general opinion, we were assured that no difference is observed between the health of those who work in brass and those who work in iron. This is a gratifying circumstance, because brass and copper are daily coming more into use in the manufacture of marine steam-engines, being less injured by sea water than iron. The *cannon-foundry* was in more active operation than we should have expected in "these piping times of peace;" but we were informed that a large supply of artillery had been recently supplied to the Dutch government. Bury & Brancker's Foundry is the great manufactory for locomotive engines. It appeared to be more economical of its power than Fawcett's, and more ingenious in its contrivances and adaptations, though the works are not on so large a scale. With these we may mention Logan's chain-cable manufactory. In this, the most remarkable thing is, the apparent simplicity of the contrivances. Iron bars, heated, are twisted into links over double cylinders, and each link, as formed, is cut off by powerful shears. A bar crosses the middle of every link; this is formed of cast metal, and is inserted cold, when the link is welded into the chain. A slight blow is sufficient to secure the bar, for the link contracts as it cools down from welding heat. Each chain, when finished, is subjected to a severe trial; the chain is exposed, by means of a lever working on a centre, to a strain of more than twenty tons. Repeated fractures occur; and it is not until this test has been several times applied, that the chain is marked as perfect.

Without the town, the botanist finds a rich treat in Mr. R. Harrison's collection of Orchideous and Parasitic plants at Aigburth; and the geologist will visit Leasowe's Castle (an inn) for the sake of the remains of its submarine forest. This lies near the mouth of the Mersey, on the Cheshire side. It appears like a peat-bog, over which sand had been lightly sprinkled. We found several specimens of trees nearly perfect; and it was easy to determine their species, from the distinctness with which the form of the leaf is preserved in the peat. Within the house is to be seen the carved roof of the old star-chamber, which was brought from Westminster Hall. Nor must we forget to mention, as among the objects best worth seeing in the neighborhood, Mr. Blundell's Statue Gallery at Ince.

Treasures of Knowsley, the seat of the Earl of Derby.—The whole of the extensive premises were thrown open to the inspection of the visitors. In the galleries and rooms of the mansion were a fine collection of pictures; but, as our time was limited, we could not examine them with the attention they deserved. The extensive aviary contains many fine and rare birds and beasts. Some of these animals are permitted to range the grounds of the aviary unconfined, being covered in by wire-work, extending over many rods of ground. Among the Raptores we observed several fine vultures; among which were two species of Percnopterus; also the *Vultur Angolensis* of authors, and all the British eagles. Of the smaller birds, the Insessores,—a species of Lamprotornis, (never before seen alive in this country,)—a group peculiar to Africa, excited, by its brilliant coloring, elegant shape, and peculiar eye, the attention of all who saw it. The large eye is perhaps the most striking part of the bird, having a deep yellow iris surrounding a small and apparently black pupil, which contrasted remarkably with its dark purple plumage. There were many other rare and beautiful species in this order, especially one of the genus Euplectes. Of the Scansores there were several fine specimens; as *Nymphicus Novæ-Hollandiæ*, the *Psittacus Novæ-Hollandiæ* of Latreille, the *Paleornis Barabaudiæ*, the *Platycercus Stanleyii*, (named after the noble Earl,) the *Platycercus Bauerii;* also a living specimen of the red-billed Toucan, *Ramphastos Erythrorhyncus.* Amongst the Rasores were some red grouse—specimens of the Sand and Blackcock—which had been bred in the cage—a very rare circumstance. There were also a great variety of pigeons, and gallinaceous birds. Amongst the former was the beautiful and interesting passenger-pigeon, in great numbers, leading to the hope that it may soon become naturalized in this country. Of the Cursorial birds there were several fine specimens. Amongst the Grallatores, the Stanley crane *(Anthropoides Stanleyanus)* formed a striking object. It is a native of Africa, and has lately been brought into this country. Of the Natatores there were also numerous species. Two very fine pelicans were in close confinement, on account of the ravages they committed on the young of their colleagues, the Anatidæ, &c. Amongst the animals were several valuable species of deer and antelope; also various Marsupiata from Australia. The noble Earl accompanied the party around the aviary, and seemed to take great interest in his extensive collections.

The Salt Mines at Northwich also attracted a good deal of attention, and a party of about eighty set off on Saturday morning to visit them. According to previous arrangement, the gentlemen who were furnished by the President of the Geological Section with the necessary tickets, assembled at the railway station at a quarter before eight o'clock, but, owing to some mismanagement, the train appropriated to the party did not start until within a quarter of nine. A little after ten, the train, after a run of thirty miles, came to a stop, and the rest of the journey, a distance of about four miles, was accomplished in vehicles which were in waiting for the party. On their arrival at the works, they were conveyed, in succession, to the bottom of the mine in a basket lowered by means of a windlass, four descending together, and then conducted through the various parts of the excavation. There are two beds of the rock-salt, the lower one being exclusively worked, owing to its superior quality. The floor of the mine is 336 feet below the surface, and the portion of the saline mass removed is about 40 feet in height and extends over an area of 30 statute acres. A great number of successive strata of clay, more or less indurated, occur between the upper stratum of salt and the surface, and the two saline deposits are separated by analogous formations, the portions of those next the salt being intersected with little veins of the Sal gem, exhibiting a beautiful scarlet color, no doubt due to the presence of a small quantity of sesqui-chloride of iron. After having traversed the whole of the excavation, which was lit up in a most magnificent manner—several thousand candles having been employed for the purpose—the visitors were regaled within this subterranean palace with a very elegant *déjeuné.* We have seldom seen a company sit down in higher spirits, or to a better entertainment; and it is scarcely necessary to say, that when the health of the proprietors—particularly of Mr. Worthington, who had conducted the party from Liverpool, and also through the mine, was given, it was drunk with the utmost enthusiasm. The entertainment being concluded, some fireworks were exhibited, which lighting up the excavation with various shades of colors, produced effects which it is no exaggeration to describe as at once grand and terrific. "God save the Queen," and, at the suggestion of Mr. Porter, a psalm, having been sung immediately beneath the shaft, the whole party ascended, and returning by the same method of conveyance, reached the railroad station in Lime Street at five o'clock. While the party was below, Dr. Crook took occasion to make some geological remarks applicable to saliferous deposits, and drew attention to a peculiar appearance in several parts of the roof of the mine, from which he concluded that the salt originally solidified in globular masses, the crystallization proceeding from a centre. The temperature of the mine, which we should conjecture to be about 48°, was understood to be very equable throughout the whole year,—and not a particle of moisture was any where to be seen.

ART. II.—*Memoir upon the Temperature of the solid parts of the Globe, of the Atmosphere, and of those regions of space traversed by the Earth;* by M. POISSON. Communicated to the Academy of Sciences, of Paris, at the Session of that body, held on the 30th of January, 1837.

Translated from the French, for this Journal, by R. W. HASKINS,* of Buffalo, N. Y.

I PROPOSE to offer, in this memoir, an epitome of the principal results which are found in my work, entitled "*Théorie mathématique de la Chaleur;*" (1) to add thereto some new remarks, and to recapitulate the principles upon which these results are founded.

Near the surface of the globe the temperature, at every point, varies with the different hours of the day, and with the different days of the year. In considering these variations, Fourier, supposing the temperature of the surface given, has confined himself to deduce from this the temperature of a given depth; thus leaving unknown the relations that should exist between the exteriour and interiour temperatures. To determine these relations Laplace has assumed, for the exteriour temperature, that which is indicated by a thermometer exposed to the air, in the shade, and which depends, in an unknown manner, upon the heat of the air in contact with the instrument, upon the radiant heat of the sun, and upon that of the atmosphere. I have exhibited this problem

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* To PROF. SILLIMAN.—*Dear Sir:* In the number of your Journal for April last, you gave a translation of one of Baron Fourier's papers upon the temperature of the Terrestrial Globe and the Planetary Spaces. A view of this subject, different from Fourier's, has recently been taken by S. D. Poisson, in his treatise upon Heat; and of which work the author has given a condensed outline in a paper that appears in *Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences*, No. for 30th of January last.

Of the merits of either of these theories I assume not to judge; but as it seems highly probable that those who take an interest in these investigations would be pleased to see something of M. Poisson's views, I send, herewith, a translation of a part of the article in question. I have given but a part, as the paper is long, and much of it is devoted to mathematical demonstration, which I suppose would hardly interest the general reader, while those who wish such demonstration will, of course, seek it at length, in the author's work, referred to.

Respectfully yours,

Buffalo, Nov. 3, 1837. R. W. HASKINS.

(1) 4to. Paris, Bachelier, 1835.

under another point of view, more in conformity with the nature of the question; and I have proposed to determine the temperature of the earth, at a given depth, and upon a given vertical line, from the quantity of solar heat which traverses the surface at each instant. In any given place upon this surface, the quantity of heat varies, during the day, and the year, with that of the elevation of the sun above the horizon, and with the declination. I have considered it as a function disconnected from time, nothing while the sun is below the horizon, and expressed at all other epochs, by means of the horary angle and the longitude of the sun; and by known formulas I have transformed this function into a series of sines and cosines of the multiples of these two angles; and by means of the formulas of my preceding memoirs, I have subsequently determined, for each term of this series, the temperature of any depth whatever—which is a complete solution of the problem.

Of this temperature there are series of diurnal inequalities, of which the periods are of one entire day or a sub-multiple of a day; and annual inequalities of which the periodick times embrace a year or a sub-multiple of a year. Upon each vertical, the *maximum* of each of these inequalities is propagated uniformly downward, with a velocity dependent solely upon the nature of the soil; so that the interval comprised between the epochs of this *maximum*, for two points separated by a given distance, is the same, and proportional to this distance, in all places of the globe where the soil is of the same nature. At the surface, the interval which separates the *maximum* of one of these inequalities from that of the correspondent inequality of the solar heat, is invariable, with regard to geographical position; but it depends, at all times, upon the nature of the soil and the condition of the surface. It is the same with regard to the relation between these two *maxima*, of which the first is always less than the second; but the length of each vertical, the *maximum* of each inequality of temperature decreases in geometrical progression when the depths increase by equal differences; and the relation of this progression depends only upon the nature of the soil. If we examine, upon the same vertical, the inequalities of temperature, of which the periods are different, their expression will show that those which have the shortest periods are propagated with the greatest rapidity, and that they decrease, also, the most rapidly.

In general, the diurnal inequalities are insensible, at the depth of one mètre, (2) and the annual inequalities disappear at the distance of twenty mètres from the surface; while at about one third that distance this is reduced to an inequality of which the period embraces the entire year. At the depth of six or eight mètres the temperature offers, then, but one *maximum* and one *minimum* during the year; which have an interval of six months between them, corresponding to the epochs of greatest and least solar heat. Beyond a depth of about twenty mètres the temperature no longer varies with the seasons; or, at least, it can only experience secular variations which have not yet been observed.

Upon each vertical the inequalities of temperature, both daily and annual, are accompanied by an ascendant or descendant flux of heat, the quantity and direction of which varies with the time and the depth. The extent of these inequalities and of this flux of heat is not the same, in all latitudes; at the equator, for example, the annual inequalities mostly disappear, and consequently the temperature should there be very nearly constant, at a much less depth than at any other place.

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Near the surface of the earth the mean temperature due to the solar heat varies with the obliquity of the ecliptick, which enters into the function I have designated by Q. This secular inequality, like those which are daily and annual, is attended with a variation in the direction of depth, which we are not able to determine with accuracy, in default of knowing the expression of the obliquity of the ecliptick, in the function of time; but the data we have of the extreme slowness of the displacement of the ecliptick, and of the minuteness of this displacement suffice to show that the variations of terrestrial temperature, arising from this cause, are very feeble, and can therefore but slightly influence the observed increase of temperature, at augmented depths. Fourier, and afterwards Laplace, attributed this phenomenon to the original heat which the earth has still preserved, and which they suppose to increase constantly, from the surface to the centre of the globe; so that, while at the centre there is a temperature excessively elevated, yet near the surface the heat, from this cause, is scarcely perceptible: that in virtue of this primitive

(2) The mètre is = 3.2808992 English feet.

heat, the temperature, at this time, is more than 2000 degrees, (3) at a distance from the surface not exceeding the one hundredth of the earth's radius; while at the centre of our globe this temperature surpasses 200,000 degrees, estimating it according to the ordinary formulas which relate to solid, homogeneous bodies. (4) But, although this explanation has been generally adopted, I have shown, in my work, the difficulties which it presents, and which, it appears to me, render it inadmissible. I believe I have there shown in what manner the earth must have long since lost all heat which it may primitively have had; and subsequent reflection having confirmed me in this opinion, I shall present it here with more precision and assurance than at first.

The almost spherical form of the earth and planets, and their depression at the poles of rotation, leave no room to doubt that these bodies were originally in a fluid state. In the problem having for its object the determination of the figure of these bodies, geometricians consider them, in fact, as liquid masses, composed of layers, each having the same density throughout all its extent; and the whole revolving round the same axis, of constant direction, with a known and constant velocity. The density decreases, from one layer to another, in receding from the centre towards the surface, either because these heterogeneous layers have distinct densities, and are regarded as incompressible, and that the most dense have sunk towards the centre for the stability of the system; or rather because, according to the opinion of D. Bernouilli, subsequently revived by Thomas Young, all these layers were formed of one homogeneous liquid, susceptible of a certain degree of compression, and of which the density consequently increases, in approaching the centre, by reason of the pressure, also increasing, which the liquid exercises upon itself. In either case they suppose the entire mass of liquid,

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(3) Centigrade division is that employed by the author, throughout his work.

(4) At page 428 of the author's *Théorie Mathématique de la Chaleur*, he has the following passage:

"At the centre, and throughout the greater part of its mass, the materials of which the earth is composed would then be in a state of incandescent gas; yet so condensed that their mean density would surpass, five times, that of water. To contain these, at such a degree of condensation and of heat, an extraordinary force would be necessary, of which we can form little idea; and we may doubt if the solidified layers of the globe would have thickness and cohesion sufficient to resist the dilating power of these interiour, fluid layers."

after numerous oscillations, arrived at a permanent figure, which was determined in this state of fluidity, and that the liquid subsequently preserved this figure while passing to a solid state. The solution of this problem of hydrostaticks requires only a knowledge of the temperature of the liquid; but now, if we suppose that this heat was very great, and much superiour to the temperature of the regions of space surrounding the planet, we see not what exteriour pressure there could have been which prevented the liquid from dilating itself to a state of vapour, instead of passing from a liquid to a solid state: and if it was possible that the layers near the surface had commenced, through condensation, to assume the solid state, before the interiour layers had lost their primitive heat, we can no more clearly understand how these last, by their tendency to dilation, of which we understand the power, should not burst the solid, exteriour envelope as often as formed. It is farther to be observed that this high temperature of our planet, in the liquid state, is a gratuitous assumption of which it would be difficult to find an explanation. (5) It is true that when a body is at first a liquid, more or less compressible, of which the layers would augment in density, in going from the surface to the centre, and terminate by passing to a solid state, by reason of the pressure from without, this condensation and this change of condition would develope a great quantity of heat; but it is necessary to observe that in this view of the subject the solidification would probably commence at the centre of the mass: the nucleus, thus solidified, would become a focus of heat, which would raise the temperature of the immediately surrounding layer, still in a liquid state; this layer, thus heated, and its density diminished, would be elevated, and its place supplied by a new layer which, in passing to the solid state, would radiate heat in like manner, and so in succession, until the entire mass should have become a solid. In this manner the solid nucleus, gradually augmenting, would communicate, to the parts still liquid, the quantities of heat successively disengaged from newly solidified

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(5) Some interesting remarks upon central heat occur in Lyell's Geology, American edition, 1837, vol. 1, p. 452, and onward. The last English edition, of which this one is a copy, was published during the present year; yet it is probable the author had not seen M. Poisson's Theory of Heat, as he quotes both Fourier and Cordier, and controverts their theory, but without mention of Poisson.

layers, while, by reason of the mobility of the liquid particles, these quantities of heat would be carried to the surface, where the whole would be dissipated, by radiation, through the surrounding space. While thus passing to a solid state, the liquid mass would lose all the heat developed by this change. But this may be better understood in ascending to the probable cause of the primitive fluidity of the planets.

This we may illustrate by reasoning on the known hypothesis of Laplace, upon the origin of these bodies, namely, that they are portions of the sun's atmosphere, which it has successively abandoned, in concentrating itself around that body. The earth was, then, primitively, an aëriform mass, of very great volume, relatively to what it now is, and formed of the different materials, solids and fluids, of which it is now composed, which were then in a state of vapour, that is of an aëriform fluid, of which the density could not surpass a given *maximum*, proportional to its degree of heat, and which would become liquid or solid according to the augmentation of the pressure it experienced, without changing its temperature. That of the earth would depend, then, upon the point it should occupy in space, and upon its distance from the sun; and might be more or less elevated. But independently of the attractions and repulsions which take place only among particles near each other, and which produce the elastick force of aëriform fluids, equal and contrary to the pressure they sustain, the particles of the earth were also subject to their mutual attraction, in the inverse ratio of the squares of their distances; and from this force there resulted, upon all the layers of the fluid mass, a pressure, nothing at its surface, increasing from the surface to the centre, and which, at the centre itself, becomes exceedingly great, surpassing 100,000 times, the weight of the present atmosphere. It is this increasing pressure, and not an exteriour temperature much lower than that of the fluid, which has successively reduced all the layers to a solid state, commencing with those at the centre, and continuing from one to another, until nothing remained except the matter composing the oceans and the atmosphere of the present day. But this reduction has not been instantaneous; for a certain period of time was necessary for each layer to approach the centre, towards which it was urged, by the pressure it experienced, and which was the exciting cause of this movement. Now we may readily infer, when we call to mind the almost infinite velocity of radiation, that time enough has elapsed for the different layers of the earth, in passing to a solid state, to have lost all the heat developed during their change, and which escaped, by radiation, through the superiour layers, still in a state of vapour; so that long prior to the present period, the last trace of this heat, however great it may have been, had disappeared. An effect similar to that we are now considering would result, for example, if we produce a horizontal cylinder, of great length, closed at the ends, and filled with steam at the temperature of the exteriour, and at the *maximum* of density. In this position of the cylinder, the weight of the fluid would exercise no influence, and the pressure would be the same throughout the mass; but if we place this cylinder in a vertical position, the weight of the various layers of the fluid would produce a pressure, increasing in the direction of gravity, that of each being added to the preceding; and in this manner the several layers would become condensed to a liquid, in regular succession. The movement of each layer, during its descent, it would be difficult to determine, but, the time of its duration would certainly be sufficient for the latent heat of the liquefied vapour to escape, by radiation, if we suppose the sides of the cylinder, or even only its top to oppose no obstacle to radiation, or to be permeable to radiant heat; and in this manner the water of which the vapour had been composed would not become heated, but would preserve the temperature of the exteriour.

In discarding, then, the opinion that the observed increase of temperature of the earth, with the increase of depth from its surface, is attributable to the original heat our globe may have had, I have proposed another explanation of this phenomenon, founded upon a cause of which the existence is certain, and which may certainly produce an effect similar to that which we observe. This cause is the inequality of heat in the regions of space traversed by the earth, in its movement therein, with the sun and all the planetary system. (6) The temperature of any given point of space, or that which would be indicated by a thermometer placed at that point, is produced by the radiant heat from the stars, which traverses space in all possible directions. These stars form, around each point of space, an immense circumfer-

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(6) Has such a movement been recognized?

ence, closed on every side; since, from such point, in any direction, whatever, if a right line be produced, of indefinite extent, it will terminate by encountering a star, either visible or invisible. Now, whatever may be its form and its dimensions, if this enclosure had, throughout, the same temperature, that of all space would be the same; but this is not the case: the heat as well as the light of each star is maintained by some peculiar cause, and these incandescent bodies tend not, therefore, to a uniformity of temperature, by the exchanges of radiant heat. This admitted, it follows that the temperature of space varies, one point with another; yet by reason of the immensity of the stellary enclosure, it is only by comparing the temperature of points greatly distant from each other that this variation would become perceptible. In distances no greater than that traversed by the earth, in its annual orbit, the temperature of space would be sensibly identical; but in regions so elongated as are parts of that through which the sun and the planets are carried, in their common movement, this would not remain the same; and the earth, in common with all the other bodies, would experience corresponding variations of temperature. Still, from the magnitude of its mass, it may readily be seen that in passing from a heated to a colder region our globe would not readily lose, in the second, all the heat it had imbibed in the first; but, like a body of considerable volume that we might transport from the equator to our climate, so the earth, on arriving in a more frigid region, would present, as we see the earth really does, a temperature increasing from the surface towards the centre. The opposite would take place when the earth, by continuation of its movement in space, shall pass from a cold region to one of a temperature more elevated.

Both the extent and the periods of these variations are unknown to us; but, like all the inequalities of long periods, like those, for instance, arising from the secular displacement of the ecliptick, if they were sensible, these variations will extend themselves to very great depths, although not to the centre of the earth; nor, perhaps, to a distance from the surface which will bear any considerable proportion to the radius of our globe: still, the increase or decrease of temperature, in a vertical direction, which will accompany them, will extend far below the utmost depths accessible to us; where they will attain their *maximum*, and beyond such point will disappear. We may assume, upon the inequalities of temperature of the regions of space traversed by the earth, an infinity of hypotheses which could serve but as examples of calculations, proper only to show how these inequalities should influence the temperature of the surface of the globe; and that this influence may be sensible it is only necessary that the consecutive *maximum* and *minimum* of the heat of space differ widely, and that they be separated by very long intervals of time.

According to the example which I have arbitrarily chosen in my work, the temperature of space, in one million of years, would pass from + 100° to − 100°, and return again from − 100° to + 100°; and if we should farther suppose that it is now at its *minimum*, an increase of the temperature of the earth, in a vertical direction, from the surface towards the centre, very nearly equal to that we observe would be the result. This increase will be sensibly uniform, at all accessible depths: it will vary beyond; and at a depth of about 7000 mètres the temperature of the globe will attain its *maximum*, and surpass, by about 107° that of the surface: beyond this it will diminish, so that at about 60,000 mètres from the surface the influence of the inequalities of the temperature of space will have entirely disappeared. In the same example the temperature of the surface of the globe, 5,000 centuries since, would have surpassed that of the present day little less than 200°, and it will again be the same when another 5,000 centuries shall have elapsed; a temperature that must have rendered, and will again render the earth unhabitable to the human species: but 500 centuries before, and 500 centuries after the period in which we live, the temperature of the surface would not exceed, by more than about 5°, that which we now witness.

Such is, in my opinion, the true cause of the augmentation of temperature which we experience upon each vertical line, from the earth's surface, towards its centre, in proportion to the distance from that surface. In this theory the mean temperature of the superficies varies with extreme lentitude, but incomparably less than the portion of temperature which might be due to primitive heat, if that was still sensible. Farthermore, this variation is alternative, and thus is able to concur to the explanation of the revolution to which the exteriour layers of the globe have been subject; while, on the contrary, such portion of the temperature as might be due to the other cause diminishes constantly, and this without alternation. If the increased temperature observed in a vertical direction should really be due to the original heat of the globe, it would follow that, at the present epoch, this primitive heat would augment the temperature of the surface itself by a small fraction of a degree; but, that this small augmentation might reduce itself, for instance, one half, it would be necessary that more than a thousand millions of centuries elapse; and if we desire to retrograde to an epoch at which this may have been sufficient to produce the observed geological phenomena, it would be necessary to ascend the stream of time such an immense number of centuries as would alarm the most fearless imagination, whatever idea may otherwise be entertained of the antiquity of our planet.

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There is reason to believe that, of stellary heat, equal quantities are not transmitted to us from all the various regions of the heavens. If we imagine a cone, extremely pointed, which has its summit in some point of the surface of the earth, and which is prolonged to the fixed stars; by reason of the very great distance of the earth from these stars, this cone would embrace an immense number of them; and it is the mean of the quantities of heat that they thus emit which I take for the intensity of stellary heat in that direction. Now it is out of all probability that this intensity would remain the same, if we suppose this cone moved round its summit, and pointed, successively, in every different direction; or if we remove its summit, and transport it, in succession, from one place to another upon the earth's surface: still the most delicate experiments would alone be able to disclose to us those parts of the heavens from which the stellary radiation is of the greatest or least intensity; nor has observation hitherto aided us, in the least, upon this subject—one of the most interesting of celestial physicks. At the different hours of the day, the total quantity of stellary heat which reaches any point of the earth, emanates from all the celestial bodies situated above the horizon of such point, and it may therefore vary, in any given time, at one place with another, and cannot be the same, for example, at the equator and at the poles. The quantity of stellary heat which comes to us in the same interval of time must also be very unequal in the two hemispheres; and this inequality is one of the possible causes of the difference of the mean temperature of the northern and southern hemispheres.

In relation to the physical constitution of the atmosphere, the laws of the decrease of the quantity of vapour, of density, and of temperature, proportioned to elevation above the horizon are not accurately known. The decrease of one degree for 172 mètres of difference in vertical elevation, as drawn from the aërostatick experiments of M. Gay Lussac refers to the temperature indicated by the thermometer suspended in the open air, but this does not disclose to us that of the layers of air themselves, of which the actual temperature determines the radiation, and perhaps exercises an influence upon the absorbent power. All we know, in this repect, is, that the mean temperature of the air in contact with the surface of the globe should equal that of the surface itself; and that, at the superiour limit of the atmosphere, the actual temperature of the fluid cannot surpass that of its liquefaction to such degree as that the density should be reduced. The first condition results, as previously stated, from the continual contact of the inferiour layer of the atmosphere with the earth's surface; the second is a necessary condition to the equilibrium of the fluid mass, and independent of the general equation of this equilibrium.

In fact, if we divide this mass into concentrick layers so infinitely thin that the weight of each layer should be insensible, the weight of an interiour layer would suffice, nevertheless, to counterpoise the difference of pressure which would be exercised, in opposite directions, upon these two faces, which has for its extent the elastick forces of the two adjacent layers; but, the most elevated layer experiencing no pressure upon its superiour face, could not, by its weight, balance the pressure exercised upon the other face, if this were appreciable; consequently the elastick force of the air should be nothing at the limit of the atmosphere, of which the distance, from the surface of the earth, is much less than the distance at which its centrifugal force would destroy its gravity. Now, the elastick force cannot be reduced to zero, because it decreases only in the ratio of the density, according to the law of Mariotte; and however reduced, therefore, the density of the air may be, it will retain an elastick force by virtue of which it will be still farther dilated; and the atmosphere thus deprived of any fixed limit, would extend through all space. It cannot be objected that the atmosphere would be maintained in place by the pressure of the ether upon its superiour surface; for this ether would penetrate into the air, and its elastick force from within would equal that from without, so that this power would be balanced. It is, then, through the agency of cold that the superiour layers of the atmosphere are deprived of their elasticity. Near its superiour surface the temperature of the air should be that of the liquefaction of this fluid, and the layer of liquid air should be of such thickness as that its weight may equal the elastick force of the inferiour air, upon which it rests. If the molecular force should disappear in this exteriour layer, in consequence of the mutual distance of the molecules, rendered very great by the extreme rarefaction of the fluid, this layer could not support itself upon that immediately beneath; the gravity of its molecules towards the earth could not be destroyed except we suppose a velocity of rotation and a centrifugal force communicated to them greater than to those of this other layer; and this experiencing no exteriour pressure, should be considered the extreme layer of the atmosphere, which can only lose its elasticity by liquefaction.

We know not, accurately, the temperature necessary to a liquefaction of atmospherick air, at its ordinary density, and still less in the rarefied state of its superiour layers; but there can be no doubt that it is extremely low, and perhaps still more so in a case of feeble density. This temperature, which is indispensable to a definite termination of the atmosphere, is, it appears to me, the true cause of the excessive cold of its superiour part, and of the decrease of the heat of its successive layers, in proportion as we ascend from the surface of the earth. This phenomenon, then, would still take place if the atmosphere were perfectly in repose; it is not therefore owing, as has been sometimes supposed, to an ascensional movement of the air, in which this fluid is dilated by the diminution of pressure, and becomes cooled in consequence. Those who have given this explanation have not observed that this upward movement is accompanied by another, in the contrary direction, and that in this double movement the masses of air mingle together, and traverse each other, mutually, so that it would be difficult to decide whether the final result should be an augmentation or a diminution of the density and the mean temperature of the whole. But we must not lose sight of the fact that this extremely low temperature of the superiour layer of the atmosphere is that of the air itself, and not that which would be indicated by a thermometer placed therein. This might be much more elevated; it would arise from the contact of the air, and from the radiant heat of the stars, sun, earth and atmosphere; but the first of these could have little influence, from the extreme tenuity of the fluid; so that the mean temperature indicated by the thermometer would differ very little from that which it would indicate if it were removed from the atmosphere and placed a short distance above it.

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NOTE.—In the proceedings of the Academy, on the 17th of April last, the following passage occurs:

"M. Poisson presented a supplement to his work, entitled *Théorie Mathématique de la Chaleur.* This supplement is constituted of the *Memoir upon the Temperature of the solid parts of the Globe, of the Atmosphere, and of those regions of space traversed by the Earth*, which was inserted in the Compte Rendu de la séance de l'Académie of the 30th of January last; and to which the author has added several notes, relating, principally, to the temperature of the earth and of space, at different epochs. One of these notes contains the complete determination of the laws of refrigeration of a sphere of very great diameter, as the earth, for example, which has not before been deduced from theory. Another contains an example of the calculation of the temperatures and densities of the atmospherick layers, regard being had to the propagation of heat from layer to layer, and to the conditions which terminate the atmosphere; that is, to the condition of an elastic force which is nothing in the upper layer of the atmosphere; which can only result from a temperature of this layer proper to its liquefaction."

ART. III.—*Miscellaneous Remarks on certain portions of the Geology of Maine, in a letter from* Dr. CHARLES T. JACKSON, *to the Editor, dated Boston, Nov. 13th,* 1837.

TO PROF. B. SILLIMAN.

Sir—I HAVE lately returned home after spending five months in the continuation of the geological survey of Maine, two months of which time has been spent in the forests of the public lands of that state.

The facts which we have observed are of a most interesting character, and much time and great labor will be required, in digesting and setting in order the various observations which we have collected.

My first object was to continue the outline survey of the sea coast, from Blue hill to the New Hampshire line. When this was completed, I made a sectional line across the middle of the state inland, parallel to the sea coast. Then I made a sectional survey, from the mouth of the Penobscott to the gulf of the St. Lawrence.

After this, I followed the east branch of the Penobscott and the Lebois to their sources, and passed over to the Aroostook river, and followed it down to its confluence with the St. John's. I also surveyed the greater portion of the New Hampshire line of Maine. By following this order, the most perfect outlines of the geological structure of the country have been obtained, and the facts are very important in relation to both science and the arts. I have had also to perform in many of my sections, the duties of geographer and topographical engineer, since the country was almost wholly unknown, and was erroneously laid down on the state maps. Difficult and laborious has been the task; but I have every reason to feel satisfied, that the work was as carefully executed as the time and means in my hands would allow.

I took great pains to ascertain accurately the altitude of every important point by barometrical levelling, and the precautions taken ensured accuracy in the results. Having procured two of the best English barometers that could be obtained, I took great care to bring them to the exact standard, and regulated the thermometers by a perfect standard French instrument, made expressly for me by Collardeau. I then established a line of barometrical correspondence across the state; this was done by making an agreement with a number of gentlemen to keep exact registers of their instruments, the difference between theirs and mine having been carefully noted. Daniel Sewall, Esq. of Kennebunk, Rev. Solomon Adams, of Portland, Prof. Cleaveland, of Brunswick, Mr. R. H. Gardiner, of Gardiner, and O. Frost, Esq. of Bangor, were engaged to keep the required registers, and were very attentive and exact in their observations. Now the object in this plan you will readily understand, was to be perfectly sure that there was no local difference in the atmospheric pressure, or if there was any, to have it noted and allowed for. When altitudes are taken with all these precautions, we can rely upon them with perfect confidence. The various tables will be published in my report for this year.

I was more especially desirous of learning the height of the tertiary deposits in various parts of the state, since they will give us the elevation formerly held by the ancient ocean which made these fossiliferous deposits. I also wished to know the height of the land for the purpose of making sections of the state in profile. I have measured also the altitude of the most remarkable mountains in the state.

I have collected, to illustrate the geology of Maine, about seventy large boxes of excellent specimens of rocks and minerals, all of which, with their localities, were labeled on the spot, the moment they were taken,—each assistant being supplied with a bottle of softened gum tragacanth and paper for the purpose. There are abundant proofs collected, demonstrating the valuable mineral resources of the state. Statistical information has also been obtained, where it was possible, respecting the precise amount of value received by the sale of quarry stones, lime, marble, &c.

I also examined into the geological origin, nature, distribution, chemical composition, and capabilities of the various soils of the state, and the information attained will form a chapter on agricultural geology,—a most important subject, too generally neglected, but one full of instruction.

We have collected a great number of observations relating to the interesting subject of diluvial transportation and diluvial furrows. How much I should be delighted could any of those geologists in Europe, who feel sceptical on the subject, visit with me the numerous and most decided proofs which are presented in Maine, demonstrating the general direction and power of the diluvial current. I think that no reasonable person would venture to stand in opposition to the facts which we can present in illustration of this doctrine. I do most ardently wish, that Mr. Lyell and Dr. Boué, two excellent geologists, who do not feel disposed to admit the results adduced by our very able friend, Prof. Hitchcock, and others, would come over to this country and see for themselves, the most tangible proofs that were ever adduced.

I have found strong diluvial marks extending across the whole state of Maine, and the transported boulders are always traced to their origin in the direction of the furrows worn on the rocks. There was never a better country than Maine, in which to settle this important question, for there are wide belts of rocks of different kinds, dividing the state into distinct geological sections. I cannot take time now to enter into details, but will observe, that the direction of the diluvial current in Maine, is proved to have been from N. 10 to N. 20° W. to S. 10 to 20° E. or the mean will be N. 15° W. to S. 15° E. This too is the uniform direction of those diluvial accumulations called "horsebacks," which abound in the state, and form long ridges like rail road embankments, frequently extending for many miles.

While engaged in the survey of the Aroostook river, I discovered another powerful bed of rich red hematite iron ore, thirty-six feet wide, running through a thickly wooded country, where it may be advantageously wrought by means of charcoal, into the most valuable kinds of iron and steel. I have also discovered several valuable beds of magnetic iron ore, which will doubtless be wrought so soon as their value is known to the people interested. Limestone, marble of great beauty, granite, mica slate, and other valuable quarry stones abound.

While exploring the soils of York and Oxford counties, I was surprised to find, that, although the country appeared to be composed wholly of granite and gneiss rocks, the soil was wonderfully rich and produced admirable crops of wheat. This was not to be expected from a purely granite soil, and on more minute examination, I found that the gneiss on the sides of most of the granite mountains alternated with thin beds of limestone, from an inch to a foot in thickness, and resembled so closely the gneiss in color as to have at first escaped my observation. This at once accounts for the fertility of the soil, for it is made up of decomposed gneiss and limestone as well as granite rocks, and hence is well adapted to the cultivation of wheat.

The soils around the Kennebunk river are generally impregnated with sulphate of iron from pyrites, and require liming to amend them and render them fertile. But little attention has been paid to the nature of soils by our farmers, and this is the reason why they do not succeed better in amending them.

The manner also in which the layers of clay, sand, and other soils are distributed is important, and comes within the province of geology. I noticed in one town a spot where this was very evident, the soil being sandy, and resting on a clay substratum. In one part of the field the corn was then four feet high, and in the other only two, although the soil was exactly alike and the manure the same in nature and amount. The cause was traced to the difference in the depth to a certain stratum of clay which was near the surface, where the corn was luxuriant, and deep below, where the corn was feeble. So the manure sank in the latter case too low to be reached by the roots of plants.

I have discovered the *actual bituminization of peat* in a bog, at Limerick, in Maine. The substance is in fibrous masses like brown coal, and burns with yellow flame and smoke. It is found ten feet from the surface of the bog. When this substance is heated in a glass tube, it gives out an abundance of coal gas, and bitumen distils off freely. This, I believe, is the first instance in which peat has been observed actually passing into bituminous coal. I have also found another curious fact, viz. three beds of anthracite coal in *slate that has been melted into hornstone by a great mass of trap rocks.*

Art. IV.—*Popular Notices of Mount Washington and the vicinity;* by G. W. Nichols,—*with additional remarks by the Editor.*

Bedford, N. Y., Jan. 10th, 1838.

TO PROF. SILLIMAN.

Dear Sir—Having made a short tour through New England, in the summer of 1836, I now send you for the American Journal, some notices of scenery and other objects, which fell under my observation while passing through the White mountains of New Hampshire.

On Wednesday, August 17, 1836, I left Bath, (a neat and enterprising village on the Amonoosuck river,) for the White mountains. The ride from this place was truly delightful; for it was under a clear sky, and very agreeably diversified by beautiful and splendid scenery. Our road lay, a part of the time, along the picturesque banks of the Amonoosuck, and it led us also over hills and through dense forests of stately evergreens. The level country, which had followed us along the banks of the Connecticut, was soon exchanged for gradual undulations, of a region with a barren soil, which continued to rise higher, and spread wider, until we reached the valley lying near the base of the mountains. A very perceptible difference in the temperature could be felt, as we gradually made our way upward; and, notwithstanding it was now not far from the middle of August, the scanty crops had nearly all been destroyed by the frost. Indeed, the weather was so cold, that blazing fires were found at most of the inns where we stopped. The sparse population of the mountains is obliged to depend upon the neighboring country for their agricultural supplies, and all that is not consumed, finds a market in Portland. Now and then, as you pass along, the eye rests upon a little strip of cleared land, composing the farm of some mountaineer. There was one which peculiarly arrested our attention. It embraced, along with a few acres of ground, a small rude hut, consisting of pine logs piled one upon the other, and made tight by means of plaster. A roof of rough boards was thrown over the logs. What a contrast between this rude habitation and the splendid mansions of our cities! Science and commerce nourish the arts, and the arts make the difference between the mountain hut and the city palace.

The scenery, as you approach the mountain, increases in grandeur and sublimity. Vast and interminable ridges of mountains rise on all sides, one above another, until they seem to be blended with the distant horizon. The white peaks of these mountain groups, appearing as if snow clad, tower above all other objects and hide themselves in the clouds.

Ascent of the Mountain.

On Thursday morning, August 18th, our company (consisting of three persons and the guide) left the dwelling of our host at the early hour of six. Thence we proceeded, as fast as our horses could carry us, through forests, over swamps and rugged steeps, by a path filled with mud, stones, and roots of trees. Arriving at some distance from the foot of Mount Washington, our horses were tied to trees and thence we proceeded on foot. The ascent was at first gradual, but soon became in the main exceedingly steep, and we scrambled on over rocks, piled one upon another, and answering for rude stairs. Nearly half our journey from the foot of the mountain was through a pine forest, and the rest over rocks and barrens. The whole distance ascended on foot is three miles. About half way up, I discerned a small shrub adhering to the rocks in the manner of a vine, and named by our guide the dwarf spruce. This was the last appearance of vegetation. The summit, for the distance of half a mile on all sides, is composed of immense rocks, promiscuously heaped together, while the view which it affords, is beyond what the most vivid imagination can conceive. In this elevated region, soft, silky clouds were seen floating around and beneath. And no object could be more splendidly gorgeous, than one of these clouds when illumined by the sun. The barrenness of an unbroken winter, whose bleak winds are whistling around, rests on all the scene. Towards the west, north, and south, it might be said of the mountains,

"Like Alps on Alps they rise,"

until, on the east, their summits mingle with the heavens. An immense valley stretches out before you, in which the Saco may be distinctly seen pursuing its way to the ocean. The furrows and ruins of a number of avalanches too, are visible in the sides of the mountains. These possess a melancholy interest from the fact, that one of them, about eleven years since, borne onward from the mountain top by a sudden deluge,* swept away an entire family, (nine in number,) into the Saco, where their bodies were found among the earth, and stones, and trees, the ruins transported by the flood. On the following day, after my return from the mountain, I stopped to view the scene of this most tragical occurrence. It lies on the public road to Portland, in a stupendous defile between the mountains, commonly called the 'Notch.' The two mountain ridges here approach very near, and there is only room for the small river Saco and a road, with a few patches of cultivated ground. The house in which this unfortunate family resided remains, and is now as it was then, an inn. Those, who at that time administered to the necessities of the traveller, are now no more! It is said that they ran out of the house during the night, supposing that the avalanche was coming

* So violent was the friction of the descending masses of rocks, that streaks of light, filling the air with an electrical odor, flashed along their paths, illuminating the palpable darkness of that dreadful night.—Ed.

directly upon them. Had they remained in the house they would have been safe, and in emerging, they ran to destruction; for at the distance of only a few yards from their dwelling, the fatal torrent overtook them and swept them away.* The view here presented of the mountain sides, on the right and left, is terrific in the extreme. Enormous ledges of rock hang over them, frowning upon the traveller below. Beautiful cascades likewise may be seen, tumbling down over these cragged steeps, and whirling in crystal eddies in the deep fountains which they have worn in the rocks. I spent some time in searching for quartz crystals, which are frequently found among the hills. They are of the brown or smoky variety, sometimes very large and beautiful, and are kept for sale at the public houses. After travelling some distance amidst such scenery as this, we at length emerged from the region of mountains and plunged again into a wide forest, which intervenes between the 'White hills' and the city of Portland.

Remarks by the Editor.

There are many facts connected with the physical features of these mountains that are worthy of description. Among them no one is more remarkable, than the trap dykes which frequently intersect the granite mountains, cutting them from top to base, and downward, into profound and unfathomable depths; their dark massy walls form a striking contrast with the white, gray, or red granite, or granitic schists, through which they have forced their way. But we leave the description of them to Prof. Hubbard, of Dartmouth College, whose account will be found in this number of our work.

Being for the second time, among the White mountains in the last week of August, of the late season of 1837, I ascended Mount Washington on the first of September, in company with my son and two gentlemen of Boston.

The day was mild, and in the main the atmosphere was clear, with occasional flying clouds, flitting over the sun, which frequently burst out with autumnal splendor, and illumined all the magnificent mountain groups, and valleys, and defiles, that cover this truly alpine region. The traveller who undertakes the ascent of Mount Washington, must lay his account to severe fatigue.

* Some additional particulars of the catastrophe of the Willey family, alluded to by Mr. Nichols, are mentioned by me, in Vol. XV. p. 220, of this Journal. I visited this place in 1823, with some friends, two years after the event.—*Ed.*

Ladies sometimes go on this adventure, but it were better, in my judgment, that they should not attempt it. It is scarcely possible to afford them any material assistance; they must struggle almost unaided, first through the arduous forest-ride, where none but the practiced and-wary-footed animals, that are trained to the service, can carry them in safety; and safety depends, very much, upon permitting the horses to wend their own way, unmolested by guiding, through the deep mud holes, the tangled roots, and the projecting stones and timber, which, notwithstanding all that has been done, (and much labor has evidently been expended here,) still obstruct no small portion of the journey through the woods. There are, however, only two or three miles that are thus anxious and fatiguing; the rest is a plain and open road, the whole distance from the hotel to the foot of the mountain being six miles. When the horses are abandoned, then commences the severe labor.

When we began our ascent, and during most of its progress, I insisted that the party should halt and sit down every twelve or fifteen minutes; three or four minutes of rest was, in general, sufficient to restore a natural respiration and to equalize the circulation of the blood, both being much disturbed by an unceasing ascent, and the muscles are thus overstrained and exhausted; the respiration becomes laborious and the circulation is hurried on, especially through the lungs, with oppressive and even dangerous celerity. These precautions are of the utmost consequence in ascending mountains, and by the neglect of them and especially by yielding to a false pride of vigor and hardihood, and to an equally false shame of being thought effeminate, health is hazarded, and sometimes both health and life are destroyed.* If ladies insist upon making this ascent, their dress should be *adapted to the service*, and none should attempt it but those of firm health and sound lungs, and although this remark applies to them in a peculiar manner, it is decidedly applicable also to those of the other sex.

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* An eminent writer and orator, one of the brightest ornaments of this country, assured me, that he never recovered from the effects of a rapid ascent in his youth, up Mount Ascutney, near Windsor, in Vermont, which is not half so high as Mount Washington.

A very lovely and accomplished young lady, of fine talents, but of a spirit which only rose with the difficulties to be encountered, is said to have laid, in this very ascent up Mount Washington, only a few years since, the foundation of an illness which cut her off prematurely in a foreign land. I knew her well. I may add also, Our younger friends had been persuaded to make packs of their great coats, being assured that, although the world was smiling below, they would ere long arrive in a region, where they would be glad to wrap their limbs in these seeming incumbrances; and so it proved; for, at the distance of a mile from the top of the mountain, we were involved in winter. The dark volumes of vapor which, from the hotel whence we departed, appeared in detached masses, only as a light drapery, gracefully rolling up the breast and over the hoary peak of Mount Washington, were now congealed, and involved us in a white driving cloud that froze on our apparel, and tufted the rocks with splendid crystallizations of ice. Here our guide, having issued the welcome command to dine, opened at once the treasures of his pack, that we might obtain vigor for the remainder of our toil, the severest part of which was still before us.

Our refreshments were indeed most acceptable and salutary; but our hands were so benumbed with the cold, that we could scarcely convey the food to our mouths.

From our hasty repast, we started again, as if pursuing or pursued, and struggled onward over immense piles of ruins frosted with the congealed vapor, and thus rendered treacherous to the feet, which were constantly in danger of sliding into the innumerable chasms and holes that yawned around our path. Our toil grew more and more severe,—not a vestige of human footsteps remained, and we were guided only by piles of stones erected as landmarks for the adventurer. The last stunted evergreens ceased to appear, the wind blew a frozen gale, involving us in white palpable clouds, which were rather masses of flying ice than ordinary snow; they invested every object, and hung in magnificent tufts of long, slender, and perfectly white crystals, from every rock and over every chasm.

Still, an occasional outburst of the sun threw a glorious flood of golden light over the enormous peaks that were grouped

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as an encouragement to those who have less vigor, that I have known a gentleman of a very feeble frame and still feebler health, and with lungs that had suffered alarming attacks of disease, ascend Mount Ascutney, about three thousand feet high, with safety and without excessive fatigue; but it was done very slowly and with frequent pauses and resting to recover. I was of the party, in 1828, and was astonished to see how little he suffered. If these remarks are of any value to the young adventurer, who may thus be saved from injury, their introduction on this occasion will be excused. I am quite sure, from considerable observation among mountains and mines, that such suggestions are too little regarded.

thickly around us, and disclosed the immense bosoms of the valleys and the green forests that opened among this wild ocean of mountains; the trees on their sides, appeared minute and delicate as geraniums, while the deep and wide chasms produced by vast slides, presented horrid features of devastation, attesting the ravages of alpine floods, bearing down before them forest, soil, and rocks, with every movable thing, and thus gashing the solid frame work of the everlasting hills with the deep wounds of the olden and the modern time.

Quite at the feet of the mountains, and along the opening vales and plains, ran in full view, silver streams, among cultivated fields, gracefully bordering the works of man—his houses, farms, and villages.

Again, the clouds of flying ice, resembling tufts of cotton, closed thickly around, and hung an impenetrable veil between us and the world below; a wintry tempest now raged around, and with great difficulty we mounted the last rocks, and saw that there was nothing higher than ourselves. Here the wind blew a furious gale, and the strongest man among us could not keep his standing without holding fast by the rocks, while those who neglected this precaution were instantly prostrated by the storm, which, as if in exultation, roared and howled with a truly savage grandeur, over this wild alpine solitude. The cold was so severe and the pelting of the storm so violent, that a few minutes at a time was all that we could give to the mountain peak. We were glad to step under a covert, where the rocks afforded a partial shelter from the tempest, and here we finished our little remaining store of refreshments.

For science there was little to survey. The piles we trod on were the ruins of the stupendous granite mountains, elevated in ancient time, lashed by the storms, cracked by frost, and mutilated for untold ages by the sure, although slow agencies of nature. The very peak of the mountain is mica slate supported by granite. There could be no doubt, that the immense masses of loose rocks, of every size, which we saw around us, were once united in a connected summit, and that these ruins are only evidence of the mighty work of demolition, which is always going on with a real although imperceptible progress. As to organic remains, it were vain to look for them in this primitive region, and almost equally vain is it to expect to find any living animal in these wild and barren solitudes. It is, however, a satisfaction to have trod on the highest peak of New England, the most elevated of the United States, and of North America, until we reach the Rocky Mountains and the table land of Mexico. The arduous circumstances of our ascent and the absence of instruments prevented any accurate observations; but the height of this peak is generally stated to be between six thousand and seven thousand feet, probably six thousand five hundred above the level of the sea.

It nearly penetrates the region of perpetual cold—therefore winter relaxes his dominion but for a very short period, a few weeks at most, in the hottest season of the world below, and summer never smiles upon the summit of Mount Washington. On the succeeding day as we travelled, we saw this mountain quite white, from its peak a long way down and around, on every side that was within our view.

The descent was of course more rapid than the ascent; it was much less fatiguing to the lungs, but very trying to the limbs, especially to the larger muscles and to the patella, which seemed as if it would part with the strain. Great caution was requisite also, to avoid falling into the innumerable holes among the rocks, and to prevent slipping from their smooth and glazed surfaces. Arrived once more at the camp where the horses, become restless with hunger and now eager for their stables, remained fast bound to the trees—we quickly mounted, and twilight beginning to set in, we hastened through the pilgrimage of the muddy forest, till having arrived in the open ground, all dashed forward with cavalry speed, and the poorest rider on the hardest horse fares ill in a race, which he is neither able nor much disposed to resist or avoid. All hurry onward, as if from the route of disastrous battle, and glad is the adventurer to find himself once more safe in the truly comfortable hotel, where he is regaled not only with all necessary refreshments, but with wonderfully fine echoes produced from the neighboring mountains by a long shrill horn, blown at the door of the hotel, after evening has closed in, and by the discharge of artillery, whose explosion is returned in deep and solemn reverberations from the winding hills. The ascent of Mount Washington is certainly worth the toil and trouble, although probably few appreciate it justly, before they have made the trial.

The pedestrian ascent occupied two and a half hours, and the entire journey about ten hours, of strenuous and constant exertion.

Art. V.—*On the Tides;* by David Tomlinson.

Schenectady, Aug. 1st, 1837.

TO PROF. SILLIMAN.

Dear Sir,—I have read with much pleasure, several ingenious strictures on storms of wind, by W. C. Redfield, as published in former numbers of your useful Journal of Science.

In your No. II, for July, 1837, in his remarks on this supposed connection of the Gulf stream, "with opposite currents on the coast of the United States," he says, "the Gulf stream, in its course from Florida to the banks of Newfoundland, is for the most part *imbedded or stratified* upon a current which is setting in the opposite direction in its progress from the polar region—that their opposite courses on the coast while in contact with each other, are no more surprising or inexplicable than the case of two opposite currents of the atmosphere, and the latter are often known to maintain opposite courses for a long period, and at high velocities, while thus superimposed one upon the other."

The different currents of the atmosphere are often rendered visible, by the courses of fleecy clouds; but, that contrary and rapid currents, of so dense a fluid as water, should be "imbedded," one in the other, appears to contradict the laws of friction, impulse, and motion.

I am aware it has been said, that, at the straits of Gibraltar, where from the Atlantic ocean a strong and regular current always flows into the Mediterranean sea, this current is caused or balanced by an under or contra one at the bottom, flowing equally swift outward into the ocean; and that this has been proved to be true by the wreck of a vessel known to have been lost in the Mediterranean sea, having been seen in the Atlantic ocean; but a single instance is not conclusive; for, if it were the same wreck, a strong east wind might have driven it out.

I know the danger of suggesting any thing in opposition to established opinions of great and learned men; for instance, in opposition to the opinion, that the moon is the cause of the flowing and ebbing of the tides. That the attraction of the moon regulates the times of the tides caused by the Gulf stream, after their becoming into existence and being set in motion, is evident; but that the flowing and ebbing is wholly caused by the moon, appears to be contradicted by strong evidence. That the Gulf stream gives the peculiar character to the tides on the coast of North America, appears certain. Where it leaves the Gulf of Mexico, the rise and fall of the tides is said to be two or three feet only. The tides increase with that current to the east, till it rises more than twenty-five feet in Nova Scotia and Newfoundland; where that wave is wafted across the ocean to the Irish and British channels, and the Bay of Biscay, of about a similar height. But at St. Ubes it rises only one to two feet, and in the Mediterranean sea there is no rise and fall of tides.

If the moon were the sole cause of the rise of tides, why is it not more evident in the south Atlantic, West Indies, and coast of South America, where her influence ought to be the greatest, in the greatest expanse of ocean? And yet the tides there are so so small they are scarcely noticed.

It is said that the Gulf stream is caused by the effect of the trade wind on the Caribbean sea, by pressing the water westward, and causes the outlet at the Gulf of Mexico. That may produce some effect; but can it be the sole cause of the Gulf stream? Although that stream may be swayed from its course (like a cable in a stream) both north and south, by long and violent winds, (as has been seen,) yet it resumes its wonted place and preserves its regular course so exactly, that in approaching it in fair and moderate weather in day light, by ascending the shrouds of a vessel, it may be seen at a great distance, and when passing it, the edge of the stream may be discerned as plainly as land from water. It appears as blue as indigo, while the adjoining water is of the usual green hue. The division is so exact, that it may be noticed as plainly as the crack between the planks in a house floor; and yet, if you dip a bucket of water from the stream, it is of similar clear and white appearance as the common ocean or other water, but warmer. Why does the ocean always run swiftly into the Mediterranean sea, as do the immense Danube, Nile, and other large rivers? No doubt to keep up the subterranean stream which passes out of the Bay of Mexico, called the Gulf stream. This sustains the usual circulation and its warm temperature and throws off an immense evaporation, as it runs towards the colder region, where it is condensed to furnish materials for watering the Atlantic coasts by frequent rains, without which, they would be rare, and the land parched by drought.

McKenzie found a tide of about fifteen feet, when he reached the ocean, on his travels to the N. W. coast of America, near Behrings' strait. It is said there is a great tide at Calcutta; yet, if we may believe the navigators, it is small at the Sandwich Islands, rising only one or two feet, the highest flood always at meridian, and being thus totally disobedient to the rising and setting of the moon in that immense expanse of ocean, where her influence ought to be greatest.

I here quote from the American Quarterly Review, No. xxxix, for September, 1836, p. 10. Art. I. Report made to the Senate of the United States, on the subject of an exploring expedition to the Pacific ocean and the South seas, by Mr. Southard, chairman of the committee, March 21st, 1836. "We shall detain the reader but a moment longer on this branch of our subject, to mention a singular fact in relation to the tides in the Pacific ocean, and we do this, in order to draw the attention both of practical navigators and philosophical observers."

"It is stated by the intelligent Mr. Ellis, the missionary who resided several years in Tahiti (Otaheite) and the Sandwich Islands, that the rising and falling of the tides, (in the South sea islands,) if influenced at all by the moon, appears to be only so in a very small degree. The height, says he, to which the tide rises, varies but a few inches during the whole year; and at no time is it elevated more than a foot or a foot and a half. The sea, however, often rises to an unusual height; but this appears to be the effect of a strong wind blowing for some time from one quarter, or the heavy swells of the sea, which flow from different directions and prevail equally during the time of high and low water. During the year, whatever be the age or situation of the moon, the water is lowest at six in the morning and the same hour in the evening, and highest at noon and midnight. This is so well established, that the time of night is marked by the ebbing and flowing of the tide; and in all the islands the time of high water and for midnight is the same. The same thing is stated by Messrs. Tyerman and Bennet, in their journal of voyages and travels: it is generally known, they observe, but may be repeated here, in connection with the aforementioned periodical but irregular inundations of the sea, that the tides *throughout the Pacific ocean do not appear to obey the influence of the moon in the slightest degree.* It is always high water about twelve, and low about six o'clock, day and night. The fact has also been noticed by a few British navigators. Capt. Beechy, after describing the harbor of Papiete and of some other places on the north side of Otaheite, says, it is generally high water at half an hour *after* noon every day, and low water at six in the morning; at the same time he observes, in language which might mislead the reader if not understood with some qualifications, that the tides in all these harbors (of Otaheite) are *very irregular*. These irregularities are, doubtless, what Messrs. Tyerman and Bennet call "irregular inundations" of the sea, which according to Mr. Ellis, are occasioned by the strong winds blowing for some time from one quarter, or the heavy swells of the sea coming from various directions. The fact is also confirmed by an intelligent correspondent, Mr. John Ball, of Troy, N. Y.,* who states, that during his three weeks' stay at Tahiti, the tide was observed to rise about one foot, and always highest at twelve o'clock, noon and midnight; and he adds, I was informed that this is always the case. Another writer, whose remarks are published in the Journal, (from that of the Franklin Institute,) adds to the testimony on this point the following,—that Prof. Whewell states, that Lieut. Malden, who accompanied Lord Byron on his voyage to the Sandwich Islands in the British ship Blonde, in 1824–25, gives a similar account of the tides at Owyhee. But the language of Lieut. Malden is, that the tide was observed to rise about four feet, and to be high water at sunset, and low water at day light, being influenced by the sea and land breezes."

Art. VI.—*Equalization of Temperature and supply of air in rooms warmed by furnaces beneath; in a letter to the editor, from* James Bolton, A. M., M. D., dated Fredericksburgh, Dec. 25, 1837.

Dear Sir,—Having amused many of my leisure hours with investigations into the best modes of applying heat to the warming of houses, I send you the following as the most important results which I obtained. Our own dwelling was warmed by an ordinary hot air furnace, and to it I found the following objec-

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* See this Journal, Vol. xxviii, p. 8.

tions. The air was admitted into the air chamber of the furnace from the basement rooms and hall where it was placed, and this air ascended into the parlors loaded with coal dust and other impurities. This evil was entirely corrected by obtaining all the air for the supply of the air chamber from without the house. A large eight inch pipe was led from the bottom of this chamber through one of the walls of the house to the open air. This, besides obviating the difficulty above stated, ventilated our rooms with a constant supply of fresh air. The next objection was, that persons sitting in our rooms complained of cold feet, while in every other respect they felt comfortable. On examining the temperature of the air in the room at different heights, I found a variation of a degree for every foot. That is, at the height of six feet from the floor the thermometer stood six degrees higher than at the floor itself. This, then, was a very serious objection, and I set about immediately endeavoring to remove it. On reflection, it occurred to me, that as our rooms were very tightly closed, having double sashes to our windows, the flues of the chimneys closely stopped, and the doors (made to fit tightly) generally closed, that there was no way of escape for the air already in the room, when the furnace was set in operation, so that it could not readily receive the addition of heated air, and none for the exit of the air after it had given out to the room its share of caloric received from the furnace. This cold air settled to the floor and there lay almost stagnant. Here, then, was the root of the difficulty. To remove it I adopted the following expedient, which proved entirely effectual. I led a pipe from the floor of each room to the bottom of the air chamber, and cut off all other supplies of air. The process of heating the air, then, was as follows. That already in the chamber was heated and ascended to the rooms above; to supply its place the cold air of the rooms descended by the pipes which I had introduced and was in its turn heated and ascended; thus keeping up a constant circulation of air in the rooms. I afterwards introduced a two inch pipe to supply fresh air to the chamber from without the house. This pipe had a valve, so that I could regulate the amount of air supplied by it. The effects of this improvement were, that there was a difference in temperature of only a degree and a half in six feet instead of six degrees as formerly, and we were no longer troubled with cold feet while sitting in these rooms.

After testing the utility of these improvements for about five years, being desirous that all using furnaces might avail themselves of them, I have sent this communication for insertion in your interesting record of the daily improvements going on in the arts and sciences.

Art. VII.—*Description of an Air Pump of a very simple construction, which acts both as an exhauster and condenser; by* John Johnston, A. M., Professor of Natural Science in the Wesleyan University, Middletown.

The last No. of this Journal* contains a description of a very ingenious air pump invented by Dr. Hare, Professor of Chemistry in the University of Pennsylvania, which is capable of performing on a much larger scale precisely the same operations as the one I am about to describe, but in quite a different manner. The next day after I had contracted with Messrs. Brown & Francis, in New York, for this air pump, which is now in possession of the Wesleyan University, I had the pleasure of viewing Dr. Hare's in his laboratory in Philadelphia.

This pump, as will be seen by the figure, has two barrels, in which the pistons are worked precisely as in those in common use, and, in general, it is constructed in a similar manner. The pistons, however, are solid, and at the base of each barrel are two valves, one opening upward and the other downward. In the center of the firm piece of mahogany, which forms the base of the instrument, are two brass tubes, which are seen in the figure at A and B, by the removal of the plate of brass D. Of these tubes, A communicates with the valves—one in each barrel—that opens upward, and B with the valves that open downward. Now when either of the pistons descends, the air in the barrel below it will of course pass out through the downward opening valve and tube B connected with it; and when it is again raised, the air will pass in through the tube A and the upward opening valve. At the center of the disc F, is an aperture, as in common air pumps, into which a tube may be screwed, and directly beneath

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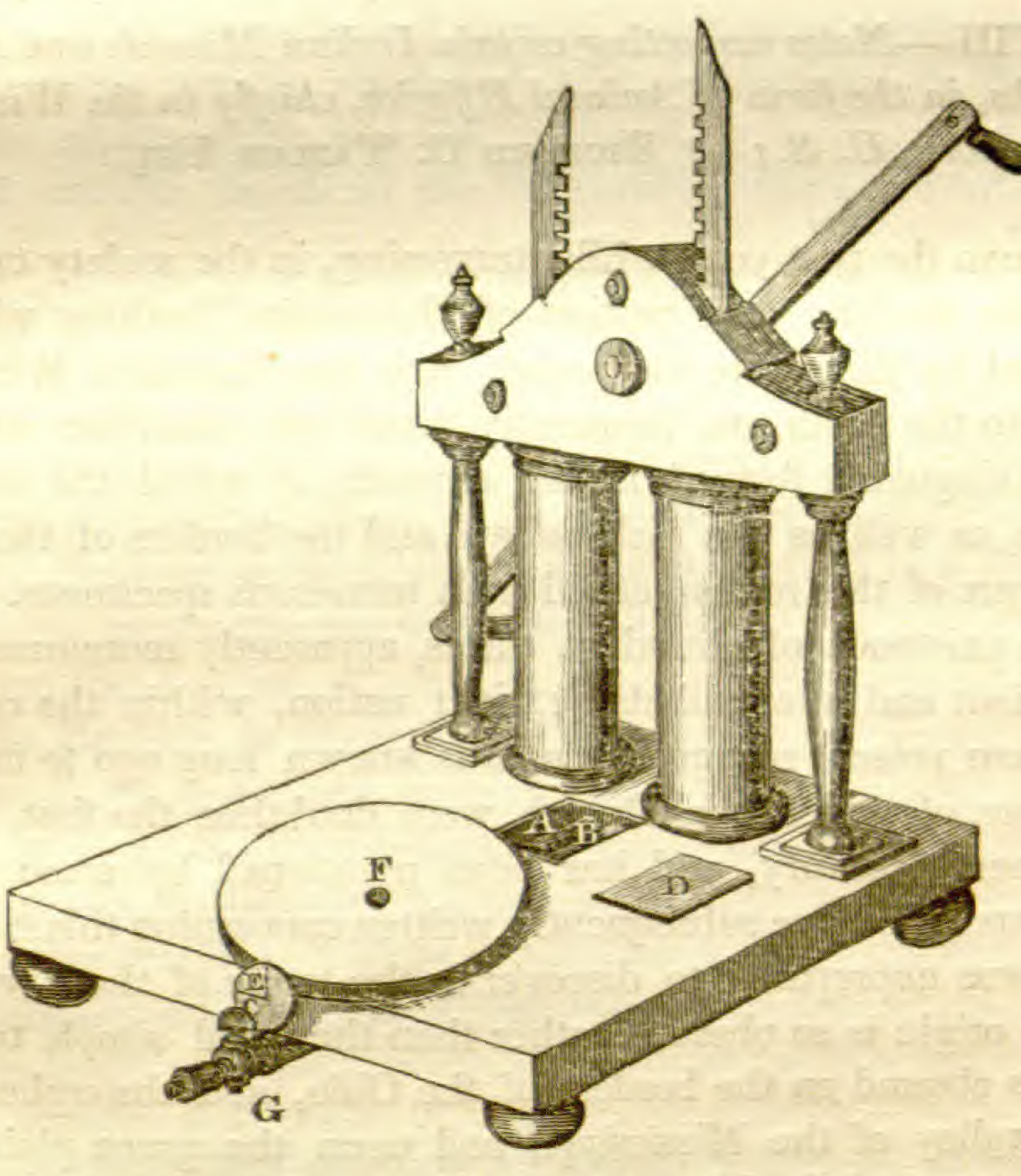
* Vol. xxxiii, page 237.

it is another aperture communicating with the tube G; and the part EC is constructed in such a manner, that when E is upward, a passage is opened between the aperture F and tube A, and also between the tubes B and G. If the pump be now worked, it is evident the air will pass in at F and out at G, that is, it exhausts at F and condenses at G. If, however, we give EC a quarter of a revolution, and bring C upward, the passages from A to F, and from B to G, are closed, and others opened from B to F, and from A to G; and by working the pump the air will now be made to pass in at G, and out at F, or in the *reverse* direction from that just described. This pump, therefore, like the one described by Dr. Hare, when worked is constantly exhausting and condensing.



The uses to which this air pump may be applied, obviously include all those of a common air pump and condenser; and also enables the operator to transfer any gas that will not corrode the metals from one vessel to another, (as does that of Dr. Hare.) To do this, it is only necessary to attach tubes at F and G leading to the different gasometers or other vessels between which the transfer is to be made ; and by means of the part EC the gas be made to pass in either direction at pleasure.

I ought to remark before closing, that previous to my application to Messrs. Brown & Francis, they had manufactured several air pumps of this description, with the exception of the tube G, which was added at my suggestion ; and which adapts it in a peculiar manner for use in a chemical laboratory.

Messrs. Brown & Francis also manufacture a much smaller air pump, with a single barrel of the same construction.

Art. VIII.—*Notes respecting certain Indian Mounds and Earthworks, in the form of Animal Effigies, chiefly in the Wisconsin Territory, U. S.;* by Richard C. Taylor, Esq.

During the past year, whilst traversing, in the society of some scientific friends, that portion of Wisconsin Territory which is bounded by Illinois to the south, and the beautiful Wisconsin River to the north, we frequently found our attention attracted by the singularly formed Indian mounds, of which the elevated prairies, as well as the rich valleys and the borders of the lakes and rivers of this region, afford such numerous specimens.

The existence of abundant traces, apparently monumental, of an ancient and now probably extinct nation, within the country under our present recognizance, was known long ago to its early explorers, of which the French were doubtless the first, in the seventeenth century, and has been mentioned by some of the travellers who have subsequently written concerning this country. But I was unprepared to discover in the forms of these remains, whose origin is so obscure, other than the usual simple tumuli ; such as abound on the borders of the Ohio, and throughout the great valley of the Mississippi, and upon the green plains and rich bottoms of the Missouri ; which tumuli do closely resemble those which are so profusely scattered over the plains of Europe, and are especially abundant on the chalky downs of England.

Rumors of the remains of an ancient city, discovered within the past year, in the eastern part of this territory, wherein the ground plans of supposed buildings and fortifications may still be traced, had been lately circulating in the United States, and contributed to lead our attention towards those singular memorials which daily presented themselves on the route through this interesting region. Respecting the so called city of Aztalan,* I was prevented, unfortunately, when within a day's journey, from reaching its site; and regret my inability to speak from personal knowledge on this subject. Information of a more detailed and scientific character than we now possess is much needed.

As relates to a great number of other positions, it was discovered that the configurations of the earthworks, or mounds as they are usually termed, which at first sight appeared decidedly to resemble the sites, or ground plan, and foundation lines of former buildings, were really designed as rude representations and outlines of certain animals, and even of the human figure; in addition to those tumuli which had been constructed in the usual circular, quadrangular, and oblong shapes.

The circular tumuli of the Wisconsin prairies, are commonly about fifty feet in diameter, and are not elevated, in general, more than ten or fifteen feet above the surrounding level; but often not half so much.

Those in the forms of parallelograms are seldom less than a hundred feet long, and are occasionally seen much longer, as in the example figured, [pl. II. fig. 3,] which is six hundred feet in length. Perhaps in this instance it was thrown up as a defensive earthwork, as its situation seems to indicate.

Above the junction of the Des Moines River with the Mississippi, in Missouri, in the region locally known as "Black Hawk's Country," we examined a long range of the circular tumuli. These were all of the common size, and some of them contained recent graves of deceased Indians, as was afterwards observed in many other localities. Thus, in the present day, the burial place of the Sauks and Fox, the Winnebago, and other tribes, is very commonly chosen upon the site of the more ancient monuments; the memorials of a people that existed in unknown times.

It is scarcely necessary here to include within our notice those mounds of much larger dimensions, existing on the borders of the Ohio and Mississippi, to the south and east. On the former

* The Mexicans have a tradition that they originally came from the north, from a country called Aztalan.

river one mound is seventy feet high, and thirty or forty rods in circumference. Even within the limits of the rapidly rising city of St. Louis, are some of great magnitude. On the American bottom, at the village of Cahokia, (Illinois,) it is stated by a contributor to a Western periodical, that more than two hundred mounds are visible from one spot; the largest being 2400 feet in circumference, and 90 feet in height; in figure approaching to a parallelogram. In the Cherokee country an earthwork has been described, as 75 feet high and 1114 feet round.

The earthworks which have been constructed in the shapes of animals, abound in the Iowa district of Wisconsin. They occur, mixed with the other varieties, in great numbers, around the high lands which skirt the "Four Lakes," forming a species of *alto relievo*, of gigantic proportions. This district appears to have been originally much resorted to by the early tribes, whose relics we here behold, mixed with those of the modern Winnebagos. At one spot alone, probably, at least one hundred tumuli may be counted. The Indian path, along which we passed, has, for near half a mile in length, a series of these, mixed with circular mounds, in tiers several deep, on both sides; forming a cemetery in magnitude of itself sufficient, one would imagine, for the chiefs and warriors, and their descendants, of a whole tribe, if such was the original design of these earthworks. On the summits of some might be seen the recent graves, protected by pallisados, of the last Indian possessors of the soil.

The site of the singular group of mounds exhibited in our figure, [pl. I. fig. 1,] is about eighteen miles west of the Four Lakes, and seven miles east of the two remarkable natural hills called the Blue mounds. The area comprehended in the drawing is about two thousand three hundred feet in length. The figures are traced from survey, and their dimensions and the intermediate spaces, were ascertained by admeasurements. In this group there are seen the effigies of at least six quadrupeds; six mounds in parallelograms; one circular tumulus; one human figure, and one circle or ring which may have been formed by the Indians in their dances, whether peaceful or warlike, or may have been occupied for some such purpose, in by-gone times, as the torturing and destroying their prisoners. The great Indian trail, or war-path, which leads from Lake Michigan, near Milwaukie, to the Mississippi above Prairie du Chien, passes along the edge of this chain of earthworks, and is now for many miles adopted as the route of the military road to the latter fort. We pursued this route for a great distance along the dividing ridge between the northern and southern waters; and we continually saw memorials of the character above described, along its borders.

What animals are represented by these rude monuments of earth, now covered with the rank prairie grass, is not made altogether apparent by their designers. If of the horse, the design is somewhat doubtful. We were rather inclined, however imperfect the representation, to attribute the intention of the constructors to be that of exhibiting the figure of the Buffalo; an animal which had here the finest pasturage, and an almost boundless range, within one of the most ample hunting grounds, and were exceedingly numerous at the time of the first exploration of the country by the French. It is nevertheless to be admitted, that the hump, a remarkable characteristic of the Buffalo, which it would seem unlikely to have been omitted in the representations of that animal, is never seen in these figures, which are distributed over the surface of so many hundred square miles of this country.

The respective dimensions of these animal effigies in our ground plan, are 90, 100, 102, 103, 120, and 126 feet in length; all of them apparently represent the same description of animal. Figures having precisely the same proportions in their outlines, may be seen at very short intervals throughout the Territory of Wisconsin, being generally from 90 to 120 feet, and extending to 150 feet long. This form, although the most prevalent, is by no means the only one, as we shall proceed to show.

In the midst of this group, represented by our sketch, and forming a very important portion of it, we have now to notice the representation of a human figure, lying in an east and west direction; the head towards the west, and the arms and legs extended. Its length is one hundred and twenty five feet, and it is one hundred and forty feet from the extremity of one arm to that of the other. The body or trunk is thirty feet in breadth, the head twenty-five feet, and its elevation above the general surface of the prairie, is about six feet. Its configuration is so distinct, that there can be no possibility of a mistake in assigning it to the human figure.

There is nothing remarkable about the oblong mounds. The circular tumulus in the centre is the highest, and overlooks the whole group. Whether all or any of these earthworks contain bones, we had no opportunity of determining. They probably all do.

The site of this interesting series is an elevated open prairie, on the dividing ridge between the waters of the Wisconsin and Rock rivers. These monuments are covered with the same green carpet of prairie grass, intermixed with bright and brilliant flowers, as the prairie itself. There is an intervening space near the centre of the group, now overgrown with bushes, which probably conceal some unnoticed mounds. The figures marked on these and the other animal outlines in our drawings, indicate their dimensions in feet.

We twice visited these singular specimens of Indian antiquity, and consequently can speak with greater confidence as to the general accuracy of the sketch accompanying this article.

Half a mile westward of this remarkable group, and on the same elevated prairie, occurs a solitary mound, about ninety feet in length, representing an animal in all respects like those we have described, but lying with the head towards the southwest. [Pl. II. fig. 2.]

Along the space of twenty miles from this position, extending to the Four Lakes eastward, similar monuments, intermixed with plain tumuli, are seen at almost every mile, in the lowest situations as well as crowning the highest swells of the prairies; and they are still more numerous all around those beautiful but almost unknown lakes. It would be a ceaseless repetition of similar forms were we to figure many of these, but the outlines of a few of the most characteristic are introduced in the plate. Had time and circumstances permitted a more leisurely investigation and survey of some of the groups of this region, there is little doubt but many drawings of a highly interesting character could have been constructed in addition to those which illustrate this communication.

Fig. 3, Pl. II. An effigy ninety feet long, in form resembling the animal outlines previously described, is placed nearly at the foot and at the point of a remarkable, picturesque, perpendicular bluff, of coarse, friable sandstone, fronting a rich meadow, the favorite resort, no doubt, of numerous buffalos in olden times. In front of this bluff, and enclosing the mound or effigy, is a long earthwork in an exact straight line, about two hundred yards in length, having an opening in the centre opposite to the animal. The position of this earthwork indicates its having been designed for the purposes of defence or fortification against an enemy; perhaps as an outwork to the strong hold in the rear, formed by the bluff itself. The great Indian road to which we have already referred, skirts along the outer or southern side of this embankment.

Fig. 4, Pl. II. This sketch is drawn from the admeasurement of a couple of animal-shaped mounds, between which passes the same Indian path, at the distance of six miles west of the Four Lakes. These figures are selected to shew that one, if not both of them, represented a different species of animal to those we have traced in the preceding outlines. In one instance only they were depicted with the appendage of a tail; the others were tailless; and whether in the present case this deviation from the usual configuration resulted from the caprice of the Indian artists, or really depictured some beast more favored by nature than his contemporaries, it is not easy at this period to decide. They are respectively one hundred and twenty and one hundred and two feet long, and perhaps may have been intended to represent foxes.

Fig. 5. Beyond the Wisconsin Territory, on the north side of the river of that name, in the region still held by the Winnebagos, are innumerable mounds, both of the circular and most of the other forms we have figured. At one position, however, near the river, and not far from English prairie, a group of six of these appear to represent birds, probably the eagle, or perhaps the crane, which was the ancient badge of the chiefs of a branch of the once powerful tribe of Chippewas.* This sketch was communicated to the writer by the person who took the original admeasurements. The scale of these is about the same as the preceding.

Pl. I, Fig. 2 is a tracing from a sketch drawn to a larger scale, of a bird-shaped mound, in the same region; which sketch was furnished me by an intelligent individual, but of course I am unable to vouch for its accuracy. Possibly the figures which elsewhere I had noticed as possessing the general form of the

* Col. McKenney's History of the Indian Nations.

letter T, might on further inspection have been found to approach to the bird form also.

Forms supposed to represent turtles have also been seen in more than one situation, constructed on an equally large scale. Of this class I cannot speak with sufficient certainty from personal observation. We know that there existed the "Turtle Tribe" of Indians, which had that animal for its badge. The "Walking Turtle" family, according to McKenney, was one of the highest distinction in the Winnebago tribe.

To the above notices may be added some memoranda of certain other points where I observed, or have knowledge of the existence of tumuli or mounds in the shape of animals in this western region.

At the great savanna or prairie on the south bank of the Wisconsin river, called English prairie, are earthworks having the circular, the oblong, and the usual animal forms, and also some which bear resemblance to the Roman letter T, as shown in Pl. II. Fig. 1.

Animal effigies occur fifteen miles to the southwest of the last mentioned locality, along the course of an ancient trail, and also of the present military road to Prairie du Chien from Fort Winnebago. Numerous others may be recognized between these and the Mississippi.

In the vicinity of the remarkable hills called the Blue Mounds, they occur abundantly. These hills were, until very lately, a great resort of the Indian inhabitants; as their existing paths, converging hither in singularly straight lines from every point of the compass, amply testify.

In the centre of the territory, at sites which it would be tedious to enumerate, we repeatedly passed by similar mounds, almost invariably contiguous to Indian paths, whose deeply-worn, but narrow tracks, attest their extreme antiquity and long use.

Between the interesting limestone hill, styled Sinsinnawa Mound, and the town of Galena, these animal representations are seldom out of sight, and are accompanied by earthworks of simpler forms. They prevail equally in the low meadow sites, as upon the higher prairie ridges.

Elevated circular tumuli rise from the flats on the margin of the Mississippi, at the old French village or trading station of Prairie du Chien.

All along the borders of the beautiful Wisconsin river, extending from its mouth to the Winnebago Portage, similar monuments are traceable on the high and dry lands. Occasionally they occur in groups and chains, and not solitarily, and are of various fashions. On the shores of Lac de Boeuf and Lac Apucaway, wherever the land is dry and sufficiently elevated, one may observe, even from the water, a vast number of tumuli. Upon the summits of some of these may from time to time be recognized the modern grave of some Winnebago or Menominie chief, strongly protected by pickets. The margins of the Fox river are remarkable for the numerous Indian remains of this description. Colonel Petitval, of the U. S. Topographical department, who was engaged during the last summer in a survey of this river, had the kindness, at my request, to give some attention to these mounds. He describes an immense assemblage of them, at a point on the river, called the Red Bank, extending far into the interior, both north and south, for an undetermined distance. Twelve of the mounds at this place were opened under his direction, among which was an animal mound one hundred and fifty feet long. All of them contained human bones in a very decomposed state.

One of the most extensive and interesting collections of these monumental structures, exists near the eastern shore of Winnebago lake, within the reservation made to the Stockbridge and Brotherton, commonly called the New York Indians. I am indebted to Dr. Lyman Foote, of Fort Winnebago, for information on this and some other localities of Indian monuments.

At a place named Crawfordsville, on the Fox river, a group of ancient mounds has recently been announced in the western papers. These structures are described as being from three to seventeen rods (two hundred and eighty feet) in length; generally about four feet high, and they are stated to resemble "lizards, alligators, and flying dragons." They here all point in the same general direction, but are not precisely parallel. Among them there is one very large mound, which overlooks all the rest.

A writer in the United States Gazette, during a late visit to Wisconsin, observed numerous mounds and large embankments, spread over a space of thirty miles around the site of "the ancient city." Some of them were designed, he states, to resemble "lizards, turtles, buffalos, and even human forms." The present wandering tribes of Indians are "entirely unable to give any account of these remains, or to furnish the slightest tradition respecting the ancient possessors of the soil."

Having disposed of as much of the details in my possession, as appear necessary in relation to the localities of animal shaped earthworks, I have little to add concerning the mounds and Indian antiquities of other parts of this continent. Ample details respecting a great many of them may be found in well known works on these subjects, such as that of Dr. McCulloch,* and the Archæologia Americana.

From these and other authorities it does appear, that the forms of these mounds elsewhere are materially different to those I have been describing in Wisconsin and to the north of it.

The animal form does not prevail in the Indian monuments within the valley of the Ohio. No allusion is made by Colonel Long, in the narrative to his second expedition, to any but the ordinary circular tumuli, in the relative positions of which the editor observes, "we could discover no order or plan." On the banks of the Miami river, a group of one elliptical and four circular mounds is described, and figured in plate 2, of the narrative.

On the Fox river, of the Illinois, Colonel Long saw many mounds, counting twenty seven at one spot, arranged with a certain degree of regularity, "varying from one to four and a half feet in height, and from fifteen to twenty five feet in length. Their breadth is not proportionate to their length, as it seldom exceeds from six to eight feet;" other mounds are described of an oval form.

The square and pyramidal mounds occur most frequently in the south; and Dr. McCulloch, who is good authority on the subject of Indian antiquities, observes, "that there seems to be a material difference in the construction and position of the mounds in Georgia and Florida, from those of Ohio, Kentucky, &c.†

Tumuli, in the form of truncated pyramids, also occur in the south. Dr. Kain has described a group of six possessing this form in East Tennessee. Their proportions are ten feet in height, by thirty or forty paces in diameter, in the base; the whole group being enclosed by a ditch.

Mounds, having an exact rectangular form, are described by travellers as existing in Tennessee.

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* Researches, Philosophical and Antiquarian, concerning the Aboriginal History of America, by I. H. McCulloch, M. D.

† McCulloch's Researches, p. 503.

Mr. Bringier, describing the Indian mounds in the region of the Mississippi, states, that from Red river to St. Louis, a distance of five hundred miles, and in breadth eighty to two hundred miles, mounds constantly occur, and for the most part are symmetrically arranged, and contain human bones and other traces of man. This writer suggests, that they may be the ruins of ancient dwellings, constructed, on the old Mexican plan, of large bricks, and were covered with earth, which, mouldering down, left mounds in such abundance that the traveller is never out of sight of them. What an immense population, he observes, must have occupied these dwellings, which cover so large a portion of the surface of this region.*

That some of the earthworks in the southern part of this continent are attributable to such an origin, appears to be the opinion of other investigators. Professor Rafinesque, on the authority of M. Rhea, states, that in an ancient walled town near Columbia, in Tennessee, are "the ruins of many houses of various sizes, from ten to thirty feet in diameter, all of circular form."

The conical form is the most prevalent in Ohio. Mr. Atwater has described many of these, and Dr. Drake, among others, has given the details of four large elliptical mounds within the limits of the city of Cincinnati.

It will be seen by a glance at our diagrams, that no precise position, with regard to points of the compass, determined the construction of the Wisconsin mounds; and that in one case a single member of a group of animals has been placed at right angles to the rest. The choice, in selecting the sites of these memorials of ancient days, appears to have been influenced mainly by the contiguity to the lakes and principal rivers, and to those great lines of interior communication which from an unknown period traversed this fine country. By this arrangement the greatest publicity was given to the burial places of the distinguished dead; to the simple yet permanent monuments erected to commemorate their fame and rank, and perhaps with the design to perpetuate the honor, and to flatter the vanity of some of the many tribes and branches into which this great Indian family appears, from remote times, to have been subdivided.

* See this Journal, Vol. III, p. 37.

Learned archæologists have speculated as to what nation, in far distant times, constructed the ordinary tumuli of circular form, so abundant in the great Mississippi valley. They have not yet, I believe, commenced to descant on the origin of those other configurations, the recent examination of which has given rise to the present article. From that highly important contribution to North American early history, the "Antiquitates Americanæ," lately edited by the Royal Society of Northern Antiquaries of Copenhagen, little or no knowledge can be acquired respecting the mounds of North America; and the communication in the same work from the Rhode Island Historical Society, refers, for the most part, merely to the chiseled figures and hieroglyphics on the rocks of Rhode Island.

There are few, if any, authentic sources at hand, from whence to draw information, and it is no doubt quite unsafe to rely upon the accuracy of Indian traditions concerning these mounds, especially as the last occupiers of the soil were but comparatively in recent possession. Successive tribes have occupied, by turns, the region of country where these apparent animal and human effigies abound. The Winnebago Indians, a branch of the great Dahcotah or Sioux family, have held possession of that part of the Wisconsin country which lies immediately south of the Wisconsin river, and east of the Mississippi, only from sixty to eighty years. Previously to this time the district was in the hands of the Sauks and Fox Indians, a branch of the Chippewas, who dug and smelted the lead ore, but were driven out by the Winnebagos. Neither of these tribes now erect permanent monuments of this character, to the memory of their dead. We have seen them, it is true, in numerous places, excavate graves, and deposit the remains of the deceased on the summits of the ancient circular tumuli, which they appear to conceive were constructed for such purposes. Some of these modern burial places are accompanied by rude memorials, denoting the tribe and rank, and sometimes by hieroglyphics, in red paint, even recording the principal achievements of distinguished individuals.

But to a far different race, assuredly, and to a far distant period, must we look when seeking to trace the authors of these singular mounds, and the earthworks of such various forms, which are spread over the North American continent, from Lake Superior to Mexico. The degenerate Menominees, and the slothful

Winnebagos, are retiring before the power and the intelligence of the white man of the old world, as the Sauks and Fox Indians had previously retreated from the Winnebagos, and at a still earlier period, the Illinois Indians were nearly exterminated by the Sauks and Foxes.* But who were they who have left almost imperishable memorials on the soil, attesting the superiority of their race? Nation and tribe and family succeed each other, and for a while occupy the land. They vanish in succession, and leave few or no traces. Yet of this unknown people, thousands and tens of thousands of monuments remain, which will scarcely be obliterated so long as the earth retains its present form.

The result of a recent examination, by a friend of the writer, of the interior of many of the Fox river mounds, shews satisfactorily that the animal shaped earthworks contain human bones equally with the round tumuli. These bones were found in a very brittle and decomposed state, having roots and fibres growing through them, and were distributed, commonly, through every part of the mounds. These researches also threw some light on the mode adopted in the construction of these monuments; for it became evident that the bones or bodies of the deceased were originally laid upon the surface of the ground, and the earth was then heaped upon them. No appearances occur of graves being dug beneath the surface, in the first instance.† Upon the summits of many of the original tumuli it is evident that the remains of other deceased persons have been subsequently placed; and a new heaping up of soil thereon contributed to augment its former height. Finally, the wandering Menominee or Winnebago, the last Indian occupant of the prairie, excavates a grave upon the summit, places the body therein, in a sitting or reclining position, and strongly defends it with pickets.

That the more ancient form of burial upon the surface, and of accumulating the soil over the remains of the dead, was not universal among the Indian tribes of North America, appears from the examination of M. Rhea‡ of some antiquities in Tennessee,

* McKenney's History of the Indian Tribes.

† One of the animal monuments lately opened by Col. Petitval near the Red Bank, in the vicinity of Fox river, was one hundred and fifty feet long. The excavation was carried along the entire length, that is, from one extremity to the other, and bones were found abundantly. The number of individuals buried in some of these earthworks must have been very great. Perhaps they each formed the cemetery of a family in those cases.

‡ Made public by Prof. Rafinesque in 1832.

where, within the ruins of an ancient town or village, fortified with walls, "graves are found in abundance, from one to three feet in depth, containing human bones. The bodies seem generally to have been buried in a sitting posture, with flat stones placed around and over them." I observed a grave or sepulchre of this kind on the summit of the natural hill, of limestone, called Sinsinnawa mound, a few miles north of Galena.

Whilst endeavoring to ascertain the origin of the animal forms, adopted in the Wisconsin territory for monumental purposes, the writer became early aware of the embarrassments attendant on all researches in Indian archæology. It has been suggested, that they might be designed merely to record the achievements of certain chiefs in hunting. That they were sepulchral, and enclosed the remains of human beings, has been proved by the recent examination of many earthworks which have the peculiar forms noticed in the preceding pages.

Concerning these ancient memorials of a by-gone people, viewing them as commemorative of the dead, it has occurred to me that they may have served in some way to designate the respective tribes or branches to which the deceased, in whose honor the structures were reared, belonged. Even at the present day it is an undisputed fact, I believe, that certain, perhaps most, Indian families and even tribes or branches, are distinguished from each other by badges indicating particular animals, or objects; or by devices symbolical of some memorable national event or peculiarity. In the same mode, and for the same purposes, many individuals also, among the more remarkable of their warriors, assumed similar devices; commemorative of personal prowess, of success in the chase or in war; and were further distinguished among their friends and adherents, by titles equally characteristic. Thus have we seen, even within the space of a few months from the time of writing this article, the survivors of an Indian chief recording at the head of his grave, by some rude hieroglyphics, the tribe and attributes of the deceased. And this is Indian heraldry: as useful, as commemorative, as inspiriting to the red warrior and his race, as that when in the days of the crusades, the banner and the pennon, the device and the motto, the crest, the shield and the war cry, exercised their potent influence on European chivalry.

In all times have nations adopted and men arranged themselves under badges and symbols, to which custom and long cherished associations endeared them. Yet were they of no higher import than those of the North American Indian. In the earliest periods men rallied around the sacred person of the standard bearer, with equal self-devotion, and perished in its defence with as much heroism, as after generations have perilled life to guard the consecrated banner, or in our day have died to maintain the glory of a national flag. So far back, even, as the time of Moses, standards were employed to distinguish the different tribes of the children of Israel. There was an assigned place to each banner in the order of the march of the entire host; and all men were directed "to pitch their tents by their own standards, every one after their families, according to the houses of their fathers."

From that time to the present, in nearly all stages of society, may be traced the existence of symbols which were adopted for purposes of a like kind; certain natural objects being commonly selected to designate particular races, nations, or tribes. Among many of such nations, these badges were emblazoned on their military standards, and depicted on their commercial flags; they were sculptured upon their monuments, portrayed upon their escutcheons, incorporated with their architecture, inscribed upon their seals, and impressed upon their coinage. We are informed that the kings of the Medes bore golden eagles upon their shields; that the Greeks, the Trojans, and other warlike nations, had devices painted or sculptured upon their shields and helmets;* and that the ancient Germans bore standards before them in battle.†

The Roman legions planted the imperial standard over a large portion of the then known world. By turns, the shores of Albion have been invaded by the Roman eagle, the Danish raven, the white horse of Saxony, and the Norman lion.

And then, when the followers of the cross led on their marshalled thousands to war against the crescent, what hosts of devices, cognizances, achievements, and symbols, were emblazoned on banner, crest, and shield;—devices derived alike from natural and from imaginary objects, and borne in commemoration of noble

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* "Mutemus clypeos, Danaumque insignia nobis
Aptemus:—sic fatus, deinde comantem
Androgei galeam, clypeique insigne decorum,
Induitur."

† Egyptians, Persians, Hebrews, Assyrians, and Greeks, all carried ensigns of different figures in their armies. Among the most celebrated standards was the black crowned eagle of Attila, king of the Huns. It was called Astur, and supposed to be the same as the Schongar of the Tartars. We might also mention the renowned Gonfalon and the sacred Oriflamme.

deeds, and indicating rank, and honor, and high resolve. Under the red cross of St. George, the lily of France, and a multitude of other standards, the leaders of the soldiers of Christendom were individually distinguished by their own proper heraldic bearings.

That spirit which the olden time originated, and which was so strikingly displayed by the chivalry of the middle ages, has, it is true, been modified; and as regards individuals, has been almost obliterated under the changed aspect of the civilized world. But with regard, perhaps, to all existing nations, these symbols are yet associated with the spirit of patriotism, with national honor, or with deeply cherished remembrances of ancient grandeur. The crescent of the Ottoman empire still shines in the East; the fleur-de-lis of France, originating at least as early as the fifth century, is still her honored emblem; the lion of England, that for "a thousand years has braved the battle and the breeze," yet remains a cherished symbol; and, although arising in later times, the eagle of America is no less an object of national pride and endearment.

The foregoing remarks arise out of the obvious similarity of method by which, in all times and in all countries, men, whether barbarous or civilized, have found it convenient to distinguish and arrange themselves. If the untutored Indians have adopted, as the badge of their nation, their race, or their kindred, some simple object in nature, so also have the more refined of the old world constantly pursued the same mode; and doubtless, one common motive led the people of Scotland to select the thistle, those of Wales the leek, of Ireland the shamrock, and of England the oak, for their national emblems; with each and all of which many fond recollections are associated. Thus also did the white and red roses of the rival houses of York and Lancaster, designate their leaders and unite their followers; and the same feeling which gave rise to the local badges of the numerous Scottish clans,* may be traced among the North American tribes, and in like manner, suggested the insignia of numberless orders and associations in the civilized world. If the mail-clad knight of old surmounted his helm with appropriate symbols of courage in the field, of devotion to the true faith, or of constancy to his ladye love, so also does the red warrior assume the attributes of fierce-

* The institution of clans among the North American Indians, appears to have been general. Archæol. Am. Vol. II.

ness, of strength, revenge, or cunning—qualities which rank among the highest in his esteem—in the trophies of the eagle, the bear, the serpent, or the fox. If among the boldest of knights and kings, Europe had her Cœur de Leon, so have the chiefs of our Indians, though far less known to fame, their appellations; such as the Black Warrior, the Grizzly Bear, the Swift Deer, the Watchful Fox, the Rolling Thunder, and the North Wind. And if in the proudest days of romantic chivalry, amidst the gorgeous panoply of the court, the tournament, or the battle field, all eyes might recognize him of the Falcon, the Leopard, or the Bloody Hand, so also in humbler guise, yet with not less pride of heart, have the brave of our aboriginal Indians commonly been distinguished. No heroes of Greece, or Rome, or the Holy Land, were prouder of the badges of victory and the trophies of conquest, than are the natives of our western world. Within their own limited sphere, they appear to have sought distinction and to have earned characteristic titles, by the exercise of those qualities which are most estimated in savage life; and our own ears are familiar, even at the present day, with such titles as the Black Hawk, the Panther, Alligator, and Rattlesnake; the Young Eagle, the Black Wolf, the White Dog.

But it was not individuals, merely, by whom such appellations were borne. We have good evidence that many tribes of North America adopted, and even yet retain for their badges, the simple natural objects whose names they also bear; as in the mentioned instances of the Fox, the Turtle, and other tribes. Information on this head may be found in Colonel McKenney's work "On the Indian Tribes of North America." Another writer, familiar with Indian history, states that "all the Indian nations are divided into tribes, after the manner of the Jews."*

The Shawanese nation was originally divided into twelve tribes, or bands, all of which tribes were subdivided, in the usual manner, into families or clans, of the Eagle, the Bear, the Turtle, &c. These animals constitute their "*totems*," among which is the family or totem of the Panther, which sprung from the Kickapoo tribe.

The Crane was the badge of a branch of the Chippewa tribe, as was, doubtless, the Fox of another. The authority last

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* Johnston, Indian Agent. Archæologia Americana.

quoted, notices that the Winnebagos, like the Algonquin, and other tribes, are divided into bands, each designated by some animal, as the bear, or by the devil, or some bad spirit.* Among the clans or bands of the Mohawks, were those of the Bear, the Wolf, and the Turtle. The Hurons also had a Bear clan. The Natches, who lived on the borders of the Mississippi, had four clans, or classes; the Sioux proper were subdivided into seven bands, and the southern Sioux into eight tribes, each being separately classed by some characteristic name.† Whether the southern Indians were similarly subdivided and distinguished does not appear. From the different structure and form of their monuments, it is not improbable that there always existed a variety of races upon this continent. And if in remote times those races were classified and designated in the mode which we have seen still exists, and long has existed,—that is to say, under the denomination of particular animals,—it is not altogether incompatible with probability, that the earthworks in which their dead were deposited, and which resemble certain animal figures, were in fact designed as representations of those national or family badges, and consequently pointed out the burial place of the members of those particular tribes.

I confess that I am aware of no positive evidence to show, that any existing tribes or branches, thus distinguished by a species of armorial bearings, actually did erect monuments of earth in the shape of the animals whose names they bear. In the absence of a more plausible conjecture, the idea suggested itself, perhaps on very insufficient grounds, that there might be some connection traced between the animal shaped configurations abounding in the west, and some of the tribes who assumed animals for their badges, and classed themselves under their names.

If, as is perhaps the case, the foregoing views are inadequate to establish the heraldic character of some of the monuments of the aborigines, they show at least that to the same common cause may be traced, at every period in the recorded history of man, in all countries, and in every stage of civilization, the adoption of symbols and devices, derived from the simplest objects, yet characterizing nations, orders and classes, and even the individual members of communities.

Philadelphia, Feb. 12th, 1838.

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* McKenney's History of the Indian Tribes. † Archæologia Americana.

ART. IX.—*Observations made during an excursion to the White Mountains, in July,* 1837; by OLIVER P. HUBBARD, M. D., Professor of Chemistry, Mineralogy, and Geology, in Dartmouth College.

TO PROF. SILLIMAN.

Dear Sir—IN an excursion to the White Mountains, last July, I made such observations in Mineralogy and Geology, as my limited time and other circumstances permitted; hoping to add something to the little already known of this interesting country, and that the facts when known may stimulate others to farther examination, they are communicated for the American Journal. The details are minute, for I have often experienced the unsatisfactory nature of meagre descriptions, and I trust they will not be useless to others who may visit the same points.

My object is to record facts, and I am happy to say they are so numerous, and so decisive that we do not seem to be in the region of theory, when we infer at once the nature of those causes that have produced the sublime and beautiful scenery that adorns the greater part of this state.

Trap Dikes in Granite, in Dorchester and Canaan.

In passing from Plymouth, through Dorchester and Canaan, over the high ground that separates the branches of the Merrimack and Connecticut, boulders of trap were observed one mile east of Dorchester south meeting-house. These are porphyritic, some of a light gray, containing a profusion of large crystals of glassy feldspar, with two perfect cleavages—with a few of iron pyrites; others of a much darker ground, with feldspar and black hornblende in large and beautiful crystals, and also dark crystallized mica. The mica is in smooth nodules, without lustre externally, but presents cleavage surfaces of great brilliancy, half an inch in diameter. It also occurs in crystals penetrating the crystals of feldspar.

Similar boulders occur in some places in great numbers, on both sides of the new road, from Wright's tavern south nine miles, to Daniel Patten's, in Canaan, near N. E. corner of Hart's pond. Between his house and the guide-board there are several trap dikes in granite. No. 1, crosses the road N. by E.—is seven feet wide, and *porphyritic*—resembling, in color and crystals, the *boulders* described above; is uncovered in several places, and its appearance varies; it ramifies occasionally into several smaller dikes and lines, and in one place, of a few feet square, are eight cut-offs, or dislocations, where the small veins terminate abruptly, and commence again forward or laterally, with granite intervening, and vanish in a line or point. The cracks in the granite pass through the dike, and at the same angle, and yet the dike intersects veins in the granite. A hand specimen obtained here, presents a rare intermixture of trap and granite—actually exhibiting five alternations of the two, as if the fingers of one hand were alternately inserted between those of the other, in the same plane.

Fig. 1.

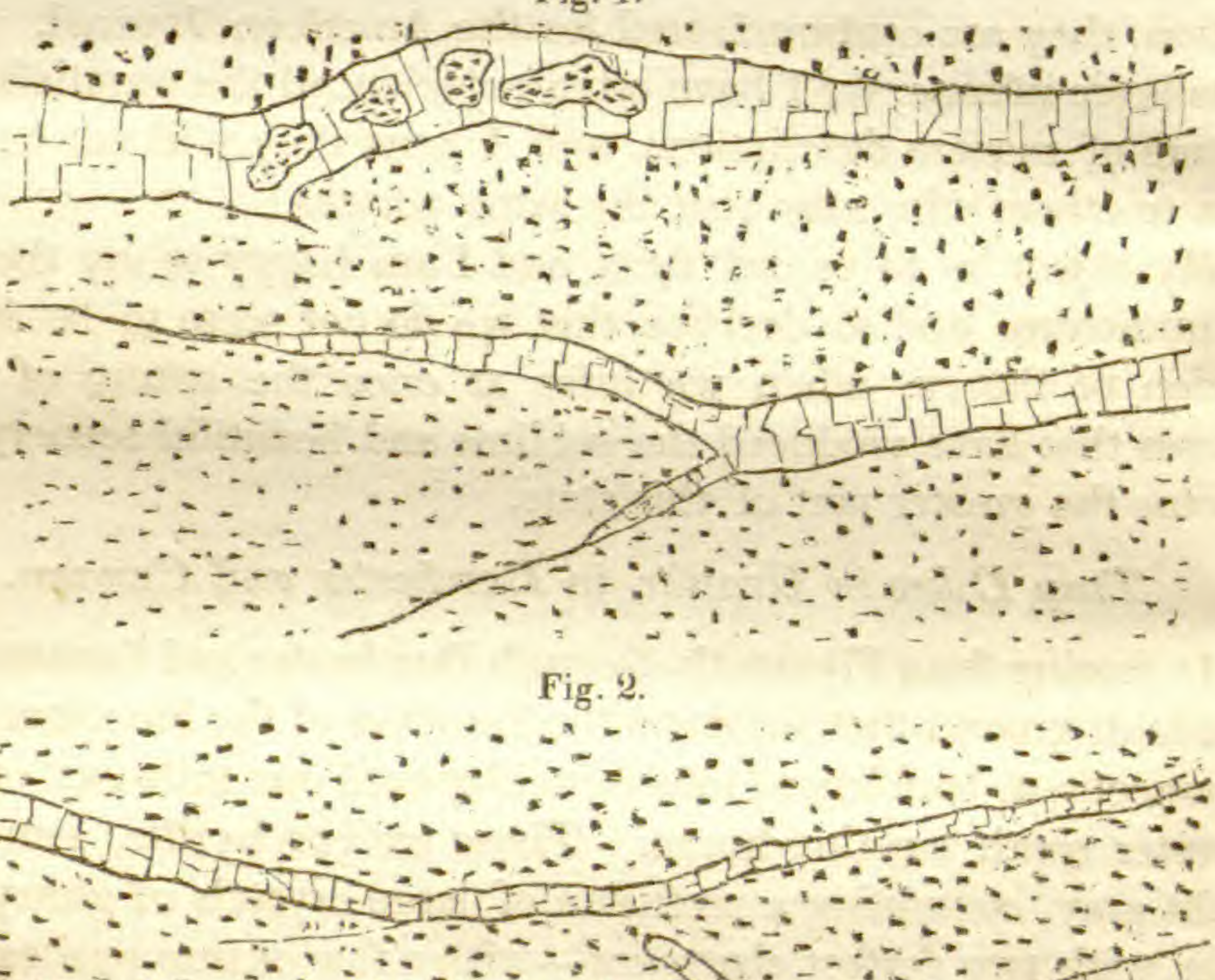


Fig. 2.

Another dike runs nearly parallel with this in the field on the west, which a little farther south, beyond the guide-board, may be observed as No. 2, crossing the E. and W. road in two veins, twenty inches apart—eastern one four inches, and western three inches wide—the former containing imbedded fragments of granite, the latter dividing into two branches, that become mere lines. Fig. 1.

North of this road, in the field, this dike is again uncovered, and appears in two veins fourteen inches apart. The eastern dike is one and a half inches, and the western, four to six inches wide, and they become, as suggested above, at the distance of some twenty rods north, one larger dike. Fig. 2.

The occurrence of the two veins in the field, after one had seemed to terminate, and the change of the vein of greater dimensions from the eastern to the western side, are only some of the phenomena frequently observed in trap dikes, several of which will hereafter be mentioned.

No. 3. A short distance west of No. 2, crosses the road, direction N. E. and S. W., two feet wide, color very dark, not porphyritic.

Trap Dike in Wentworth.

On the road from Orford to Plymouth, one mile west of Wentworth, above the saw-mill on Baker's creek, is a trap dike in granite, on the left hand close to the road, course north, ten feet wide, color dark gray, and even black, very fine grained and compact in some parts, and fracture smooth; in others, amygdaloidal, and contains nodules of chalcedony, and numerous very small round white spots of zeolite, which, from its pearly lustre, foliated structure, and low degree of hardness, is, I think, *stilbite.* Where the surface of the rock is weathered, the stilbite is decomposed, and the cavities are empty.

Darker specimens strike fire with steel, and all give, when breathed upon, an argillaceous odor, most striking in the softer specimens.

Half a mile S. E. of Wentworth, by the roadside, are fragments of red feldspathic granite, lying on granite *in situ*, with a very hard, compact trap, adhering to them, but no dike was observed.

Tourmalines and Diluvial Scratches in Rumney.

A rounded, well defined ridge of granite, terminates abruptly on the south side of the stage road to Plymouth, and is divided from top to bottom, longitudinally, by fissures, into regular masses, several feet in thickness. On the eastern side is a large vein of granite, filled with large black tourmalines in good crystals. The feldspar of the vein phosphoresces very beautifully with a pale sea-green light.

Diluvial Scratches, of uncommon distinctness and dimensions, are seen on the west side of this ridge, on an inclined surface, near the road, running east and west.

Trap Dikes at the falls in Campton.

Two miles north of Plymouth, at the falls of the Pemigewasset, are some remarkable dikes. The whole bed of the stream is of solid rock, and the river which makes here a considerable fall, runs in several channels, separated by rugged rocks, each of which must be crossed by a dam to secure the whole power of the stream for manufacturing purposes, which is now in process of execution.

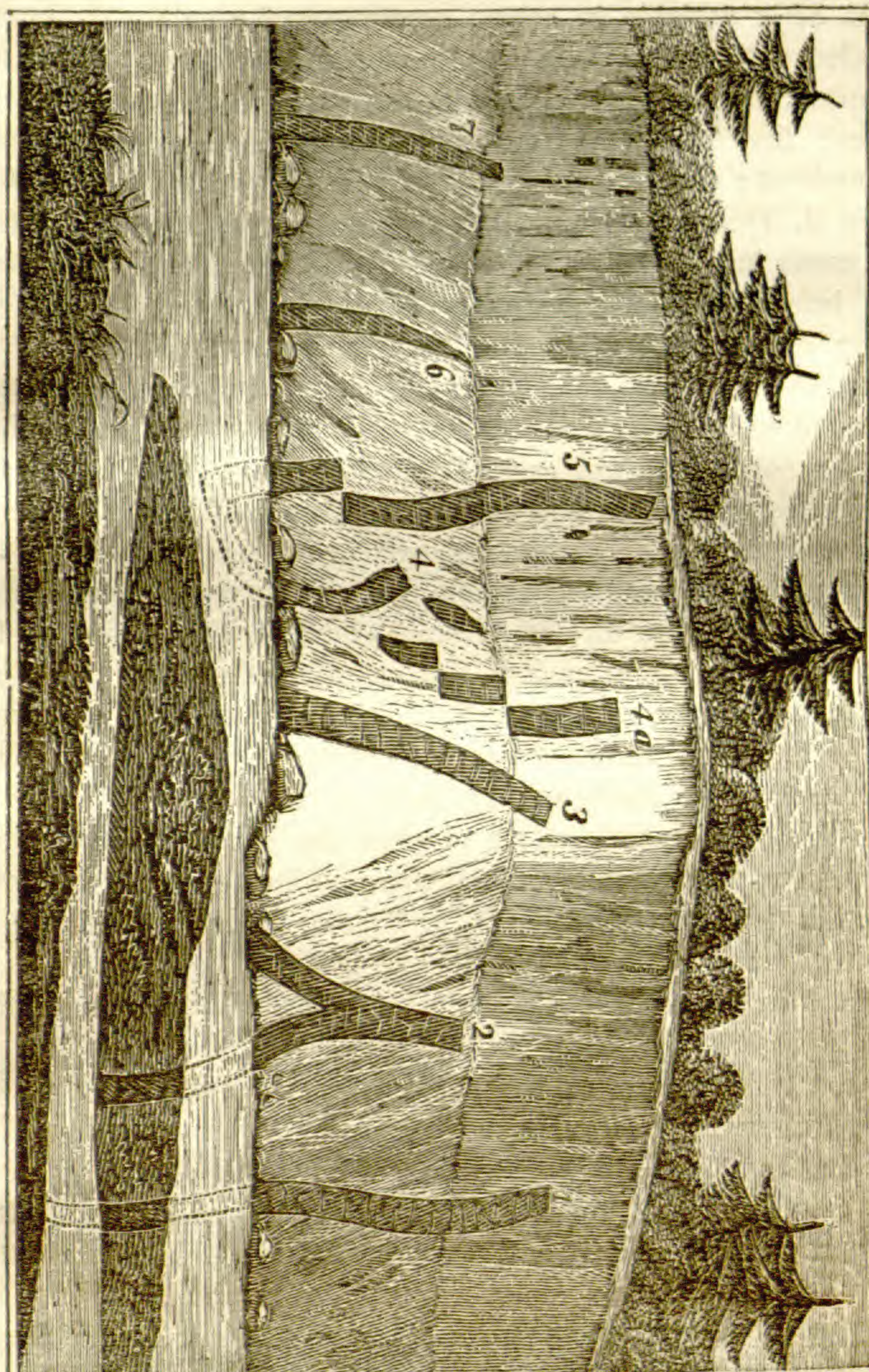
The rock is granitoid, partaking in different parts of the varied character that belongs to the several members of this family, and perhaps may be called *gneiss*, as nearly as any specific name will apply; course N. E.; estimated dip 30° east. This is, however, quite variable, as at dike No. 6, the dip of the strata is near 60°, and the cause is apparent. There is a group of dikes half a mile or more above these falls, which I had no opportunity of examining, but hope the next season to visit them. My description at present is only of that group that occurs at the falls. The number of dikes in this is *seven*, all of which may be examined very conveniently, unless it be No. 7, which, at certain heights of the water, is not quite as accessible as the others. The west bank is intersected by all these, which in some cases may be seen cutting the bed of the stream, the rocky island, and even the opposite bank; and all occur within a distance of a quarter of a mile.*

No. 1. Just above the bridge; dark gray, and nearly black; contains crystals of black hornblende and points of feldspar; crystals and films of iron pyrites in trap and associated rock, in small fissures extending from one to the other; some specimens fire with steel. Course E. and W., and cuts, as in Fig. 3, the island in the stream, and is seen in the eastern bank; intersects veins of quartz.

No. 2. (First below the bridge;) direction E. and W., and in upper part four feet wide; divides a few feet from the water into two branches; the upper one is seen in the island; structure very compact, like feldspar; fracture uneven; color light greenish gray; powder almost a clear white; weathered surface dark brown; fires with steel; translucent on the edges; effervesces abundantly (in powder) with dilute sulphuric, hydrochloric and nitric acids;

* The accompanying sketch is not intended as a correct topographical *view* of the falls at Campton, but only as showing the *manner* in which the dikes occur. The sketch was made wholly from memory.

Fig. 3.



moist litmus paper held over the solution is reddened by the *carbonic acid* evolved, and the color is discharged in drying; specific gravity 2.61. From the external characters this is a true *clinkstone*, which Gmelin has shown (Edin. New Phil. Journal, vol. vii, p. 68,) consists of mesotype and feldspar.

No. 3. Four feet wide; direction N. W. and S. E.; inclines N. E. 35°; variable in color; specimens of a yellowish brown, clouded with red; others of a handsome light gray; structure compact; fracture flaky, with sharp edges; translucent on the edges; fires readily with steel; minute iron pyrites diffused throughout; effervesces briskly with sulphuric acid, like No. 2.

No. 4. Direction E. and W.; terminates abruptly ten feet from the water in a quartz vein, and with a disconnected lateral shoot, and intersects many quartz veins; curves at and beneath the water, and unites at the distance of five feet with No. 5.

4a. Between 3 and 4, consists of three nearly distinct portions arranged in a curve; convex northerly; the terminations all abrupt, except the lower end of the lowest portion. These are, clearly, parts of what was once a continuous dike, and the dislocations evince a disruption subsequent to the injection of the trap; width of 4 and *4a* variable, from six to ten inches.

No. 5. Direction E. and W. and two feet wide; breaks a few feet from the water and is dislocated northerly by its whole width, so that the south side of the upper portion is in a line with the north side of the lower part; continues up the inclined bank to the soil above, thirty or forty feet.

In this and 4, and *4a*, we observe the effects of one dislocating throw, which has displaced them all in the same direction; whether the movement was N. or S., can be determined only by a critical examination of the rocks in place.

No. 5 is exactly like fig. 89, in Lyell's Geology, Am. edition, Vol. ii, p. 237.

No. 6. Terminates eight feet from the water in a blade; intersects numerous quartz veins; six inches wide; nearly perpendicular; but the rocks dip at an estimated angle of 60°: another result coincident with the contortion of 4 and 5, and probably from the same cause. Nos. 4 and 5, we have seen, are united; but all from 4 to 6, inclusive, are so similar in mineralogical characters, they may be regarded as ramifications of the same main fissure, ejected from the same focus.

Characters.—Color, black; fracture very uneven; granular; strike fire with steel; contain iron pyrites, and a dark green mineral diffused in small dots, which in vitreous lustre and hardness, very nearly resembles olivine.

No. 7 was not visited for want of time; but as I am informed, is similar to those last described.

Porphyritic Granite.

Proceeding E. from Plymouth, two and a half miles, we find *boulders* of this rock; soon the underlying rock, a decomposing pyritous mica slate crops out, and at three miles, porphyritic granite appears *in situ*, and continues several miles, and along the north shore of Little Squam lake. This rock seems to consist of crystals of white feldspar, some of which are three to four inches long and two inches wide, and held together by quartz and mica, in about the same proportion to the feldspar as the cement of a breccia to the fragments.

Common granite is found *in situ* at the top of the hill, after crossing the outlet of the lake; but the boulders of the porphyritic granite are seen, diminishing in number, quite to Centre Harbor; distant ten miles from where they were first observed.

Trap Dikes on Red Hill.

Red hill or mountain, near Centre Harbor, Lake Winnipiseogee, is usually ascended by visitors to enjoy the beautiful scenery of the numerous lakes, with their hundreds of islands, and also of several mountain ranges not very far distant from this peak. The mountain consists of reddish sienitic granite, and its sides are covered with fragments partly decomposed. Near the path leading to the top of the mountain are two dikes.

No. 1 is a few rods north of the second house; seven feet wide; course E. by N.; dip 15° to 20° N.; granite altered at junction, appearing burned and baked; on the lower side the dike is exposed by the removal of the granite, and appears as an inclined wall a few feet high. The color and weight of the trap led some time ago to the supposition, that it was an iron ore, and several tons were quarried under this impression, which, upon better information, were never removed.

No. 2 is one eighth to one quarter of a mile E. of No. 1. Course N. by E.; average width twenty-five feet; dark brown; slight lustre, owing to brown mica diffused through the mass; pyritous, and fires with steel. Near this, but separated eighteen inches from the dike, is a mass of trap several feet in dimensions, and pasted into granite.

Trap and Granite Boulders, and Granite Veins.

East of Centre Harbor, two and a half miles, are numerous fragments of large size, of trap in granite, but no dikes appeared; some of dark blue, others of a reddish brown; a mixture of red feldspar and hornblende, mottled with dark spots; fracture conchoidal, and edges very sharp; strike fire with steel; and others frequently met with in this region, composed of hornblende and feldspar, with an excess of the former, such as Saussure characterizes, judging from description, by the name *cornéene.*

At four miles from C. H. are immense granite boulders, strewed for miles, and the exhibition of granite veins in them is truly remarkable. They are very numerous, usually fine grained, and much whiter than the rock; the regularity and parallelism of their sides is as exact as if drawn by art, seldom over a foot wide, and usually but a few inches, and less: sometimes a rock is cut from side to side by a vein, retaining the same direction and thickness throughout; sometimes by two veins, which are parallel, and again by several, running in every direction, intersecting each other, the older cut by the more recent. In the present state of our knowledge of the formation of veins, and especially of veins of the same composition as that of the rock containing them, whose sides present none of that irregularity common in dikes, an observer might almost hesitate to record facts that may add to the obscurity of the subject, were it not, that valuable general truths can be derived only from an extensive comparison of individual facts.

Dikes in Moultonboro'.

Two trap dikes, in sienitic granite, are found on the right of the road on the top of Rogers' hill, one and a half miles from Moultonboro' corners, towards Tamworth; course W. by N.; parallel, and both contain fragments of granite of considerable size. Fig. 4.

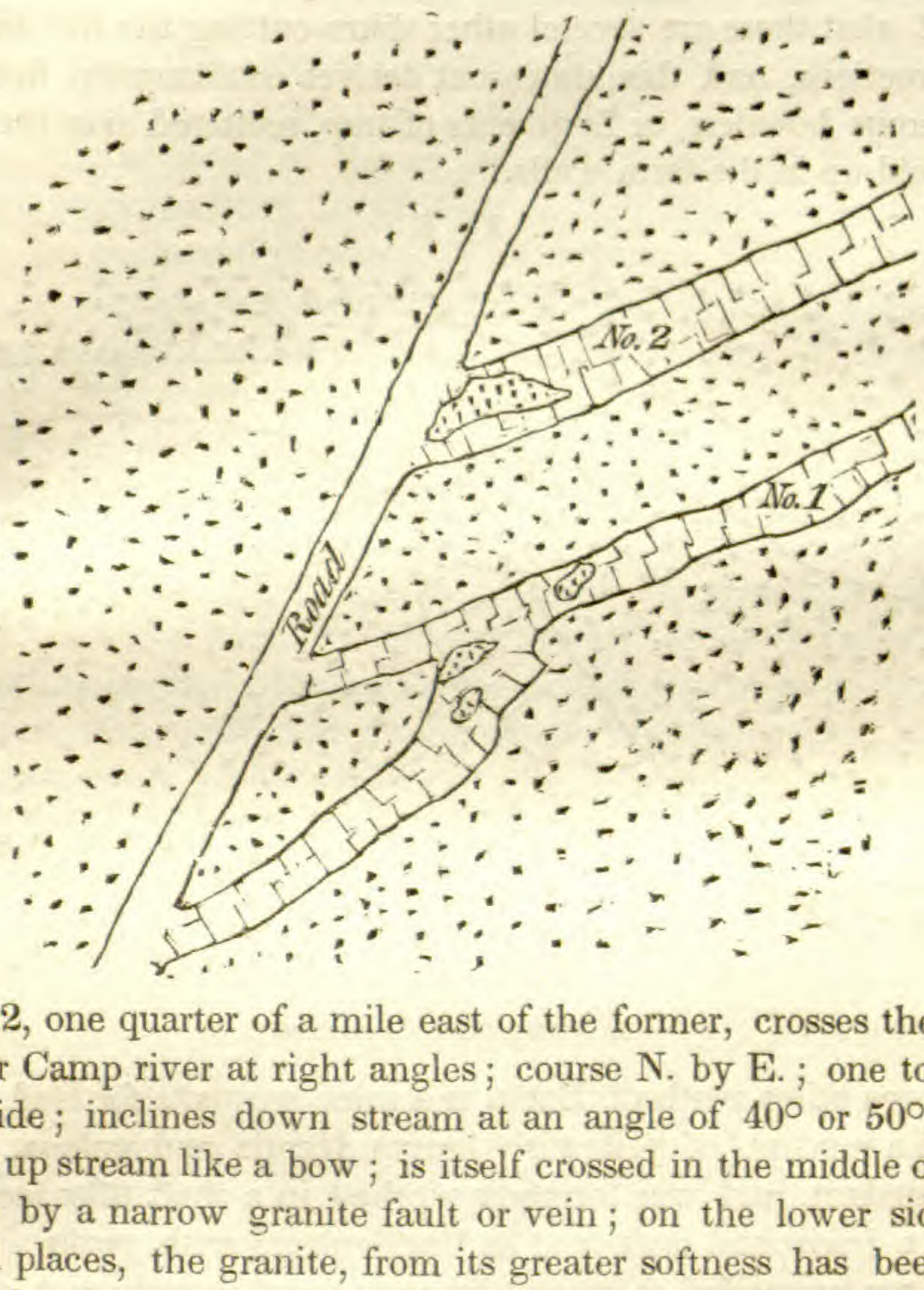
No. 1; one foot wide; sends off a lateral branch which curves southerly; eight inches wide.

No. 2; three feet from the former, is two feet wide, and porphyritic, with crystals of feldspar.

Dikes in Tamworth.

At Fort Jackson, in Tamworth, about four miles west of Things' tavern, on the right of the road at top of a hill, fifty rods from Bear Camp river, is a small trap dike in granite, six inches wide; course E. and W.

Fig. 4.



No. 2, one quarter of a mile east of the former, crosses the bed of Bear Camp river at right angles; course N. by E.; one to two feet wide; inclines down stream at an angle of 40° or 50°, and curves up stream like a bow; is itself crossed in the middle of the stream by a narrow granite fault or vein; on the lower side in several places, the granite, from its greater softness has been removed by the water and the dike, being left prominent, presents the appearance of a dam. This exposes, on the side of the dike, a series of longitudinal light and dark gray stripes, never over two inches wide, arranged horizontally in regular alternations.* The river bed *above*, as well as below this dike, is filled with trap ruins.

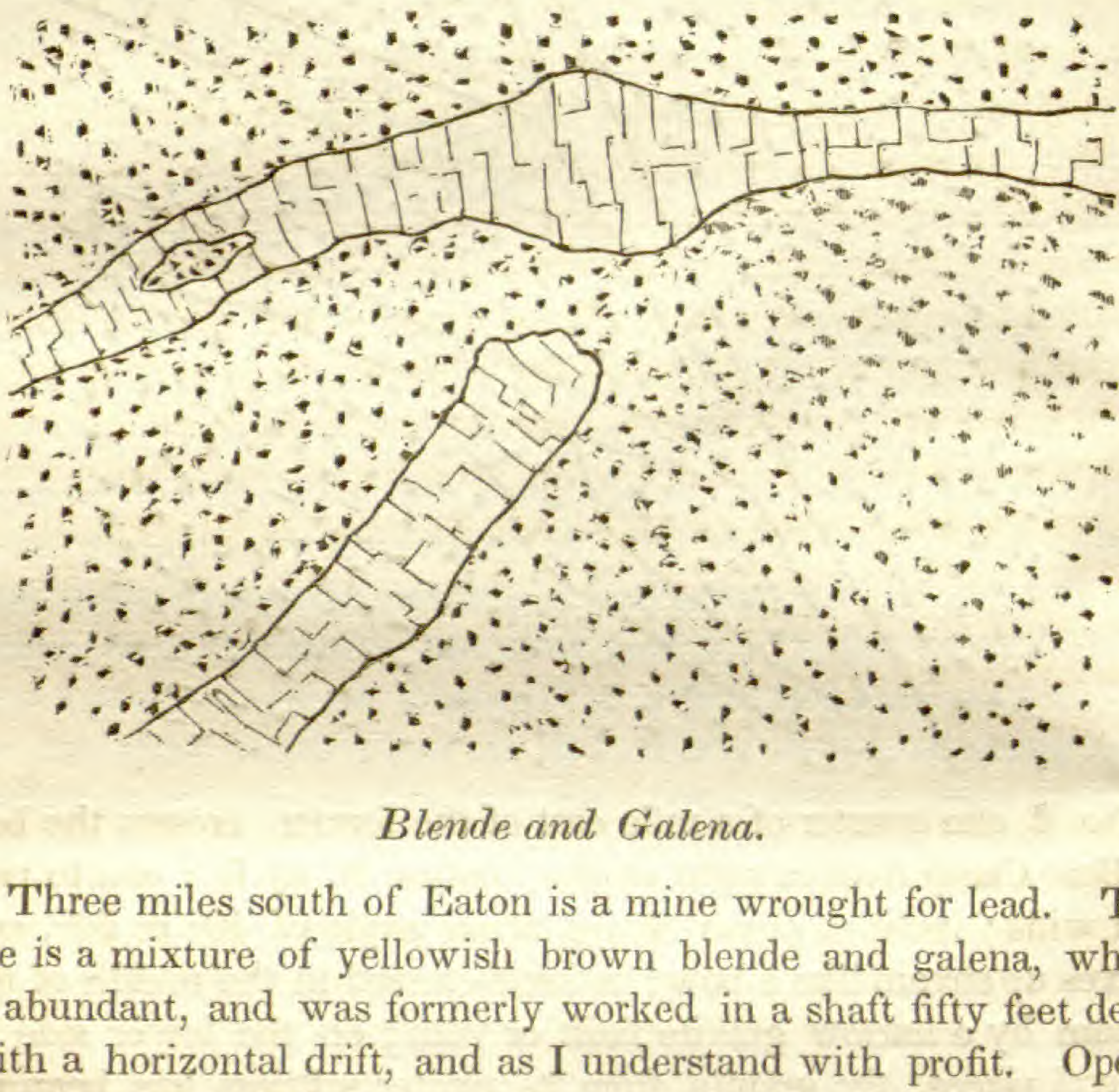
Dikes in Eaton.

On the hill, near Mr. Eleazar Snell's, one quarter of a mile east of the village, are two dikes from two to three feet wide and three feet apart; course in general N. E. by E.; one containing a

* I owe this notice to the kindness of a friend.

fragment of granite imbedded. Fig. 5. A farmer of the vicinity stated, that there are several other dikes cutting the hill in similar directions, and this statement derives confirmation from the numerous boulders, or fragments of trap, scattered over the fields and laid up in the farm walls.

Fig. 5.



Blende and Galena.

Three miles south of Eaton is a mine wrought for lead. The ore is a mixture of yellowish brown blende and galena, which is abundant, and was formerly worked in a shaft fifty feet deep, with a horizontal drift, and as I understand with profit. Operations are suspended at present by some legal impediment, and not through a deficiency of the ore. The specimens, with the two sulphurets intermingled, are beautiful, and will reward the mineralogist for his labor in procuring them.

Crystallized Smoky Quartz,

is found near Pendexter's in Bartlett, occupying large geodes in masses of decomposing granite on the flanks of Kearsage mountain. The crystals are very clear and beautiful, from one to four inches long, and even one and a half to two inches in diameter.

Arsenical pyrites, crystallized and massive, occurs in a large vein, in a mountainous tract, four miles north of Bartlett, belonging to Mr. Eastman.

The White Mountains.

It is remarkable, while hundreds of travellers annually visit these mountains, attracted by the grandeur and beauty of the scenery, the salubrity of the air and the delights of the deep retirement from the busy world, that so little has been done to develope the geological character of the region. We may hope the day is not distant, when, in the geological survey of this state, proposed by our Executive, this great desideratum will be accomplished. The labor and expense of exploring the structure of this extensive district with its associated ranges, is altogether beyond the resources of an individual; while, if prosecuted under a liberal legislative provision, the results could not fail to promote largely the welfare of the community and bring to light valuable mineral resources, and advance very much the interests of science.

These mountains will ever be memorable for the dreadful storm of August 28th, 1826, the awful effects of which, even at this period, are every where visible.

The deep channels, worn by the avalanches that then descended from their summits, still form a striking and picturesque feature in the scenery, and the immense heaps of ruins, boulders, and large isolated masses of granite that cover their base, and are strewed in the beds of the streams, testify to the long continued action of degrading forces.

In addition to the graphic accounts of this event in this Journal, Vol. xv, p. 217, some facts came to my knowledge, which I do not recollect to have seen published; and as they were communicated by eye witnesses, and serve to illustrate the power and local character of the storm, they are worthy of record.

At Bartlett, twenty miles below the Notch, the water of the Saco, which runs through it, rose on the morning of the 29th of August, twenty-six feet in one hour, and was filled with earth, like mud, and the sulphureous odor emitted by the attrition of the rocks borne along by the torrent, was almost insupportable. Rev. Mr. Wilcox, in his account, Vol. xv., says, the water of the Amonoosuck, about ten miles from the mountains, was, at daybreak on the 29th, raised from a depth of three or four feet to twenty feet, and sixty feet wide, and "as thick with earth as it could be without being changed into mud." A gentleman of this village, Hanover, (which, by the course of the Connecticut, and its branch the Amonoosuck, is not less than eighty or eighty-five miles from the mountains,) observed the same fact here, under the following circumstances.—He had returned from a ride of a few miles up the Connecticut, and along its banks, and noticed the water but slightly risen above its usual summer height, and clear. In about half an hour, he was informed, the river had suddenly assumed a very peculiar aspect, and so different from what he had just seen, that he was incredulous of the truth of the report. On going to the bridge, (half a mile,) he saw no longer a river of pure water, but the channel somewhat fuller than when he last saw it, and a semi-fluid mass, of a light *brick red*, descending in a sluggish current. The water, in fact, was charged with as much earth as it could sustain, and retain its fluidity. Unfortunately, no memorandum was made, so as to recall the exact time of this occurrence, and thus enable us to measure the velocity, or the time taken to reach this place; but it was coincident with the arrival of the news of the storm, and the river continued to flow thus for several days.*

The mountains furrowed by the channels above mentioned, are in a peculiarly favorable condition to be examined, and the records of their history are written in indelible characters. There is the most abundant evidence of the prevalence of igneous agencies in elevating these mountains, and afterwards filling the fissures with intrusive rocks; and from the numerous trap dikes in the sienite and other rocks of the New England coast, and the very remarkable ones in the highlands of Essex county, N. Y., it is not improbable the whole of this primitive region has been convulsed and elevated by the same causes.

Decomposing Granite.

There are many violent causes at work to reduce the large masses of granite to fragments; but as those which are at rest and removed from the action of running water and violent concussions

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* The oxide of iron, arising from the decomposition of the rocks for years, seems by this storm to have been swept away, and carried down by the streams; and the inhabitants who live on the bank of the river opposite this village, speak of this ochery appearance of the water as entirely peculiar, having occurred only at this period during the last twenty years.

The gentleman above mentioned has been perfectly acquainted with the river during his whole life, and he assures me nothing of this kind has been known here except on this occasion, for the last *fifty years*.

seemed to be undergoing this change, we must look for another and more silent cause. This must be found in frost, moisture, &c., operating especially upon the large proportion of feldspar, the alkali of which is removed, and the mass is thus rapidly disintegrated. The masses exfoliate on their angles and curves, and it is not uncommon to meet with those that seem to be affected by what Dolomieu calls *la maladie du granite*, which, on being struck with a hammer, fall entirely in pieces or grains. The extent of this process may be imagined from the fact, that from Bartlett to the Notch, (nearly thirty miles,) the surface of the ground (as cut by the road ditches) seems entirely made up of decomposed feldspathic granite sometimes to the depth of two feet.

Octahedral Fluor Spar.

Half a mile above the tavern of the elder Crawford, in the ruins of a slide east of the Saco, this rare mineral is found, which was mentioned twenty eight years ago in Bruce's Mineralogical Journal;* but the difficulty of obtaining specimens is much less than formerly. The spar is found in masses of radiated quartz, easily broken; and occurs in pale green octahedra, from one fourth of an inch to one inch and one fourth in diameter, but is easily fractured in breaking the gangue; it phosphoresces most beautifully, on hot iron, with at first a yellowish light, which becomes finally of a peach blossom color. On ascending the gorge about five hundred feet, (here about ten feet wide,) the quartz is found in place, on the south side of it, in close contact with the granite, which on the other side is removed, forming a vein or dike, (*for it is really one*,) two feet wide, and continuing farther up the mountain. Its structure is drusy, and there is near the middle a double serrated line, formed by the interlocking of quartz crystals. By unknown causes, the fluor has been in many cases partially or entirely removed, and the cavities thus formed are now filled with quartz in plates and crystals. Such a phenomenon in calcareous rocks and veins would be easily explained. The fissure existing, the calcareous matter in solution is deposited on either side, till the drusy surfaces unite in the middle. What greater difficulty in applying the same solution to deposits of siliceous matter in veins? The fluor is not equally disseminated

* Mineralogical notice respecting American fluates of Lime: by the Editor. Bruce's Min. Jour., p. 33, Jan. 1810.

through the vein, but is confined to a portion of one side, three or four inches in thickness, and easily separable from the mass of the vein.

Trap Dikes cutting the White Mountains.

At the foot of the gorge south of the Willey house, we find in abundance fragments of altered slate, slaty trap and basalt, and I am informed by a gentleman who passed over the mountain through this gorge, that in the upper part near the top, it is crossed by *several trap dikes.* Immense ruins lie at the foot of this and the gorge back of the Willey house, which appear as firm as the mountains, and are covered with grass, shrubs and trees, concealing their deformity; but those who have read the description in Vol. xv, of the wild devastation that reigned here, will at once penetrate the deceptive veil which vegetation throws over the whole scene.

Dike in the Willey Gorge.

From the melancholy associations of the last named gorge, my attention was more particularly attracted to it. The lower portion for a considerable distance is obstructed by the rocks and gravel that have rolled down from above. There is a handsome vein on the north side, of crystallized feldspar, of a pale yellowish hue, with crystallized mica in granite. In the bed of the gorge, where it is but thinly covered by debris, beautiful flesh-red feldspar occurs, with many small cavities containing crystals of the same. Ruins of trap found here led me to ascend farther, and on passing the debris, a trap dike appears, forming part of the bed of the channel. Its width is from two to six feet, usually averaging not more than four; course N. E. and S. W., closely embraced by the red feldspathic granite, which is worn down to the same level with the trap. The dike is crossed about five hundred feet from the bottom, by a quartz *vein* or *dike* four feet wide, with parallel and vertical sides, at an angle of about 60°, the parts of which, on the opposite sides of the gorge, would be joined by right lines in the direction of its course, which indicates no disturbance or shifting.

In the bed of the channel may be seen the trap, the quartz and the granite, all so interlaced, that it would seem impossible to decide whether the trap or quartz were the intersected vein; or if they were not both contemporaneously injected, and that too when the granite was not in a consolidated state. Above this, we may observe the dike passing in full width; then sending off branches from the main body, including *apparently* detached portions of granite, or separated by long narrow and broad lines of granite; then becoming confluent into a lesser dike, to be again enlarged, and subdivided into tortuous lines, or stand in curved plates, covering concave surfaces on the side of the gorge, from which the granite has flaked off, or in shoots terminating abruptly, or in evanescent lines, every where enclosing granite, and the granite in turn enclosing trap. This constantly varying appearance of the dike and granite at different elevations, forces the conclusion that the granite was fissured while a tenacious mass, and is still united by filamentous portions running in every direction, and the granite and trap both reticulated, so that if it were possible in a given spot to remove one layer after another, of only a few inches in thickness, each new face would present a varied aspect according to the size and inclination of the portions intersected.

This dike was traced as far as circumstances allowed some fifteen hundred feet high, till the ascent became impeded by a perpendicular front six feet high. The dike was visible above this point till a turn in the gorge, and there can be little doubt that it extends to the top of the mountain, and has completely riven it in two. The gorge is from thirty to fifty feet deep, and at top twenty to thirty feet across, excavated in the rock itself; its sides very steep, vertical, and even overhanging in some places. The trap is generally of a dark or blackish gray, fine grained, crystalline, very compact, hard, fires a little with steel, and contains no foreign minerals; another portion is light gray, and compact; and still another, light gray, seeming like a decomposing earthy sandstone, filled with smooth rounded nodules of the size of a small pea and less, very prominent on a weathered surface, occasionally containing white crystalline matter, but usually earthy throughout, and scratch glass readily. This at the time was saturated with water that runs in the gorge, and the specimens being disintegrated, readily parted, and required careful handling till dried, when they became more coherent. The junction of the dark gray trap and granite is most perfect, as if soldered together; and these specimens presenting a beautiful contrast, may be easily obtained, as a fracture seldom occurs at the line of junction more readily than through the mass.

Dike at the Notch.

On the east side of the Notch, in the face of the cliff, quite elevated above the road, there is a dike four or five feet wide, that may be seen at a considerable distance, crossing several furrows in the cliff, and strongly contrasted in color with the rock.

Mount Washington.

This eminent peak, which is still generally acknowledged to be the highest point of land east of the Rocky Mountains, is one of very great interest to the geologist; and here, possibly, many points in meteorology, affecting materially the history of that branch of science in our country, are to be decided.

Brackett and Weeks gave a rather extended, though general, notice of the White mountain range, in the "Historical and Miscellaneous Collections," Concord, April, 1823, and took levels, in 1820, from the Connecticut river, at Lancaster, to E. A. Crawford's (now Fabyan's) Mountain house, eighteen miles, and found it 1,000 feet higher than the river; then to the top of Mount Washington, and found it 5,850 feet above the river. The facts in this account are interesting, and it would form a very convenient guide-book to any who should wish to examine the range. The only particular to which I wish at present to invite attention, is the nature of the rock crowning the summit of Mount Washington. The visitor, on the west side, has to encounter much less difficulty in ascending the mountain than formerly, as he can ride on horseback seven and a half miles; then commences his journey on foot through the woods, from which he occasionally catches a glimpse of the mountain tops, and when he emerges from the woods, where his vision is unobstructed, the various views are very beautiful; but the object of his pursuit appears still a mile distant. The peak he sees capped with a rocky covering, destitute of vegetation, broken up into huge masses, which, as he passes from rock to rock, seem as disjecta membra in the wildest confusion; but when he has once surmounted the peak, and recovered from the mingled emotions of surprise, pleasure and sublimity which fills his mind, and given his attention to nearer and minuter objects, his satisfaction, if he be a geologist, will hardly be less than when viewing the more distant and imposing scene.

The foundation, or mass of this mountain, as it is seen in the deep gorges cut by the slides in the western side, is granite; and the top has been stated, by those who have and by others who have *not* ascended it, to be granite; and Alpine travellers, who have visited Mont Blanc, have thought they saw in the vast ruins surrounding the summit, the remains of lofty aiguilles, that towered above the present peak; but let the observer stand at the most elevated point, near the rude artificial monument, as in the centre of a decapitated summit, and let him critically examine the rocks in the whole circle about him, and he will soon discover the incorrectness of these opinions. He will find the rocks stratified, layer upon layer, and symmetrically arranged around the center he occupies. The rock is *mica slate*, consisting of coarse mica and fine quartz, occasionally with fine grained veins of the two minerals, with a little feldspar, and some considerable veins of white *quartz.* The uniformity of this surface, in level and appearance, is such, that a passage to the top is marked out by no ravines and eminences, but the path leads directly over the ruins, and the *guide* himself is directed by masses of white quartz, or collections of stones raised at proper distances. Near the top are small *black tourmalines*, and also a small spring of water.

The case is clear. The mountain of granite was raised from the deep, bearing up on its Atlantean shoulders this huge covering of mica slate, that extends a quarter of a mile below the summit, and by disruptive agencies has been fissured in every direction, and reduced to ruins. The granite, instead of rupturing the mica slate, and protruding at the centre of elevation, itself forming the peak, has broken it at some distance from the centre, and we ought to find the long line of disruption of the mica slate, if the rocks remain and are uncovered, very far down the mountain; if not, in the low grounds of the valleys.

The different zones, or belts of vegetation, are distinctly marked on the flanks of the mountain—the lower forests with their varied hues—the upper belt of sombre evergreens—the highest of dwarf trees, stunted shrubs, and long grass and mosses, and terminates at the lower line of the rough weather-worn rocks that form the summit. From this height the several belts may be traced, with the eye, for a great distance each way. The upper limit of vegetation indicates very definitely the comparative elevation of the neighboring peaks, according as it surmounts or falls below their summits; though in the article quoted above, it is asserted, that vegetation uniformly rises higher on the western side than on the eastern of these mountains, and the difference is attributed to the greater elevation of the whole country on the western side.

The Franconia Notch,

seven miles south of the village of Franconia, is approached by a very considerable ascent in the road to the summit level. Some beautiful lakes on the north of this give rise to one branch of the Amonoosuck, and another lake on the south forms one of the sources of the Pemigewasset, while lofty mountains rise on each side of the road, which on the left are almost perpendicular.

The profile on the west, or La Fayette mountain,* is still in high perfection, reminding one of an ancient warrior with his grisly beard and projecting helmet, and a countenance of determination and majesty; the whole presenting, in sharp outline, a face full of expression, like the most labored production of the chisel.

The Basin.

Three miles south of the mountain-house, on the right of the road, is a wonderful excavation in the granite rock, called "the basin." It is perfectly ovoidal, and its diameters (by the eye) twenty five and twenty feet, depth fifteen feet, and filled with water of a pellucid sea-green, and rounded stones in great number lying on the bottom.

A small stream, the outlet of the lake above, pours through "the basin" with great vivacity, entering on the N. E. strikes against the south, and receives a circular motion westward, producing eddies and a complete revolution, and is discharged on the S. W. side. The concave above the water, which is perfect on the N. W. side, and projects over the basin at a height above the water (to the eye) of some fifteen feet, is beautifully rounded and smoothed. It is obvious that the water once flowed so as to strike the highest point, where the granite is most worn, and by its constant circular motion, aided doubtless by the stones and gravel carried round with it, has produced this astonishing cavity. The ledge of granite above, and especially below the basin, is

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* See a notice and sketch of this colossal profile, Vol. XIV, p. 64, of this Journal.

furrowed and rounded for a great distance in a very remarkable manner, into troughs bounded by large salient and re-entering curves, and presenting also many subordinate basins of considerable size.

The basin is of the same class with the pot-holes at the foot of cataracts, and owing to similar causes; but from the smallness of the stream, and the nature of the rock, a remarkably hard and compact granite, it is one of the most extraordinary cavities of the kind that has been described.

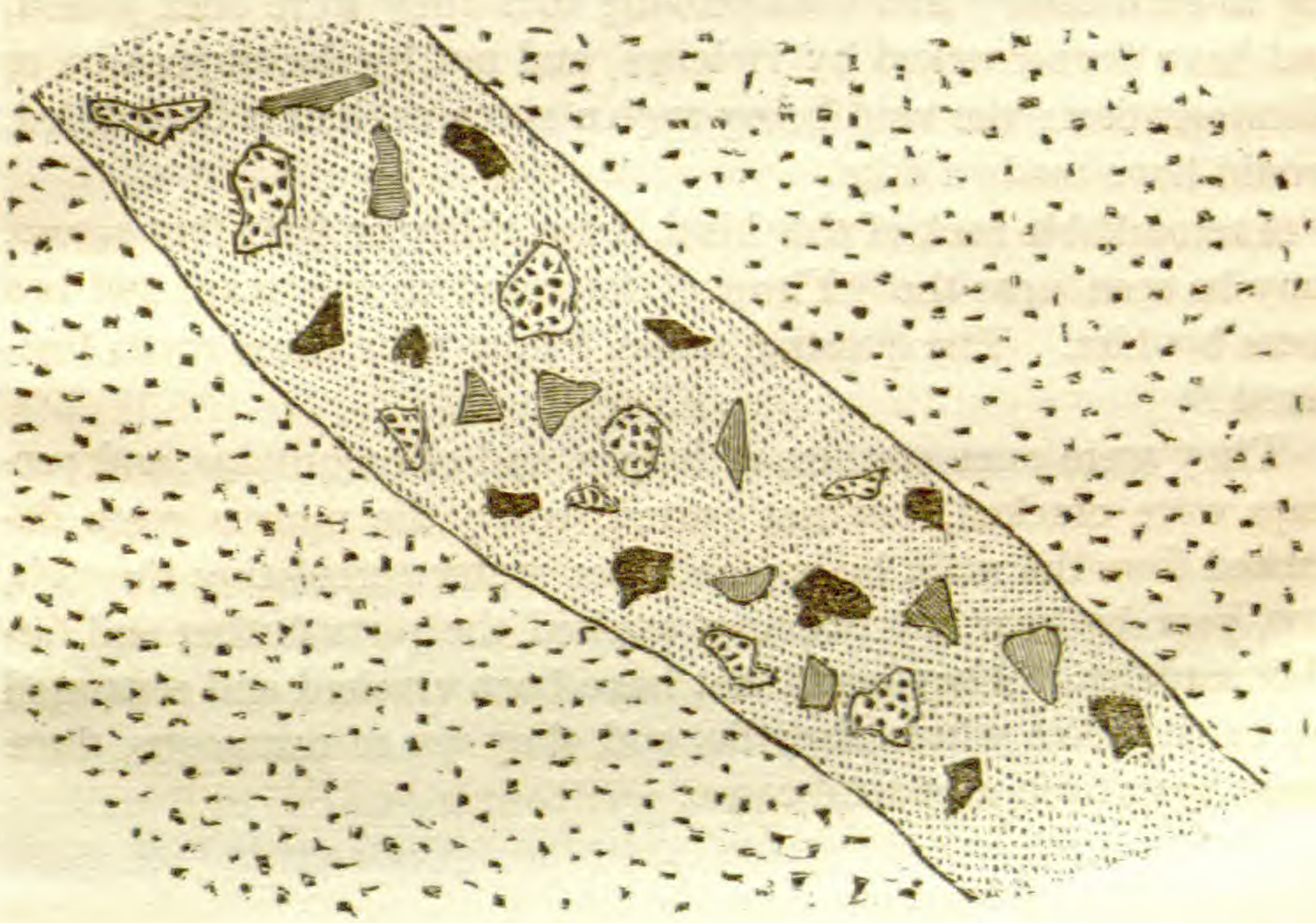
In beauty it may justly rival the Castalian fountain; but as a chronometer it is most interesting to the geologist.

Science has not yet discovered, by experiment and observation, the law of attrition of granite by running water; and the stream that flows here seems utterly inadequate to the production of the effect within the historical period, and would seem to carry back the antiquity of the world to a remote era.

Granite Veins in Granite.

These are very numerous, and on a large scale. There is a remarkable one of this character, on the right hand of the road, just north of the basin. The granite is fine grained, and dark, with mica or hornblende. The vein, on the contrary, is feld-

Fig. 6.



spathic and white, six feet wide, and contains in abundance imbedded fragments of granite, like that enclosing the vein, and also of *slate and trap*, all finely contrasted in color with the vein, and pasted into it like fragments in a breccia. Fig. 6.

The circumstances existing at the time this vein was filled, may have been these. The granite was consolidated, and covered by slaty rocks, (since removed,) and by masses or fragments of trap, which were all fissured simultaneously, and the fragments of all falling into the fissure were entangled in the fused rock thrown up; or the granite was covered with the ruins of slaty and trap rocks, and when it was fissured the fragments torn off were enveloped together with those of slate and trap, and all consolidated. Whatever was the state of things here, the dike is clearly not one of segregation, but of injection from below; and its relative age is certainly more recent than the consolidation of the granite, and the period when the slaty rocks were deposited in this region, or the ejection of trap.

Detached Masses of Granite.

In this vicinity there are numerous detached rocks lying on the ground, and some of enormous size, which are fractured through and through, sometimes in two pieces, sometimes in more, the parts with their salient and re-entering angles exactly corresponding to each other; and thus proving that they were once joined, and have been cracked by violence, and not by decomposition or disintegration: the void being such a space as, had it been filled, would have made a dike.

A remarkable rock of this kind, some thirty or forty feet across, may be seen near the "Flume," fractured in this way, and is a mere boulder. The question arises, "how were these rocks fractured?"

They were once portions of ledges, and of mountains, and perhaps were cracked, but not parted, when the masses were detached from the main body; and then water percolating through, has, year by year, by freezing, pushed the parts farther and farther asunder. They could not have been cracked and separated by earthquakes where they lie, and they are so numerous, there must have been a general cause.

Art. X.—*Prof.* Locke *on Magneto-Electricity, and Electro-magnetical Machines.*

Med. Coll. of Ohio, Jan. 28th, 1838.

TO PROF. SILLIMAN.

Dear Sir—I mentioned to you in my last letter, some experiments which I was about to make in Magneto-Electricity; I have now finished one series of them, part of which I propose to communicate to the public through your Journal. As it is possible, that some of your readers may not be sufficiently acquainted with the principles of magneto-electricity, to understand fully the apparatus and experiments which I am about to describe, I will take the liberty to prefix a concise statement of a few of the most important elementary principles.

1. Whenever a permanent steel magnet or loadstone attracts a piece of soft iron, it converts that iron into a magnet, so long only as it attracts it, with poles opposite in their character to those by which they are attracted. This takes place when the horse-shoe magnet attracts its "keeper."

2. If the soft iron, thus made magnetical by the attraction of a permanent magnet, be forced off and reversed in position, its polarity or magnetism will be reversed.

3. If the "keeper," or soft iron attached to the magnet be wrapped by an insulated coil or "helix" of copper wire, as a spool is wrapped by its thread, and be applied to, or detached from, the permanent magnet, or be reversed in position so as suddenly to acquire, lose, or change polarity; electricity, at the moment of change, will pass through the coil with its usual characteristics.

4. If the end of a bar magnet be thrust within a coil, or withdrawn from it, an electrical current will be momentarily excited. (Faraday.)

5. Even the feeble polarity excited by terrestrial magnetism on placing a bar of soft iron perpendicularly, and suddenly reversing it, is attended by a sensible evolution of electricity in a coil surrounding that bar. The experiment succeeds still better, by making it in the line of the "dip," viz. with the upper end inclined about 20° to the south.

6. Electricity thus produced by a magnet, is called magneto-electricity.

7. The common magneto-electric machine consists of a wrapped "keeper," revolving almost in contact with the poles of a powerful horse-shoe magnet. This form of the instrument is attributed by Mr. Faraday to Mr. Saxton, now residing in Philadelphia. For figures and descriptions, the reader is referred to the last number of this Journal.

Having premised these elements, I proceed to the subject of my investigation, which was to determine whether more electricity is developed in a coil by passing the included iron abruptly *by* the pole of a magnet, or by passing it *along* from the middle or neutral point of the magnet to the pole, as close as possible to it throughout the whole course, thus exciting the polarity gradually. As I solved the problem with a new instrument which answers several other purposes, I will first describe that instrument and the several uses which I have made of it. I propose to call it the Electro-magnetic Dipping-needle. It was in the first place intended only for class experiments, and consisted of an iron bar eleven inches long, half an inch wide, and one tenth of an inch thick, bound with about twenty five feet of copper fillet, and fastened to a horizontal axis about two and a half inches long, pivotted in two upright brass columns so as to give rotary motion in the plane of the meridian, exactly like the motion of the dipping-needle. On the axis were two copper wheels about half an inch in diameter, insulated, and running in mercury grooves in a piece of ivory, and having the two ends of the copper fillet soldered to them. By connecting the poles of the battery with the mercury grooves it became an electro-magnet, having free rotary motion.

Class experiment of showing the Dip by Electro-magnetism.—The needle being placed horizontally, and the poles of the battery connected with the mercury grooves so as to produce polarity, that end possessing north polarity immediately descended to the line of the dip. The wires being changed so as to reverse the polarity by reversing the current of electricity, the opposite end immediately descended to the same line. Thus to exhibit strikingly the effect of terrestrial magnetism in producing the dip, was all that had been so far contemplated.

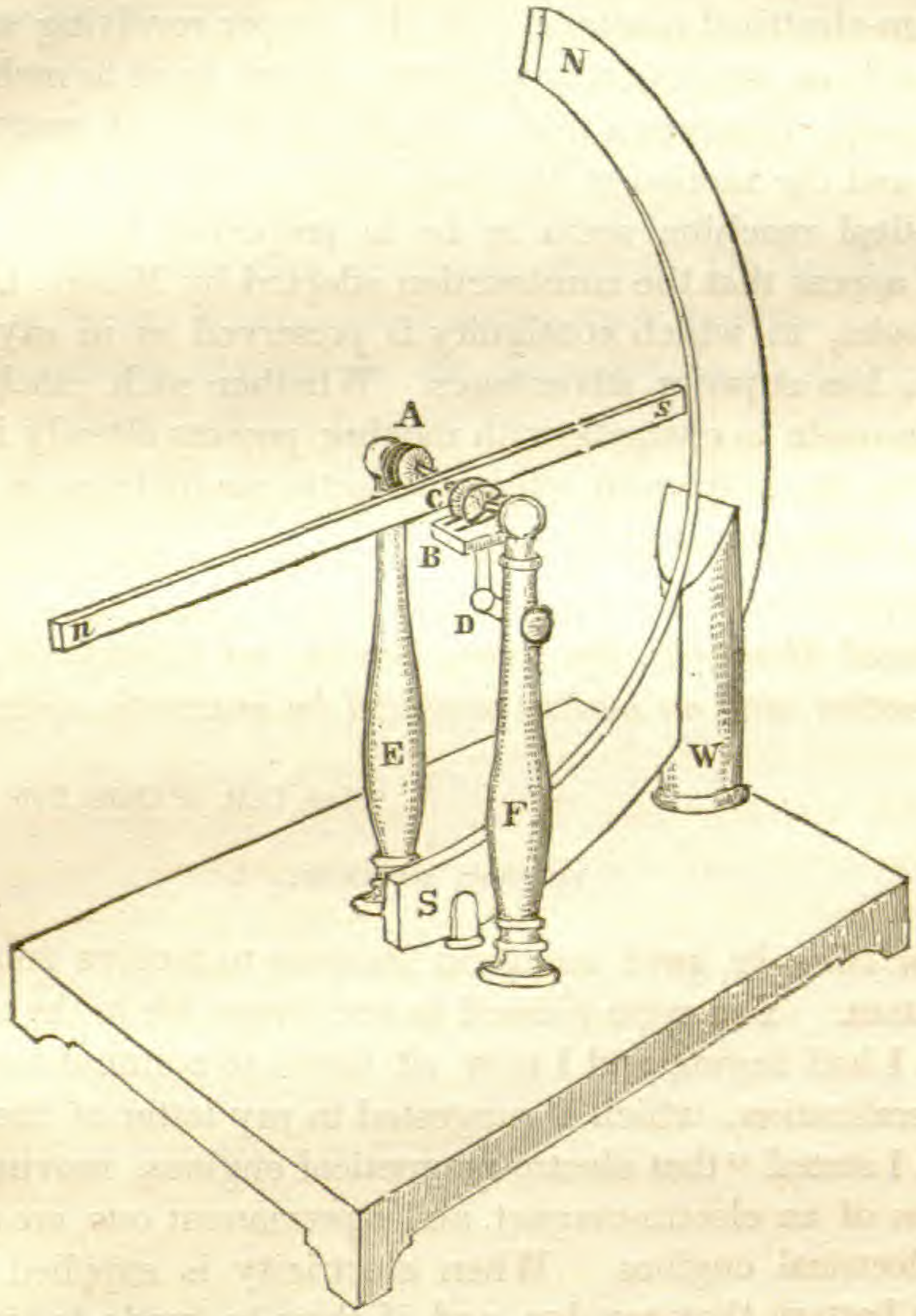
The Dipping-needle made to revolve by Terrestrial Magnetism.—I afterwards attached to the axis four semicircular "cams," running in mercury grooves in such a manner that the needle, by its own motion, produced the necessary reversals, when, upon the application of a vigorous calorimotor, it performed one hundred and fifty revolutions per minute, in the plane of the magnetical meridian, thus exhibiting terrestrial magnetism in a very agreeable manner.

The north end of the earth shown to be virtually a Magnetical south pole.—While the needle was revolving by terrestrial magnetism, I brought the *south pole* of a feeble artificial magnet to the lower point of the dip, so that the pole of the needle passed near to it. The motion was immediately accelerated. On presenting a north pole at the same point the motion was retarded, stopped, or reversed, according to the strength or proximity of that pole.

The south polarity of the north end of the earth still more strikingly exhibited.—I constructed a semicircular steel magnet, the inside diameter of which just permitted the dipping-needle to revolve within it, and attached it in such a manner, that the *south* pole of it was at the lower point of the dip, and bending round to the south had its north pole at the upper end of the dipping axis. The battery being applied, the revolutions were exceedingly rapid, *and in the* SAME DIRECTION *as by terrestrial magnetism.* On reversing the semicircular magnet and bringing the *north* pole at the lower point, the motion was reversed, and CONTRARY to that produced by terrestrial magnetism. In this form, the instrument resembles Messrs. Davenport and Cooke's model, as exhibited last spring in New York, one of their semicircular magnets being removed and the instrument being turned down on one side, so as to bring the diameter of the other into the dipping axis.

Magneto-Electricity produced by Terrestrial Magnetism.—Removing the semicircular magnet and the battery, connecting the poles of my thermoscopic galvanometer with the mercury grooves, and giving the needle a smart whirl by hand, say one hundred and fifty revolutions per minute, I obtained a sufficient quantity of electricity to deflect the galvanometer needle 40° by impulse, and that too against a torsion wire six inches long, weighing one third of a grain. And here I ought to remark, that the mechanism used for the reversal of electrical currents, and consequently of the polarity, when the instrument is used as a self-revolving machine, was precisely what was required in producing deflection by magneto-electricity, for it sent the currents all in one direction, instead of producing the alternate or vibrating motion occasioned by the common magneto-electrical machine. It is curious to observe that electro-magnetical engines, moving by the reaction of an electro-magnet and a permanent one, are also magneto-electrical engines. When electricity is supplied to them from a battery, they revolve; and if they be made to revolve by hand or otherwise, they give out electricity; electricity and motion producing each other reciprocally.

The problem proposed in the first part of this paper, solved by the Dipping-needle used as a Magneto-Electrical Machine.—Does a magneto-electric helix, or coil, act more powerfully by passing the poles of the exciting permanent magnet abruptly, by moving in a plane perpendicular to that in which the magnet lies, or by approaching the pole of the magnet from the middle or neutral point, keeping constantly close to the magnet itself? I restored the semicircular magnet to its place, still keeping the galvanometer connected with the instrument. Here, as the coil-bound iron needle revolved in the plane of the magnet, and close to it, I had one of the conditions proposed in the question. I adjusted the torsion index so that it required sixty revolutions of the iron needle per minute, to keep the galvanometric needle constantly at the point of strongest deflection, viz., parallel to the coils of the galvanometer; then letting it return freely to its place, I found the torsion to have been 62½°. Taking out the semicircular magnet and placing it in a plane, at right angles to that in which the coil-bound iron needle revolved, so that its convex bend presented to the west, and its poles only were presented to the iron needle at the points of the dip, I obtained the other condition of the question, the abrupt production of polarity. I then proceeded as before, to adjust the torsion index until sixty revolutions per minute would evolve electricity enough to hold the galvanometric needle constantly to the point of strongest deflection, and letting it return freely to its place found the torsion to have been 41°. From these experiments, it appears that the deflecting power, by abruptly passing the poles, is only about two thirds as much as when continuous proximity is preserved. In order to determine whether electricity, produced by inversion of polarity, is in the simple ratio of the number of inversions in a given time, or increases in some higher power, I varied the above experiments, and instead of changing the torsion so as to obtain an equal number of revolutions, I let the torsion remain constant and changed the number of revolutions to produce equal deflection, and found that to maintain a torsion of $62\frac{1}{2}°$, required sixty revolutions per minute in one case and ninety in the other, which being nearly in the inverse ratio of the deflecting forces, I inferred that the deflecting forces are as the number of reversals in a given time.



Explanation of the Figure.

n s. The electro-magnetical dipping-needle, fastened to an axis pivoted in the two brass columns, E and F.

A. Two copper circles or wheels, to which are soldered the two ends of the coil which wraps *n s*.

B. A block of ivory having two mercury grooves, in which play the two pairs of semicircles of copper, C.

D. The support of the ivory.

N S. The semicircular magnet, supported by the wooden column, W.

The above experiments have a bearing on the construction of magneto-electrical machines, and may possibly account for the effect of those machines, in which the coil is made to revolve at the side of the magnet* instead of acting opposite to the ends of it. It should be observed, however, that the armature or coil-bound keeper, in the common magneto-electric machine, is so short, that it scarcely leaves one pole before it begins to be in contact with the next opposite one. Yet it seems to me, that a magneto-electrical machine with the keeper revolving within, or at the side of, semicircular magnets, joined so as to make a complete circle, deserves a trial. As the evolution of magneto-electricity and the motion of the same instrument used as an electro-magnetical machine seem to be in proportion to each other, it would appear that the construction adopted by Messrs. Davenport and Cooke, in which contiguity is preserved as in my dipping-needle, has superior advantages. Whether such machines can ever be made to compete with moving powers already in use, or to attain the maximum effect of electro-magnetism, is an interesting philosophical problem.

Additional Remarks, by PROF. LOCKE, *on Electricity produced by motion, and on motion produced by magnetic electricity.*

Med. Coll. of Ohio, Feb. 10, 1838.

TO PROF. SILLIMAN.

Dear Sir—IT gave me great pleasure to receive yours of the 1st instant. You were pleased to encourage me in the researches which I had begun, and I now sit down to communicate to you a generalization, which I suggested in my letter of the 28th, in which I stated "that electro-magnetical engines, moving by the reaction of an electro-magnet, and a permanent one, are also magneto-electrical engines. When electricity is supplied to them from a battery they revolve, and if they be made to revolve, by hand or otherwise, they give out electricity; electricity and motion producing each other reciprocally." I have since examined

* As in those made by Mr. Clarke, of London, and figured in the last number of this Journal.

that subject more particularly, and find the generalization may be extended still further, and include *all* electro-magnetical motion produced by two magnets, or by a conductor and a magnet. It may then be stated as follows: If a galvanic current from a battery produces an electro-magnetical motion in any piece of apparatus, and that battery be detached and a galvanometer substituted in its place, and connected with the same wire or poles of the apparatus; then, on compelling the same motion in the apparatus by hand or otherwise, the galvanometer will be deflected, showing a current of magneto-electricity in a direction opposite to that current from the battery which had produced the same motion. I have tried the experiment with Barlow's "revolving star,"* the "revolving wire" of Mr. Faraday, the "revolving cylinder," with Andrews' revolving magnet, De La Rive's coil, and also with one galvanometer acting upon another.

The revolving magnet is the most simple magneto-electric machine possible. Take a cylindrical straight bar magnet, and holding two wires from the galvanometer, one in contact with one end of the magnet, and the other in contact with the middle, let an assistant twist the magnet round on its axis, the wires slipping on its surface; the galvanometer will immediately indicate the production of magneto-electricity. Or, the lower end of the magnet may be sharpened into a sort of pivot, and be pressed by the breast down into an indentation in one of the conductors, while the contact at the middle and the rotation of the bar are performed without an assistant. With a magnet eight inches long, and one sixth of an inch in diameter, made of watch-maker's wire, nicely pivoted, and turned by drawing the finger across it, I obtained a deflection of my twelve inch galvanometric needle of sixty six degrees, viz. from N. 45 E. to N. 21 W. It is evident that the galvanometer itself is included in this rule. I connected my large thermoscopic galvanometer, by long wires, with the poles of an elegant and delicate Mellonian galvanometer, and then put the needle of the larger one into rotary motion by hand. The needle of the smaller instrument was deflected quite to the west, while the needle of the larger swept one half of its

* This experiment is identical in principle with the mode of Mr. Faraday, the apparatus for which is figured in Brande's Chem. 1836, p. 315.

circuit; and quite to the east, while it swept the other half. Most, if not all, of the elements of this generalization have been before obtained by such distinguished experimenters as Faraday, Henry, Becquerel, Pixii, and others, yet I have not seen it stated in a form so convenient to those who are already acquainted with electro-magnetism, and are just commencing the converse subject of magneto-electricity.

ART. XI.—*Abstract of a Meteorological Journal, for the year* 1837, *kept at Marietta, (Ohio,) in Lat.* 39° 25′ *N. and Lon.* 4° 28′ *W. of Washington City;* by S. P. HILDRETH.

Months.	THERMOMETER.				Fair days.	Cloudy days.	Rain and melted snow.		Prevailing winds.	BAROMETER.			
	Mean temperature.	Maximum.	Minimum.	Range.			Inches.	100ths.		Mean.	Maximum.	Minimum.	Range.
January,	28.00	54	6	48	8	23	-	42	W., S. W. & N.	29.20	29.65	28.75	.90
February,	34.70	62	4	58	15	13	1	80	W., S. W. & N. N. W.	29.25	29.85	28.65	1.20
March,	41.33	70	12	58	19	12	3	-	N. W. & S. E.	29.33	29.75	28.90	.85
April,	45.33	86	24	62	20	10	1	17	N. N. W. & W.	29.15	29.60	28.70	.90
May,	60.50	92	28	64	20	11	4	8	S., S. E. & N.	29.30	29.55	29.05	.50
June,	66.83	88	45	43	16	14	7	84	S., W. & N.	29.20	29.50	28.93	.57
July,	71.17	89	54	35	27	4	5	13	W., N. & S. W.	29.32	29.55	29.10	.45
August,	69.70	88	48	40	21	10	4	84	S., S. W. & N.	29.40	29.60	29.20	.40
September,	62.71	85	41	44	19	11	4	23	S., E. & N.	29.50	29.73	29.28	.45
October,	54.44	80	20	60	22	9	4	25	N. & S.	29.49	29.73	29.25	.48
November,	48.51	71	19	52	21	9	3	30	N., S. & S. W.	29.33	29.88	28.78	1.10
December,	35.57	71	13	58	16	15	3	80	W. & S. W.	29.30	29.70	28.90	.90
Mean,	51.57				224	141	43	86		Mean range, 29.31			

Observations on the year 1837.—The mean temperature of the past year has been a degree and a half greater than that of the year 1836; which, although small in amount, has nevertheless had a decided influence on the season. The heat has also been more equally distributed through the year, and not subject to any great vicissitudes. In winter the temperature has at no time been at zero; and in summer it has not risen above ninety degrees of Fahrenheit.

The average heat for the different seasons of the year has been as follows, viz.

For the winter months, ...	32.80°
" " spring months, ...	49.50
" " summer months, ...	69.25
" " autumnal months, . . .	55.22

The winter has been three degrees warmer than that of 1836; and the autumn five degrees; while the summer has been two degrees cooler, and the spring one degree warmer: thus equalizing the heat, and favoring the growth of the vegetable world. From the cool and wet state of the summer, the wheat crops were ten days later than usual in ripening, and the harvest continued until the fore part of August, while in usual seasons it is completed by the middle of July. The crops of all kinds were uncommonly fine. Indian corn suffered somewhat from the excessive rains in June, thereby preventing its receiving the usual dressings from the plow and hoe.

The blossoming of fruit and other trees was retarded beyond the average period in the spring, but was in the following order: Peach in bloom the 28th of April; pear and cherry, the 1st of May; apple, 5th of May; papaw, black walnut and butternut, the 16th of May; Ribes villosa and Prunus virginianus, the 16th of June.

June and July of this year were remarkable for excessive rains and tornadoes. The bottom lands on all the small streams which rise in the broken country near the Ohio, were overflowed from two to three times, and the crops of grass and grain along their borders either entirely destroyed, or greatly damaged. The loss to the agricultural community was very great.

The amount of rain for the year has been $43\frac{80}{100}$ inches, which is over the mean for this region. The aurora borealis has been seen a number of times during the year, especially on the 25th of January, when it was most grand and splendid; also on the 2d and 3d of June, and 1st of July. We have been visited by no destructive storms of wind or hail, and the year, on the whole, has been a very propitious one to man and the vegetable and animal kingdoms.

Marietta, February 2d, 1838.

Art. XII.—*Geology of Upper Illinois;* by Charles Upham Shepard, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

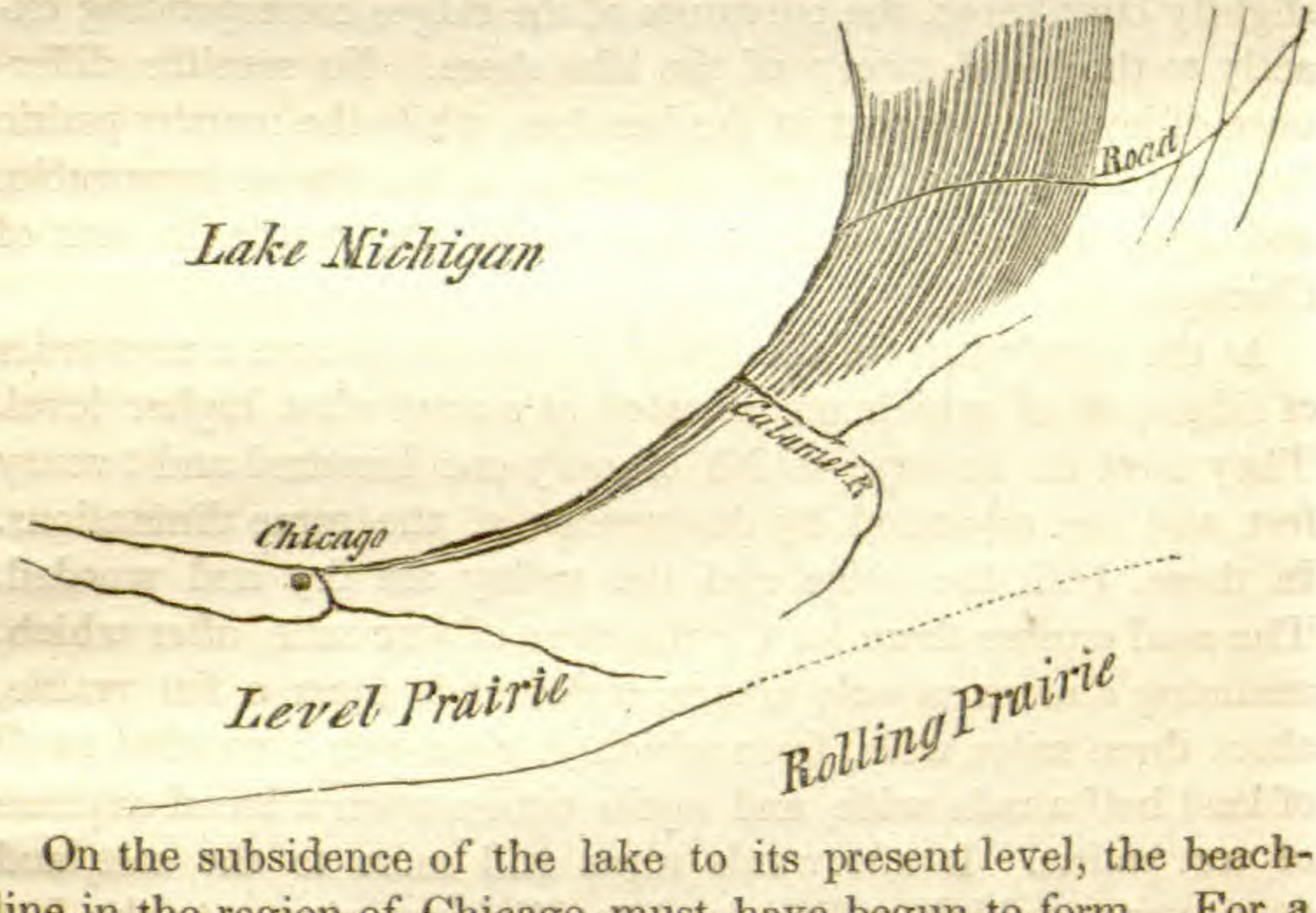
The remarks contained in this memoir are derived from observations made the past season, during a short residence at Rockwell, in La Salle county. Having entered Illinois by the way of Chicago from the northern lakes, I shall commence my observations with some account of this place and its vicinity.

Lake-shore near Chicago.

The western shore of Lake Michigan, above Milwalky, presents no rocks as seen from the lake, being generally level, and but little elevated above its surface. It consists either of a sandy beach, or, as is more commonly the case, of an abrupt bank of blue clay. Chicago is situated on a beach-shore; but the low ridge of sand which formerly intervened between its site and the lake, has in a great measure been obliterated, in order to improve the building lots contiguous to the water. The easterly gales, however, silt up fresh deposits of sand and gravel, which singularly enough for this secondary region, abound in grains of garnet, magnetic iron and epidote, as well as in pebbles of granite, gneiss, sienite and trap. These foreign materials are no doubt derived from primitive boulders scattered over the bottom of the lake.

The city plat scarcely varies from a perfect level, and rises only high enough above the surface of the lake to secure it a bare immunity from inundations during severe gales, and seasons of unusually high water. In the rear of the town lies a broad level tract of wet prairie, still lower than Chicago, being only about ten feet above Lake Michigan. The width of this tract varies from six to nine miles, while it extends as far down the lake as the unobstructed view can reach; and in an opposite direction, follows quite round to the head of the lake, where however it experiences an extraordinary modification from the presence of sand-ridges, which we shall presently describe.

The origin of so extensive a region of lagoon, which is almost completely submerged during the spring freshets, is not easily accounted for; since it is not contiguous to a broad slope of country, or one whose rapid descent might measurably compensate for want of area in giving rise to alluvial deposits. Neither do rivers of any magnitude find their outlet here, which, like the St. Clair where it enters Lake St. Clair, might produce flat plains of considerable extent. Its origin seems to have been connected with a higher level of the lake, when its waters advanced inland quite to the rolling prairie. Nor would this supposition be at all satisfactory perhaps, except for the knowledge we possess of the almost universal, rocky substratum which prevails over the wet prairie, coming for the most part to within a few feet of the top of the ground,—thus giving us the conditions of a hard bottom as forming the shore of the lake, upon which the sediment and wash of the coast was in the progress of ages spread out. The deposit covering this rocky floor, is a horizontally stratified blue clay, on top of which at Chicago, rests a yellowish clayey loam.



On the subsidence of the lake to its present level, the beach-line in the region of Chicago must have begun to form. For a long distance up and down the lake, it is confined to one or two embankments; but on drawing near the head of the lake, by the way of the road to Michigan city, we find the surface of the prairie invaded far inland by a succession of ancient beaches, formed with the utmost regularity as to width and height, as well as conformity to the existing shore of the lake. I shall describe them as they came into view on the stage road, endeavoring to render their character the more intelligible by means of the above sketch, constructed from recollection. Leaving Chicago, the road for about fifteen miles is on the beach, or just behind it, on the border of the level prairie. It then begins to diverge from the shore, and passes obliquely across a succession of ridges, each resembling a turnpike in its rounded form. These ridges are wooded, while the intervals between them consist of wet marsh, or level prairie. Advantage is taken of the ridges as far as possible for the course of the road. After proceeding a number of miles in a south-easterly direction, the road takes a south course at right angles to the coast, and runs for a distance of five miles over about fifty of these ridges. They vary from four to ten rods in width, each one, however, preserving with exact uniformity its own breadth, and separated from each other by intervals of from six to forty rods. When midway between any two beaches, the eye is presented in opposite directions with an almost interminable vista, whose bounding lines of trees are perceived to be slightly curvilinear, the curvature of the ridges corresponding exactly to the broad sweep of the lake shore. No sensible difference of level is apparent in the beaches, while the marshy prairie between them is so low and sunken as to be almost impassable, and apparently corresponds in level with the prairie in rear of Chicago.

At the termination of the above series, commences a new order of ridges, all of which are situated at a somewhat higher level. They have an average width of only one hundred and twenty feet, and are separated by depressions of the same dimensions. In these, both the ridge and the valley are dry and wooded. The road crosses them for the distance of one mile, after which, assuming a more easterly cousre, it descends upon a flat prairie, about three miles wide, from which it rises over a wooded swell of land half a mile wide, and again comes upon a broad expanse of wet prairie. It afterwards turns still more to the east, and continues over high rolling land to Michigan city. As the last fifteen miles of the ride was by night, I cannot record the remaining features of the route.

The succession of beaches described, would appear to have been occasioned by the action of northerly winds operating on the whole range of the lake, thereby producing an accumulation of water in this region, as well as a strong impulsive action upon the bottom of the lake from the motion of the sea towards the shore. In explanation of the existence of but a single beach-line at Chicago, it may very obviously be remarked, that an easterly storm, (the only one that could here produce any effect,) acting simply on the breadth of the lake, would have very little power in giving rise to beaches, compared with gales traversing the entire length of such an immense body of water. Besides which, the line of coast on the western shore is so broad as to prevent the heaping up of the water to any extent, compared with what must take place at the confined extremity of the lake.

It will be an interesting inquiry to ascertain if possible, the length of time requisite for forming a single beach at the head of the lake, since, if this could be settled, we should have the elements for the chronological computation of all the ridges belonging to the first system, above described. Could this be satisfactorily made, the era of the second series might perhaps be found capable of an approximative determination, as well as that of the third and fourth belt, both of which correspond in outline to those first mentioned, and are therefore plainly of lacustrine origin.*

Before dismissing this very striking appearance of the coast connected with the action of the lake, I must be permitted to express the opinion, that a careful examination of the country bordering on the Kankakee and the Des Plaines valleys, will afford evidence of the occasional overflow of the lake at ancient periods, in those directions. It is a well known fact, that the lip of the lake, near its south-western extremity, is at one place so depressed as to permit canoes to pass from the head waters of the Chicago river across to that of the Des Plaines. Nor would the circumstance cease to be an alarming one to the safety of this portion of country, except for the fact that the border to the lake is every where composed of a firm limestone. If then the waters of the lake are still capable of interlocking with those of the Des Plaines, it is clear that at a higher level of the lake, considerable descents of water upon the low country must have taken place. Traces of such incursions appear to exist on the stage road from Chicago to Ottawa, in the general direction of the swells of land on the rolling prairie, and more particularly in the

* How much farther inland these formations extend, I cannot say; but I should not be surprised to learn, that they prevail under various modifications, quite back to the summit level which turns the waters of the country into the Kankakee, a distance of fifteen or twenty miles.

width and depth of the Des Plaines valley, and the immense diluvial accumulations it contains below Juliet.

Route of the Michigan and Illinois Canal.

No internal improvement in the country will surpass in commercial importance the canal which is to unite the waters of Lake Michigan and Illinois river, since it will complete the navigable route from the Gulf of St. Lawrence to the Gulf of Mexico, and open a water communication, so to speak, from the Rocky mountains to the Atlantic coast. The cost of the undertaking in some degree keeps pace with its importance; for although neither the line of its extent, nor the amount of its lockage, is great, still the difficulty which grows out of obtaining an adequate supply of water for the summit division of the route, renders it the most expensive work of the kind ever projected. It is indeed a fortunate circumstance as affecting the certainty of its completion, that the means for defraying its construction are already in the possession of the State, the general government having given the alternate sections of land for five miles on each side of the canal to the State of Illinois, to be appropriated to this important undertaking.

Before speaking of the geological features of the country over which the canal passes, a brief sketch of the route it takes, and the nature of the difficulties it has to encounter, will be given, inasmuch as such a notice will serve in some degree to explain the topographical features of the region.

The canal passes up the south branch of the Chicago river a distance of four miles, thence over the level prairie in a direct line eight miles, to the valley of the Des Plaines river, down the valley of this stream, past the mouth of the Kankakee, to the banks of the Illinois, whose border it pursues for a distance of fourteen miles below Ottawa, where it enters the river. Its length is one hundred and two miles; and it is constructed with a breadth of sixty feet at the water surface, and a depth of six feet. The lockage is all downwards, and amounts to one hundred and forty two feet.

Before adopting the present route, an attempt was made to obtain a supply of water for the summit division, from the Des Plaines, the Calumet, and the Fox rivers; but on running a level from the Des Plaines, nearly opposite the mouth of Portage lake, to the Fox river at Elgin, (thirty-five miles south of the State line,) where the surface of the stream is one hundred and fifteen feet above Lake Michigan, it was found, that the intervening ridge had an elevation of fifty or sixty feet, the cutting down of which would be too expensive to justify the expedient. The commissioners were accordingly led to adopt the magnificent plan of making Michigan the feeder to the canal. The first level thereby becomes thirty-four miles in length, with an average depth of cutting of eighteen feet, which is principally in solid rock. The depth of six feet of water has been decided on, in order to secure to the canal a constant depth of four feet during the fluctuations of tide in the lake, occasioned by high winds. A declivity is given to the bottom of the canal, of one tenth of a foot per mile. There are two locks situated at the end of this level, having a lift of eighteen feet. Above the first of these, for the distance of three quarters of a mile, the canal has a width of one hundred and twenty feet. The estimated expense of this level is $5,871,324.

The middle division of the work extends thirty-seven miles from the head of the first lock. It has six locks, with an aggregate lockage of fifty-seven feet in the first four miles, for the whole of which distance the route is over little better than solid rock, and is consequently very expensive. Another difficult portion of this division commences about two miles below the crossing of the Du Page, and extends nearly to Dresden, below the mouth of the Kankakee. The bluffs here are from one hundred to one hundred and fifty feet high, and approach so near the river as to be washed by it, which renders it necessary to construct the towing path wholly or in part, in the river, for a distance of more than two miles; consequently, an expensive protection will be demanded to defend the work from the ice-floods of the Kankakee.

The western division has sixty-eight feet lockage, and is twenty-nine miles in length, exclusive of four miles of the Fox river feeder. From the first lock, below Ottawa, to the termination of the canal at La Salle, (on *section* fifteen,) the route lies through much wet ground, being along the bottoms of the Illinois, just under its northern bluff. As these lands are overflowed during the spring-freshets, the level of the canal requires to be considerably raised, and to be guarded by strong embankments.

The construction of a canal-basin, at the termination of the canal, with an area of five and a half acres, whose bottom is to be considerably elevated above the present level of the bottom-lands, serves to render this division of the undertaking also, very expensive. The cost of the entire canal, as estimated according to the report of the commissioners, is $8,654,337 ; but it is admitted that the estimate is too low, it being generally believed that the work will not be brought to a state of completion under ten millions of dollars.

The geology of the chief portion of the route above described, is exceedingly simple and uniform, the great rock formation of the country being the *magnesian limestone ;* at least, this is the rock from the commencement of the canal, (four miles from Chicago,) nearly to the mouth of the Kankakee. It also reappears west of the Fox river, as will presently be pointed out, and enjoys a wide distribution probably throughout the whole of Upper Illinois and Wisconsin. A good opportunity for examining its character occurs near Chicago, where the excavations have already been commenced. It here rises quite to the surface of the prairie. It is imperfectly stratified, with an evident dip of 10° or 15° to the north-west. Its color is light grayish white, with a frequent shade of yellow. It is compact in texture, and often slightly cellular or cavernous—a peculiarity which seems to be connected, for the most part, with the profusion of organic remains existing among its materials at the period of its formation. The following is a brief list of the fossils which fell under my observation at this locality: two species of *Orthocera*, a *Turbo* (one and a half inches in diameter) with a depressed spire; a large species of *Pectunculus ? ;* a *Terebratula*, (with very prominent ribs, and but few in number ;) two species of *Ammonites ;* a *Caryophyllia*, and a *Favosites.** Some of the beds are wanting in fossils, and occasionally the rock puts on a shistose or slaty structure, in which case it forms a valuable flagging-stone, which is already employed to some extent in Chicago.

The same rock reappears in the bed of the Des Plaines, twelve miles from Chicago, on the road to Juliet, as well as near the sur-

* Several of these species I am persuaded are new ; but I defer a particular description of them until I shall obtain an additional supply of specimens, promised me by Dr. BRAINARD, of Chicago.

face of the prairie at Plainfield, nine miles from Juliet, and very abundantly also at this last place. The beds at Plainfield and Juliet, however, are not rich in fossils. The rock is quite close in its structure, and where acted on by the weather, of a yellowish buff color, much resembling the lithographic stone of Sohlenhofen, in Bavaria. The quarries at Juliet, afford it in very even, distinctly stratified layers, whose position is nearly horizontal, their thickness being such as to render it a very valuable building material. I noticed one variety of the rock at this place, which had been thrown out in sinking a well, the appearance of which was very analogous to that of true dolomite, (the gurhofian variety.) Its color is a grayish white, with a tinge of green; throughout the masses were crevices and openings, whose walls were lined with transparent crystals of quartz.

The magnesian limestone continues very abundantly in the bed of the Des Plaines, below Juliet, and recurs frequently on the road across the prairie to Holderman's grove, twelve miles east of Ottawa; after which, no more rock was observed until I reached the bed of Fox river, just above the village of Ottawa. At this point, we strike upon the coal formation.

Of the existence of formations more recent than the magnesian limestone in this region, my own observation permits me to add nothing, beyond what has already been stated under the head of the lake shore near Chicago. By the kindness, however, of Mr. W. B. Ogden, the mayor of Chicago, and Col. Thornton, president of the board of commissioners for the canal, I am enabled to annex some additional particulars. The excavations for the canal on the wet prairie give the following superficial formations: one to two feet, black vegetable mould, and two to six feet, yellow, clayey loam, resting on blue clay. On reaching the Des Plaines, the sections give, in the first place, one foot of black mould; secondly, four feet, yellow sandy clay; thirdly, one and a half feet clean black sand, and lastly, twelve feet "vegetable formations with shells."*

The occurrence of boulders in the rolling prairie had often been mentioned to me, under the significant and original appellation, bestowed upon them in this region, of "lost rocks." Their

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* From the same source, I learn that the magnesian limestone beneath these deposits often abounds with vertical fissures, filled with clay, from one inch to several feet in breadth.

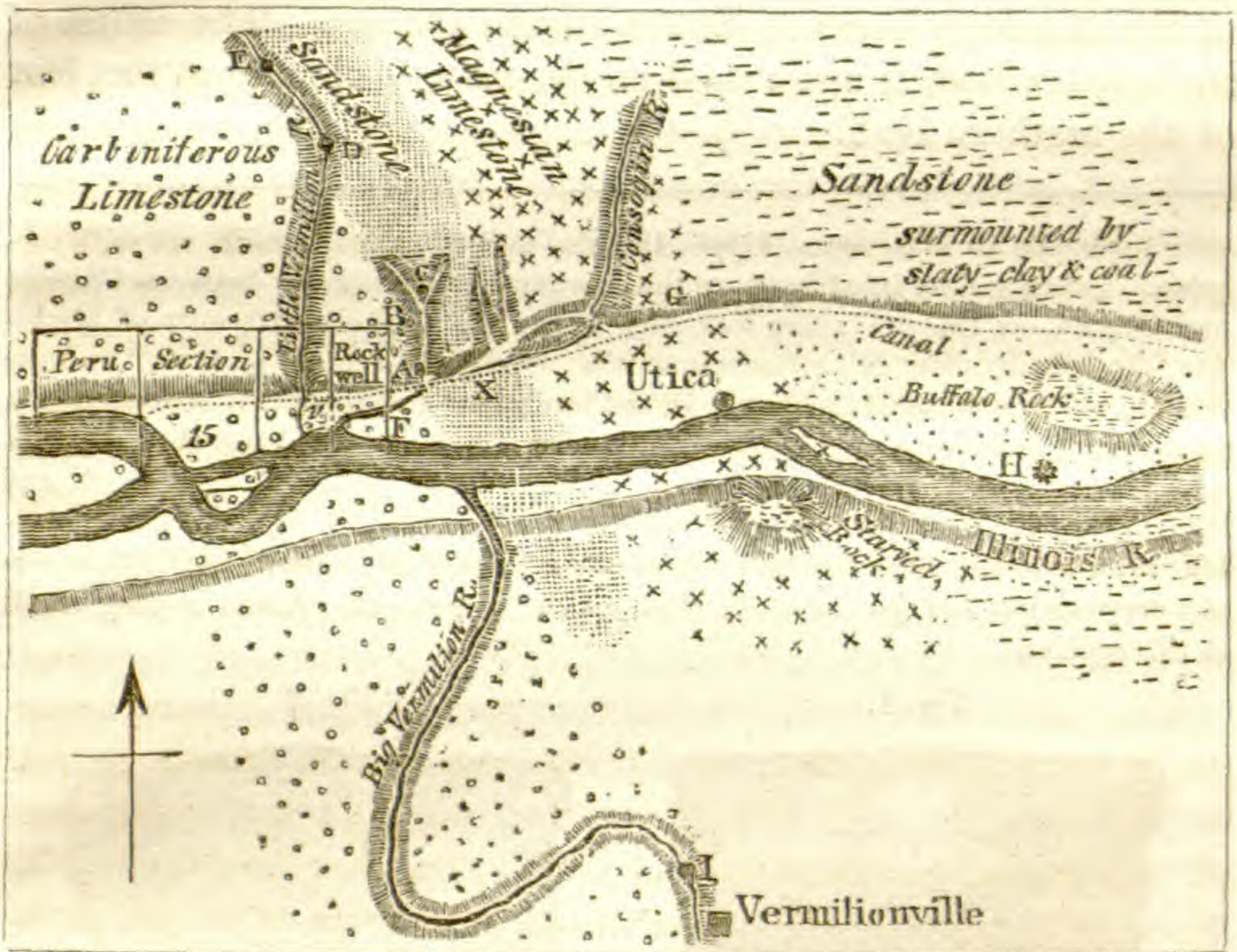
abundance, however, surpassed my expectation. They first attracted attention soon after leaving the twelve-mile house from Chicago, and appeared to form a belt between a quarter and half a mile in width, whose direction was north-west and south-east. In crossing this belt, it was uncommon to pass many rods without encountering a boulder. In general, they were rather more than half buried in the soil. They varied in diameter, from ten inches up to three feet, and belonged to the following species of rocks; granite, granitic gneiss, and trap. A few detached boulders only were noticed between this deposit and Ottawa. Soon after leaving this place, however, another band or patch of them was passed. They were here scattered over the Illinois bottoms so plentifully, as to prove objects of no inconsiderable annoyance in the road. Two miles below this locality, likewise, a number of large masses were seen. Others were occasionally met with south of this point, out upon the rolling prairie, in the direction of Vermilionville. What serves materially to heighten our interest in these boulders is, the consideration that they must have been transported over a distance of between two and three hundred miles, since the southern shore of Lake Superior is the nearest region affording rocks of a similar character, *in situ.*

Coal Formation.

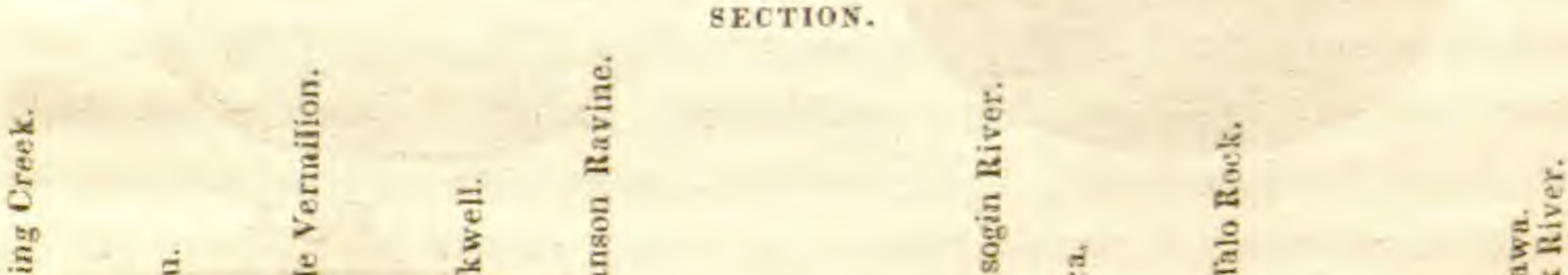
The northern boundary of the coal formation in Illinois, I cannot define with precision, not having been able to explore its limits in detail. As the result however, of inquiries from intelligent persons and such observations as I was permitted to make in the region of the Illinois river, I am led to adopt the following as its general outline :—a line commencing just north of the mouth of the Kankakee and running west, across the Fox river, about eight miles north of Ottawa, and the Little Vermilion, five miles north of Rockwell. Whether it still continues without interruption, across the country to the mouth of Rock river, a distance of about one hundred miles, is uncertain. Coal is found on Green river, however, at a distance of twelve miles above where Rock river enters the Mississippi. It is possible, instead of thus crossing the elevated country to Rock river, that the border of the coal-field simply sweeps round by Princeton, ten or fifteen miles west of Hennepin and Henry, and then descends the Illinois river at about the same distance from its western bank. From the mouth of the Kankakee, the coal passes off in a south-easterly direction to the Wabash, in Indiana, at a point several miles above La Fayette.*

We are now prepared to enter upon a more minute description of the geological features of the country, contiguous to the western termination of the canal, where the coal in particular is largely developed. To render the subject the more easily intelligible, a sketch of the region, together with a cross section exhibiting the north bluff of the Illinois river, from Ottawa to Spring creek, are subjoined.

MAP.



SECTION.



* In speaking of the boundary of the coal-field, I wish to be understood in general, as treating of its line of junction with the magnesian limestone. Whether the coal-beds run out against this rock, or are continued beneath it, no facts have yet been observed in this country sufficient to show. The extent of the magne-

Rockwell is situated on section fourteen, which is next to the section against which the canal terminates. The width of the Illinois valley varies in this vicinity from one to two miles. Its bluffs, which are generally of naked rock, and nearly perpendicular, are between one hundred and one hundred and twenty feet in height. Their course and position with respect to the channel of the river, may be seen upon the accompanying map. The bottom of the river in the vicinity of Utica is solid rock, with which also the bottom-lands are underlaid at very partial depths. Indeed, the strata often attain the surface over considerable breadths of the meadows between Rockwell and Ottawa. The course of the canal, which is also traced on the map, is directly at the foot of the northern bluff.

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sian limestone in Wisconsin, Upper Illinois, and Missouri, struck me with surprise. I observed it, in addition to the country already noticed between Chicago and Ottawa, as the prevailing formation about the northern extremity of Michigan, the islands about Michillimacinac, the mouth of Green bay, as well as near Navarino, at the head of the bay. In the last mentioned region, it abounded in a species of *Producta*, which I take to be undescribed, and shall therefore denominate the *incurvata*. Specific character. *Semi-circular: hinge nearly straight and the length of the shell; with fine longitudinal striæ; flattish; edge crenated; shallow valve concave, basal margin incurved; muscular impressions and hinge-process very distinct.* (Figs. 1 and 2.) The space between the valves is very small in this species.

Fig. 1.

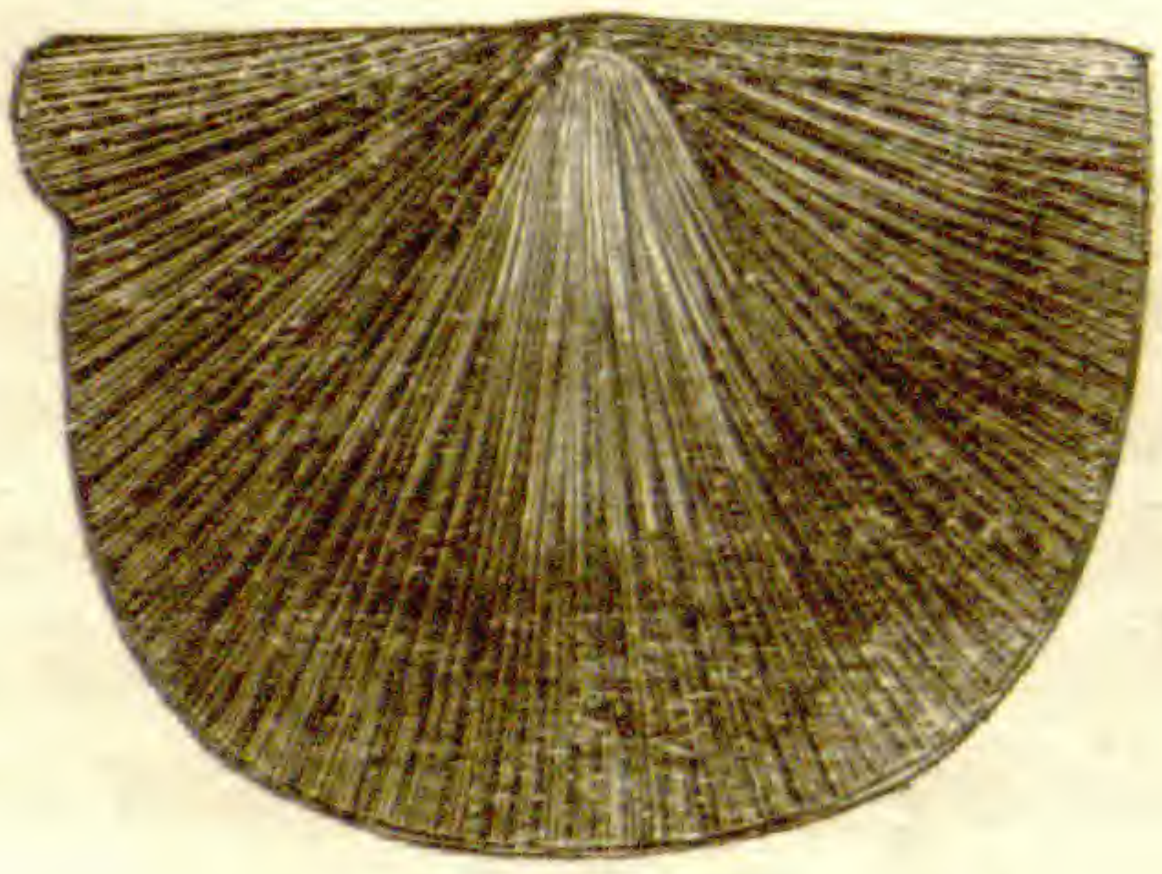


Fig. 2.

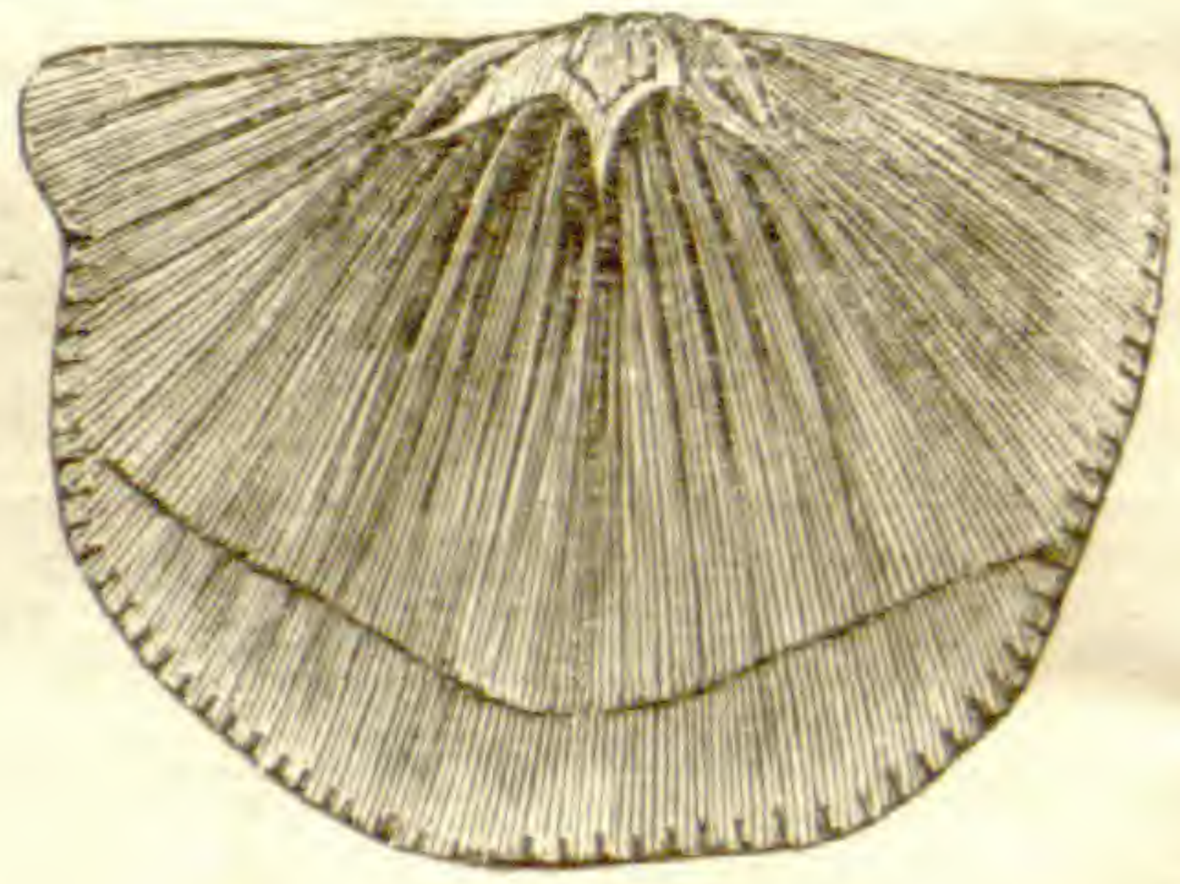


Fig. 3.

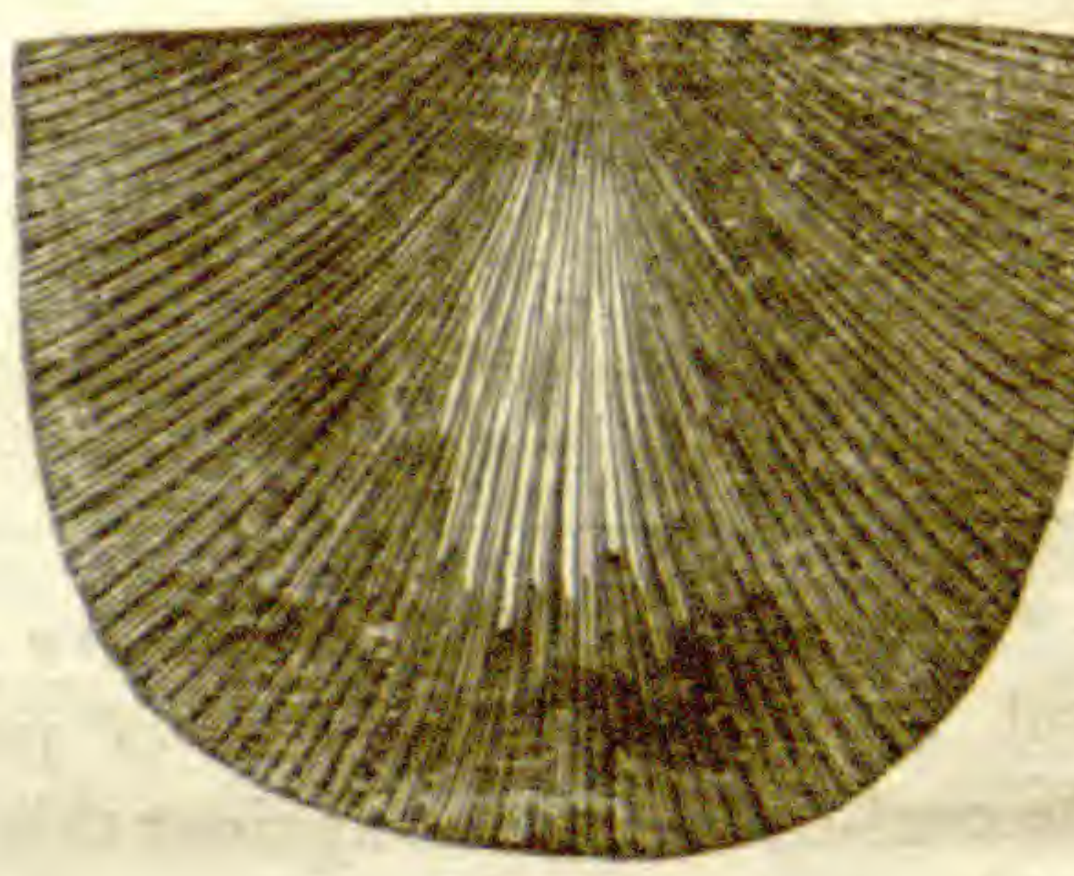


Fig. 3, represents a second species of the same genus, which is also probably new. The large valve is deep and very gibbous. Its striæ are distinct, and resemble the ribs of the Pectens.

Along with these species occurs a polypifera, apparently belonging to the genus *Flustra*.

To the traveller who enters the Illinois valley at Ottawa, after having been satiated with the boundless views of rolling prairie, no scenery can be more novel and enchanting, than that which he beholds between the mouth of Fox river and the town of Rockwell. The first striking object he encounters after leaving Ottawa, is Buffalo-rock, an interesting plateau, whose top corresponds in level with the high prairie, and whose sides are equally precipitous with the main bluffs of the valley. The area of Buffalo-rock is about one square mile. The river sweeps directly past its southeastern base; while the canal, as will appear from the map, is carried along between it and the north bluff of the valley. At a distance of about a mile from this insular elevation of prairie, and directly by the road-side, is situated one of those beautiful mineral springs (of whose chemical constitution we shall presently speak,) for which this part of Illinois is remarkable. Two springs break out within a distance of a rod, both of which occupy the same basin-like depression, whose surface is about five feet lower than that of the adjoining bottoms. The larger of these two springs discharges at least ten gallons of water per minute, and rising through a bed of fine white sand, (which it keeps in constant agitation,) forms a very striking object. The water from the springs, after flowing a distance of fifteen rods over the bottoms, falls into a rocky channel worn out of the sand-rock, along which it rapidly descends for a couple of rods farther, where it enters the river, but not before it has received the water of another spring whose issue is from between the sandstone layers. Two miles after leaving the springs, the traveller is opposite the tragically famous *Starved Rock*.* It forms a part of the bluff on the south side of the Illinois, projecting promontory like, quite into the bed of the river, and rising twenty or thirty feet higher than the average level of the bluffs. Its face towards the river is perpendicular, and even overhanging. On some of the maps of the county its height has been stated at two hundred and fifty feet, which is certainly incorrect,—it having recently been measured by Mr. O. W. Jerome, civil engineer of Rockwell, who finds its elevation one hundred and forty feet above the level of the Il-

* About one hundred years since, a ferocious tribe of Indians, being driven by their enemies upon this projecting point of the Illinois bluff, were reduced to submission by actual starvation.

linois. The prospect from this point is inimitably fine. A long stretch of the valley, both up the river and down, is at full command. The river here flows over a level rocky floor, and the water is so clear as to enable one to discern the large fish swimming quietly along upon its bottom ; while at no great distance, flocks of wild geese, in the most unalarmed manner, occupy the bosom of the stream. A large island, wooded with an almost tropical denseness and luxuriance, is situated in the river nearly opposite to the rock, which greatly adds to the beauty of the scene. Another point of interest occurs in the topography of the valley just before we reach Rockwell. It is where the Consogin river cuts the bluff and enters the meadows. Its present issue is at right angles to the course of the valley ; anciently, however, it did not find its exit so high up the valley, by more than half a mile, but on reaching its present mouth, it turned down the Illinois, (still within the high prairie,) and continued nearly to Camp-rock, (X on the map.) The wearing away of the bluff, by the waters which excavated the Illinois valley, in progress of time, however, furnished a new outlet to the Consogin, in consequence of which, a long ridge of prairie stands insulated upon the bottom-lands, whose shape and contiguity to the main bluff render it a conspicuous object. It has been called Chimborazo, and the idea of building upon it a town, as well as upon Buffalo-rock, has even been entertained by some individuals in this region ; but of both these situations it may be said, that the inducements to occupy them are rather such as are connected with fine views of valley scenery, than with the actual facilities and conveniences of life. The canal passes directly under the south side of Chimborazo, though it is said to have been for a time debated, whether the better route would not be in the ancient channel of the Consogin. It is, moreover, a singular circumstance relating to the Consogin, that on entering the valley, it soon loses itself, and does not rise into view until it has passed Camp-rock, (X on the map,) when it begins to re-appear in a considerable sheet of water, especially as it enters the town of Rockwell. It here forms, directly under the bluff, a narrow lake, five or six hundred feet in length, by more than one hundred in width, which in seasons of the greatest drought has a depth of about six feet. I am the more particular in describing the situation and dimensions of this strip of water, because, from its particular location in relation to the Illinois river and the canal, it is intended, by means of a short cut across the bottoms in the direction of the dotted lines, (*v* on the map,) to admit boats from the river; and thus at a trifling expense, to convert it into a steam-boat basin. An *improvement* of this nature will have its value greatly enhanced, arising out of the mineral resources so remarkably accumulated at this point, the future development of which is destined to confer upon Rockwell numerous commercial and manufacturing advantages.

It is within a few rods only of the eastern extremity of the Consogin basin, that the largest out-crop of coal in the valley of the Illinois occurs. By a reference to our map, a ravine will be noticed as descending from the high prairie, at a distance of about seventy rods from the eastern boundary of Rockwell. This is the Swanson ravine. Its bed is entirely within the coal strata, and very nearly conforms in direction to their basseting edges. The slopes of the ravine consist superficially, to a considerable extent, of soil and loose materials. Slight excavations however, are all that is requisite to reveal the strata, which, on the west side at least, are uniform and continuous up the valley. Commencing at the mouth of the ravine on its western side, we have a good view of the position of the coal-bed, where it has been partially laid open, for supplying to some extent fuel to the vicinity, especially for blacksmithing purposes. The following section was taken at the locality, from the top downwards:—

50 to 60 feet of the superior slope, concealed by soil.
4½ feet gray marly slate-clay.
4 inches argillo-calcareous iron ore.
8 " gray marly slate.
1 foot 4 inches limestone.
1 " 4 " black bituminous slate.
2 feet gray marly slate-clay.
6 " coal.

This brings the coal-stratum nearly to the bottom of the ravine, in which however, a well has been sunk, thereby making us acquainted with the strata for a depth of at least thirty feet more, but showing only alternations of blue and gray slate-clays. The dip of the coal and its associated layers is W. S. W. at an angle between 15 and 20°.

As the State owns the section on which this coal opening occurs, no farther labor has been expended with a view to trace the bed up the ravine, until we ascend to the point B, on section twelve. Here we find a layer of coal two feet in thickness, forming the lowest part of the ravine, and traceable by means of a little gully descending from the east slope of the ravine, quite up to the level of the high prairie, a distance of eight or ten rods. In addition to this stratum, there shows itself at B, on the western slope of the Swanson ravine, and thirty feet above its bottom, a bed of coal four feet in thickness. Both the beds here described correspond, in direction and dip, with the main bed at the mouth of the ravine, nor can it admit of a reasonable doubt that the upper bed (whose thickness is four feet) is a continuation of the great deposit first mentioned.

Still higher up, at C, where the ravine forks, the thick bed has been uncovered in two places, a few rods only apart. The coal here occupies the bottom of the valley, which, it must be understood, is situated at a level at least forty feet higher than at B. In the banks near the openings at C, occur frequent indications of the former combustion of the coal, in the abundance of brick-red slate and porcelain-jasper. Indeed it appears not improbable, that the entire ravine owes its origin to the inflammation of a body of coal near its out-crop, to which water, the exciting cause of combustion, must have found an easy access. In this way a channel may have been formed, which the spring freshets have widened and deepened, until the ravine has been brought to its present dimensions.

Among the loose materials accumulated against the edges of the strata in the upper part of the ravine, I observed an abundance of gypsum, in small white grains, resembling common salt, blended with argillo-marly soil; also frequent balls and kidney-shaped masses of argillaceous iron-ore.

Both branches of the ravine are shallow at C, and in running northward, soon attain the general level of the prairie; after which, the strata of course become concealed by the soil. But by taking the direction of the out-crop to the coal-bed, which is northwesterly, and proceeding a mile and a half across section eleven upon section two, the sandstone which dips under the coal-bed of the Swanson ravine, reappears in slightly cohering strata, and still farther, by a distance of about half a mile, in the same course, at E, we strike the banks of the Little Vermilion, the east bluff of which, for some way, is composed of the identical grit of

Camp-rock, whose direction and dip it likewise exactly imitates. The opposite side of the river, (at E,) moreover, offers us apparently the entire series of slates, shale, and coal, which overlie the sandstone in the Swanson ravine, though the coal has as yet been fairly laid open only at two spots, D and E. At both these places, the thickness of the coal-stratum is four feet. No doubt, therefore, can reasonably be entertained of the unbroken continuity of the coal across section eleven to the Little Vermilion on sections two and thirty-four. The southeast angle of the latter section touches the northwest corner of the former, as the sectional maps of the region will show. In following the river above E, no farther traces of the coal-rocks, are discovered. On the contrary, the magnesian limestone soon takes their place and forms the bed and banks of the Little Vermilion, and of its tributary, the Tomahawk.

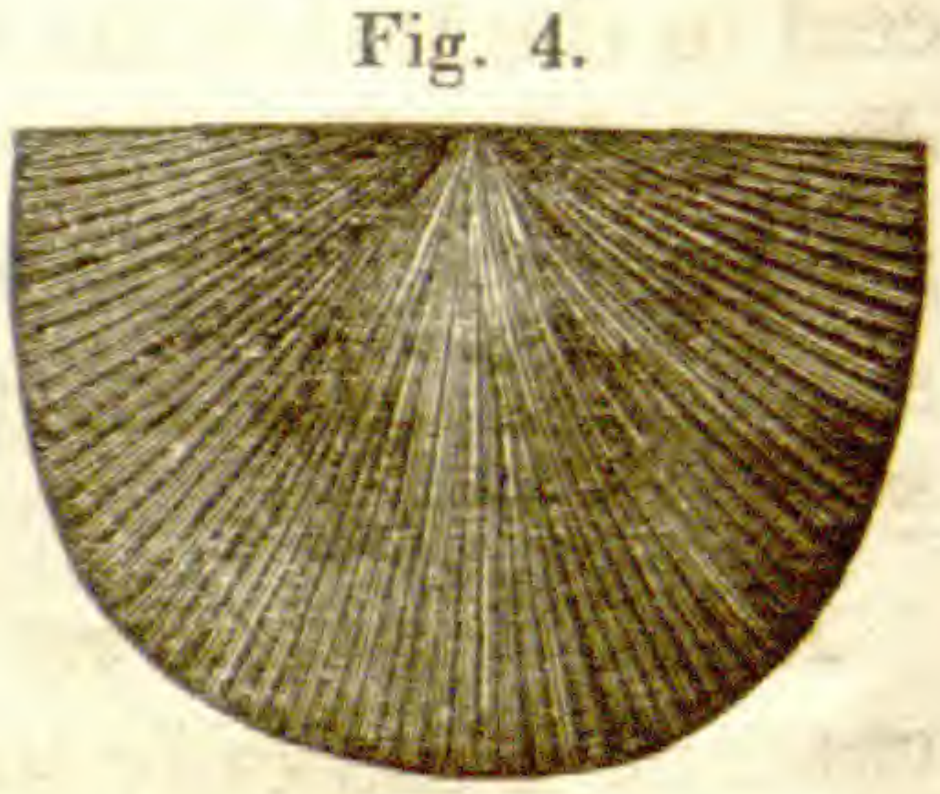
Having satisfied myself of the general direction of the coal north of the Illinois, it became a matter of interest with me to learn whether it obeyed the same law in an opposite direction, viz. in its extension towards the southeast. That this is the fact soon became apparent. The bluff on the south side of the Illinois, a little east of where the Big Vermilion enters, exhibits the same formation as Camp-rock. But no rocks manifest themselves in the line of direction from this place, until we reach the banks of the Vermilion at I, near Vermilionville. Here we recover the coal in the bed of the river, presenting its characteristic thickness, dip, and leading associates, with the exception of the underlie of sandstone, which, if existing, is concealed by loose materials and soil. The coal has the same thickness as at the mouth of the Swanson ravine.

As my travels were extended no farther in the direction of the outcrop, I can only state what I was able to learn from others respecting its course beyond Vermilionville. Abundance of coal is said to occur at several points for ten or twelve miles up the river, all of which may reasonably be considered as belonging to one and the same stratum. Indeed it is not impossible that future researches will prove the extension of the present outcrop quite across the country, even to the Wabash, in Indiana.

The coal at Vermilionville is situated directly in the bed of the river, on its west side, at the base of a very steep portion of bluff, which is at least seventy-five feet high. It consists of five or six alternations of black bituminous shale, with a dark gray, friable, slaty marl, the series being surmounted by a heavy bed of encrinal limestone. The shale is in beds of between three and four feet in thickness, while the clayey marl-strata are considerably thicker. The shale-stratum next the coal, embraces a layer of limestone about ten inches thick. Large balls of limestone also, of a very peculiar appearance, are common throughout the shale. They may be described as flattened spheroids, extremely regular in shape, smooth, and of a black color. They are arranged between the layers of the slate, with their flat surfaces coinciding with the stratification. Veins of calcareous spar, tinged brown by petroleum, divide their surfaces off into quadrangular and pentagonal shapes, thereby imparting to the balls a tolerable resemblance to certain tortoises, petrifactions of which animals they are considered to be, by many people of the neighborhood. In some instances, these balls, which are in reality a species of *septaria*, have a diameter of between two and three feet. The dip of the bed at this place, is about 10° or 12° to the W.

The rock on which the coal rests, as may be seen a little higher up the river, is a light gray, highly crystalline limestone. It occasionally embraces small seams and irregular shaped masses of calcareous spar, and is generally so rich in bituminous matter, as to afford the odor of this substance on friction. But three fossils attracted my notice in it: these were a trilobite, (a species of *Calymene,*) a *Flustra*, and a *Producta*, which so closely resembles a pecten in general figure, as well as in the delicacy and distinctness of its ribs, (56 to 60 in number,) that, believing it to be new, I shall call it the P. *pectenoidea.* (Fig. 4.) The two latter fossils are very common. Of the tribolite I saw but a single sample, and that was presented me by Rev. Mr. Elliot, of Vermilionville. The bluffs on the east side of the river, in the vicinity of Elliot's dam, abound in the relics of the spontaneous combustion of coal, such as hardened slate and detached grains and crystals of gypsum, mingled with clay and marl. It is in the bed of the river near this place, also, that several mineral springs occur, a more particular notice of which will hereafter be given.

Fig. 4.



Before entering into additional details respecting the coal, it will be proper to say something *farther* of the horizontal formation of Rockwell and the Little Vermilion river, beneath which the coal of the Swanson ravine dips. They are well understood, from an inspection of the western bluff of the Little Vermilion, at the saw-mill near the river's mouth. We have here the following arrangement, from the top downwards:—

12 feet limestone.
4 " blue and red slaty clay.
12 " limestone.
1 foot blue slaty clay.
2½ feet black bituminous shale.
4½ " blue slaty clay.
3 inches coal.
5 feet blue slaty clay.
30 " limestone.

In sinking wells in the town of Rockwell, fifty rods back from the bluff, where the surface is about fifty feet higher than it is immediately at the top of the bluff, a succession of clay and marl beds is penetrated before reaching the stratum of limestone first mentioned in the foregoing arrangement. The marl has a dull red color, and is very friable,—falling to pieces, or slacking on a short exposure to the weather. It contains frequent impressions of a species of *Pecten*, (Fig. 5.) and of a second bi-valved shell, (Fig. 6.) much resembling a *Unio*, though it is quite possible it may be a *Mya* or a *Tellina*.*

Fig. 5.

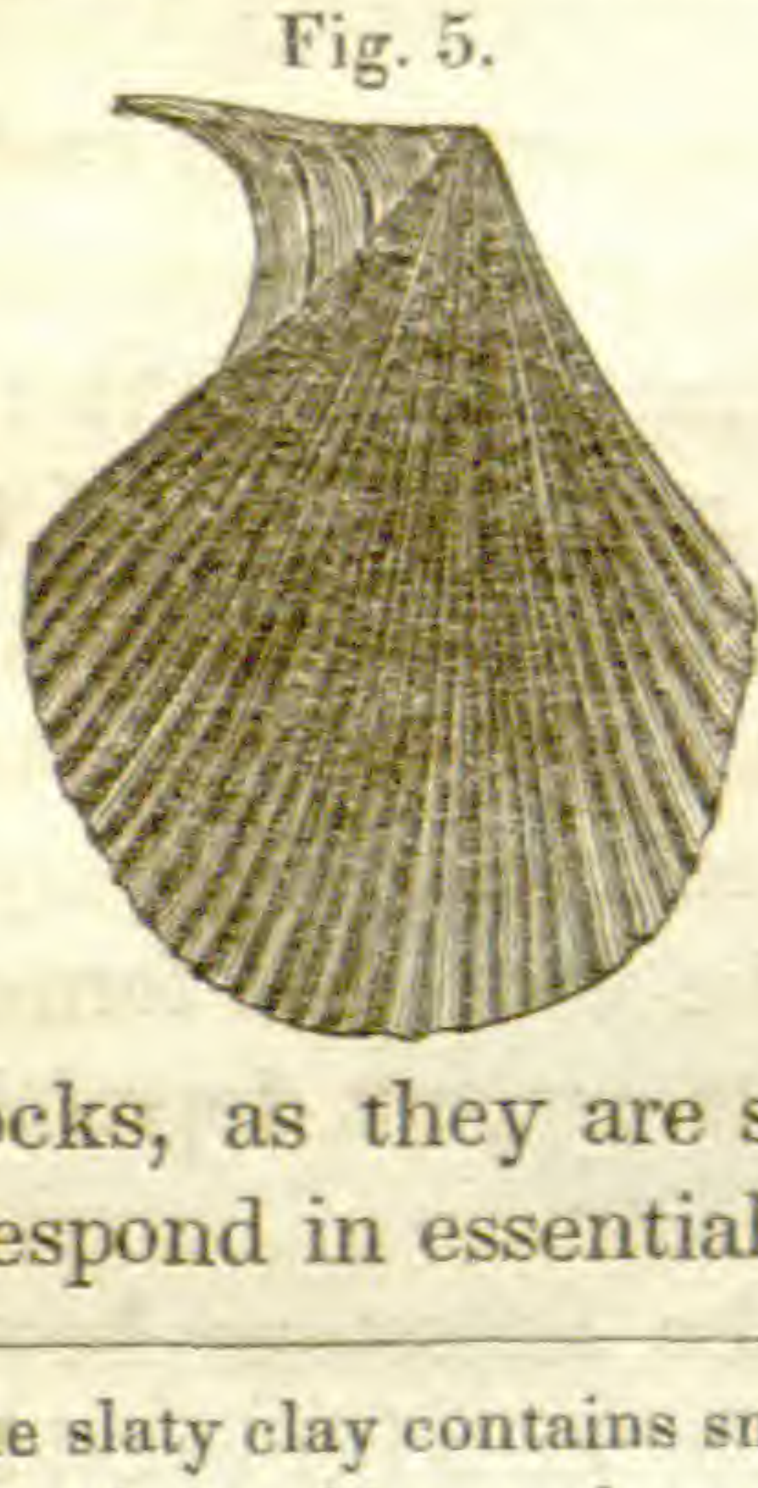


Fig. 6.

The rocks, as they are seen on the face of the bluff at Rockwell, correspond in essential characters with those given above for

* The blue slaty clay contains small crystals of iron pyrites, which for a time led to the opinion that gold was also present in the formation. The application of the nicest chemical tests however, fails to detect its existence.

the Little Vermilion. We observe, however, that the upper limestone strata at the former place are less fine and crystalline in their texture; but possess, on the contrary, a tendency to rapid disintegration, separating into ovoidal or lenticular masses, from two to six inches in diameter. The lower bed is more compact in structure, although it still contains frequent rifts and fissures.

A partial digging has been made into the bituminous shale and coal-seam of Rockwell, which fully proves the correspondence between them and those above described. The shale however, at this spot, afforded distinct impressions of a minute *Patella*, and a perfectly flat valve, (Fig. 7.) with very delicate and almost obsolete concentric striæ, apparently appertaining to a species of *Placuna*.

Fig. 7.

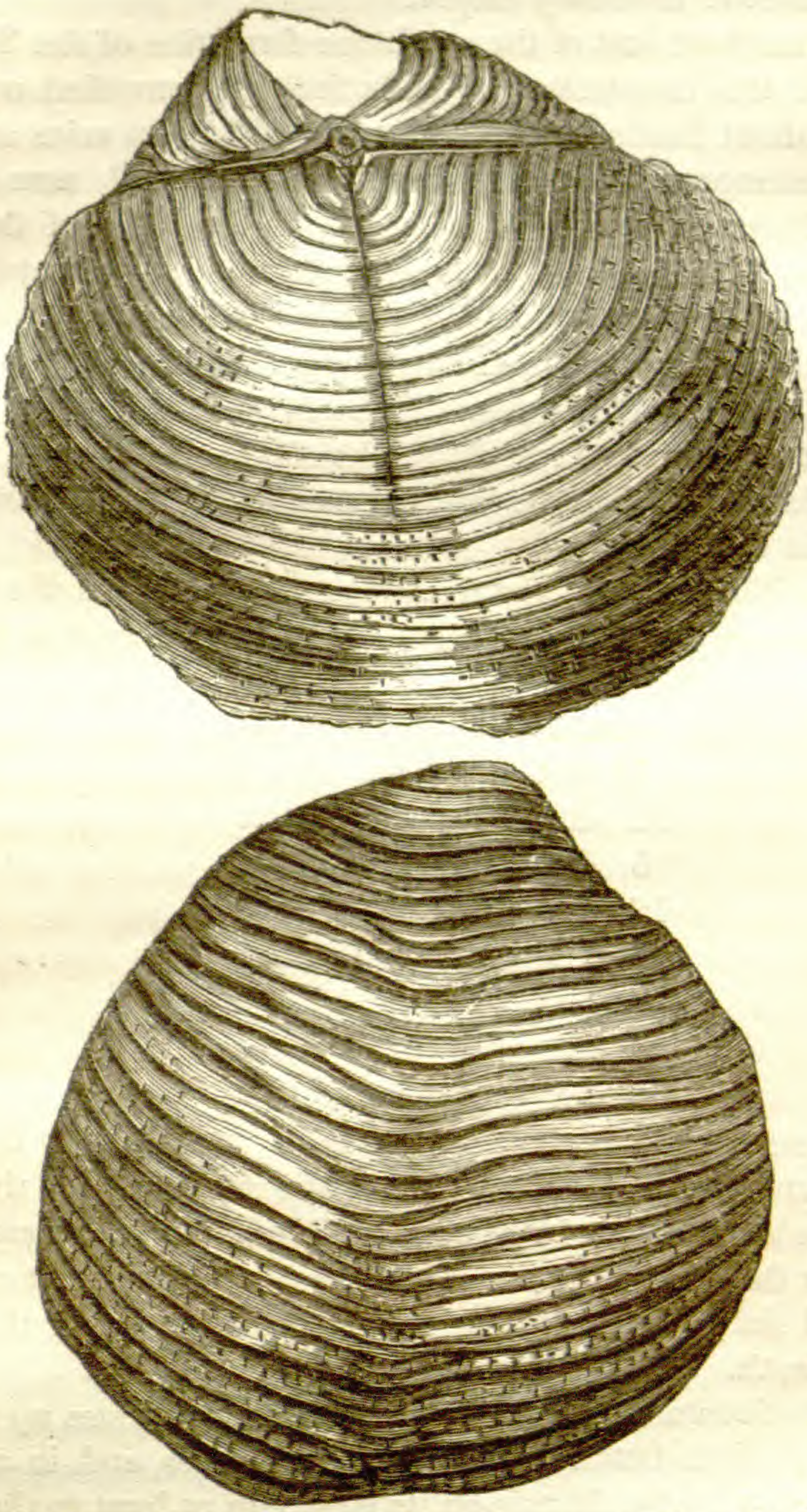
Fig. 8.

The limestone of the western bluff of the Little Vermilion is a tolerably compact, crystalline rock. It embraces occasionally, as well as the looser variety of Rockwell, encrinal remains, and a small species of *Terebratula*, (Fig. 8.) whose surface is delicately striated, and of a silvery white color and strong pearly lustre. Should it prove to be undescribed, it may be called the *T. argentea.*

An interesting deposit of travertine occurs on the eastern bluff of the Little Vermilion, opposite to the point where the section above given was obtained. The spring which gives rise to the formation, issues from the limestone near the top of the bluff; and the tufa, after accumulating in considerable masses, becomes detached and falls in large blocks into the valley. Among the loose masses under the bluff, I noticed several of a purely siliceous nature, proving, that the character of the water has formerly been different from what it now is, since its present deposition is entirely calcareous.

Two miles farther west at Peru, the limestone becomes still more crystalline, and is quarried into blocks with considerable facility. It here includes several very distinct fossils, among which were recognized Encrinal stems, a large *Spirifer*, the *Pholadomya elongata*, (of Morton,) and a species of *Producta*, of which a figure is annexed, and which I shall denominate the *semi-*

Fig. 9.



punctata. Description.—*Length rather surpassing the breadth: slightly inequilateral. Concave valve with a fold in the middle. Lower valve slightly concave. Hinge-line two thirds the length* *of the shell. Ligamental cavity deep. Flat valve marked by a vertical line extending from the summit half way to the base. Transversely banded. Minutely punctuated; the punctules being impressed, excepting when the shell is entire, the surface is then granose or obscurely hispid.*

The limestone east of the sandstone formation of the Swanson ravine, is the magnesian. It is horizontally stratified and generally without fossils, though often abounding in veins and nodules of hornstone. Ten miles north of Rockwell, near the village of Homer, it is seen to advantage in the banks of the Little Vermilion. It here almost exactly resembles the metalliferous limestone of Missouri, (which I find to be the magnesian limestone also,) having its peculiar buff color, and like it, embracing siliceous seams and nodules. The only fossils I found at this spot were a distinct species of *Turbinolia*, and a part of the vertebral column of a fish, the latter as well as the former, firmly imbedded in the limestone.

For an illustration of the formation which adjoins the magnesian limestone on the east, I shall give a vertical section taken at Ottawa.

Soil and diluvium.
1½ feet limestone.
11 do. marly clay slates.
6 do. sandy clay.
12 do. blue slaty clay.
1 foot bituminous shale.
2 feet coal.
3 do. gray slaty clay.
30 do. sandstone.

And inasmuch as borings for salt have been made to the depth of one hundred and thirty feet below the surface of the river, at a place five miles west of Ottawa, near Starved rock, we are able to say, that the coal is not repeated for a depth of at least one hundred and sixty feet, sandstone being the only rock for the whole of this depth.

The horizontal formation last described, continues up the Fox river north from Ottawa for a number of miles, and in an opposite direction up the Illinois on its west side, at least to the mouth of the Kankakee. The coal of which I heard, as existing in a bed three feet thick near the mouth of the Mazon river, probably pertains to the same stratum as that at Ottawa.

We shall now treat of the economical value of the coal to this region. Bituminous coal is valuable in every part of our country; but to a rich prairie section, where the climate in winter is severe, and where wood is scarcely abundant enough to supply materials for fencing and building, its importance is almost incapable of being exaggerated.

The deposit, upon which main reliance is likely to be placed for coal, at least for a considerable time to come, is the stratum which crops out in the Swanson ravine. This bed will probably be found workable under the entire tract, bounded by the ravine on the east and the Little Vermilion on the west. At what depth below the surface it will be found, situated on the western portion of this tract, it is of course impossible to say; but from what is known of coal-fields in other countries, we are authorized in believing that as the bed is worked down, its present pitch will alter, and that at no great distance from the ravine it will assume a horizontal position.

The thin horizontal bed of coal which has been opened at so many points between Utica and Ottawa, and which is worked at several openings near the latter place, is undoubtedly capable of furnishing a large supply of this fuel. But the difference of expense in working a thin and a thick stratum is so great, especially where the thin bed, as in the present instance, is horizontal in position, and overlaid by a vast accumulation of fissile strata, that it gives to the main deposit an obvious superiority. It is plain, therefore, that the canal commissioners have judged correctly, in affixing a high valuation to the coal-mines of the state on section thirteen.

The coal at Vermilionville, besides being a number of miles from navigable water, is so situated, with regard to the bed of the river in which it occurs, as to render its exploration unusually inconvenient and expensive. It will not, therefore, be likely to come into market, until the supply near the canal and the Illinois river has been to a degree exhausted. No coal is obtained from down the river short of Henry; nor even at this place within several miles of the river.

It appears quite certain therefore, that Chicago and the region bordering on the upper lakes are destined, on the completion of the canal, to receive their bituminous fuel very largely from Rockwell and its immediate vicinity, since there is little prospect of the discovery of any nearer source of supply. At present, the region referred to, is furnished by the coal mines of Ohio, which are situated one hundred miles from Cleveland, on the Ohio and Erie canal. It would seem however, that coal can be delivered cheaper at Chicago from Rockwell, than at Cleveland, for although the distance is the same, yet the dimensions of the Chicago canal and its smaller amount of lockage, will give it a decided advantage over the Erie canal in the expense of transportation.*

The quality of coal, so far as can be determined from the limited exploration thus far made of the Illinois beds, is in no way inferior to that of the Ohio coal. It belongs to the variety of bituminous coal, known in Great Britain under the name of caking coal, in consequence of the property it has of breaking into a great number of pieces on the application of heat, all of which become cemented together into a solid mass or cake. Its color is grayish black. It has a lamellar or foliated structure, the layers separating from each other with great facility at various intervals, from an eighth to three quarters of an inch. Their surfaces often present thin films of what is called mineral charcoal, consisting of the remains of various plants, in which the bituminizing process has not taken complete effect. The cross-fracture of these layers is generally resinous and shining, while the slaty surface is dull. It is very easily frangible. Its specific gravity is 1.273.† It ignites with great facility, and burns with an abundant yellow flame. One hundred parts by weight, on being heated, so long as it burnt with a flame lost 47.5 p. c. in weight; and the residuum after ignition until all the carbonaceous matter was removed, lost 46.5 in addition; thus leaving 6 p. c. of ash, which was white, and consisted of silica, oxide of iron, alumina, and lime.

The ease with which it burns and the abundant flame it emits, must serve to render it a most valuable fuel. For while it will afford a warm and cheerful fuel for the grate, it is peculiarly adapted also to steam boilers, and to all the operations of heat-

* Coal is raised and delivered to the boats in Ohio, at four cents the bushel. It sells in Cleveland at from fourteen to sixteen cents, and in Chicago, at fifty.

† One cubic foot of this coal will, therefore, weigh $79\frac{121}{1000}$ pounds, which will give for a bed six feet thick in one acre, nine thousand two hundred and thirty one tons.

ing and evaporating fluids. It will also give rise to a côke of a medium quality, the presence of iron-pyrites not being found so considerable as to interfere with its employment by the blacksmiths of the country, who prefer it indeed in their work, to charcoal.

Mineral Springs and Salt.

Sulphureous and saline waters appear to be of frequent occurrence in the region of the coal-deposit above described. Copious springs occur at and near Ottawa, particularly on the Illinois bottoms in the vicinity of Buffalo rock. Others again exist in the bed of the Big Vermilion, at Vermilionville, and near the mouth of the Mazon river.

The springs on section twenty three (H,) have already been alluded to. The two which come to the surface near together, and by the road-side, may be denominated saline waters. Their temperature was apparently above that of other springs in the vicinity, and decidedly superior to the mean temperature of the climate. No odor of sulphuretted hydrogen is evolved from either of them, nor do they blacken a solution of acetate of lead. The application of the usual tests, proved them to contain the following principles :—

Carbonic acid.
Nitrogen.
Super-carbonate of lime.
Bi-carbonate of soda.
Chloride of sodium.
" of calcium.
" of magnesium.
Sulphate of lime.
" of magnesia.
" of soda.

The spring issuing from the sandstone layers, nearly on the bank of the Illinois, is a strong sulphureous water; and in addition to the above enumerated ingredients, contains free sulphuretted hydrogen and the hydro-sulphuret of sodium.

Both these springs were tested for iodine and bromine, without discovering either of these substances; although the examination was made on less than a gallon of water. If these principles are present therefore, their proportion must be inconsiderable, compared to the other ingredients.

It is certainly a circumstance which considerably enhances the value of these springs, that one of them is a sulphureous water, while the other two are saline only. Their effects on the animal economy will undoubtedly be different, and a much larger class of invalids may therefore resort to them with advantage. As the country of the Upper Illinois has been settled only a few years, of course nothing has been ascertained from experience with regard to these waters; but from what is known of the constitution of the Virginia springs, it may fairly be presumed, that the use of of these waters will be attended with the same beneficial results, as are experienced at some of those celebrated resorts. The Illinois springs occurring, moreover, in a region distinguished for the beauty of its scenery, and lying directly on one of the greatest thoroughfares in the west, must also have their value much enhanced from these considerations.*

The springs in the bed of the Vermilion, at Vermilionville, (O,) are sulphureous in their character; and at the same time, equally rich in saline matter with the Illinois springs.† They are unfortunately so situated, however, as to make it difficult to obtain a supply of the water they afford, since their points of issue are completely overflowed at high stages of the river. The spring at Ottawa is simply a saline water. I had no opportunity of testing its ingredients, but should judge from its taste that it will be found to resemble in constitution, the main spring on section twenty-three.

A still more valuable resource to the country is fully indicated by the composition of these springs, and the circumstances under which they occur. The large and constant proportion of chloride of sodium they contain, taken along with their occurrence in a region of coal, sandstone, and red marl, leaves no room to doubt, that borings of a suitable depth will lead to the supply of a strong and pure brine well adapted to the manufacture of salt. Nor need any apprehension be felt at the detection of so many foreign substances in the waters of the existing springs, since these will be replaced by chloride of sodium, in the supply to be expected

* That they were frequented in former times by the deer and the buffalo, is apparent from the remains of the skeletons of these animals found buried in the soil in their immediate vicinity.

† I examined these waters on the spot, and subsequently a sample of them condensed by evaporation, which was furnished me by Dr. Hatch.

from a greater depth. For it appears to be ascertained in respect to these ancient saline deposits, that the common salt in a state of perfect purity, forms the lowest stratum of the series, while the upper layers and members of the formation, such as marls and clays, abound in the sulphates, other more soluble chlorides, iodides and bromides.*

To what depth it may be necessary to penetrate in this region, in order to obtain a supply of salt water, may perhaps be inferred from the borings in Ohio, where they work down from seven to nine hundred feet, which is several hundred feet below the level of tide-water at the mouth of the Mississippi. Now, provided the salt-stratum lies at the same level in Illinois as in Ohio, (which perhaps is not an unreasonable conjecture,) the borings in Upper Illinois would not have to be carried as deep as in Ohio, since the surface in the latter region is obviously more elevated than in the former.

Iron Ores, Sand, Clay and Soil.

Argillaceous carbonate of iron in balls, tuberose masses and kidney-shaped concretions, occur in the clay and marl beds of the Swanson ravine ; but whether in such quantity as will ultimately lead to extensive iron manufactures, cannot at present be determined, though when the coal comes to be extensively worked, enough ore will perhaps be obtained to furnish the region with a full supply of iron for castings. It is not uncommon to find balls of many pounds weight ; while strong indications of a continuous stratum of the ore, several inches thick, exist at the coal opening on section thirteen. Its specific gravity is 3.025, and being mingled with limestone, its reduction will of course be effected with great facility. A sandstone moreover, is at hand for the construction of furnaces, while the coal will afford an excellent fuel to be employed in the process.

Iron-pyrites exists in the large coal stratum in two layers, each about an inch in thickness. As it is a variety strongly prone to decomposition, it can be employed to great advantage in the manufacture of copperas, from which salt, both sulphuric acid and colcothar, may be obtained, should their production be found an object in that region.

* Report on Mineral and Thermal Waters, by Prof. Daubeny, made to the British Association for the Advancement of Science, in 1836, p. 18.

Clays, well suited to brick making, are abundant in the prairie country; and others, adapted to the manufacture of fire brick and pottery, are found overlying the horizontal coal near Ottawa, and at the mouth of the Kankakee.

Extensive beds of pure, white sand, derived from the decomposition of the sandstone, occur north of Rockwell, near the little Vermilion. It is advantageously employed in the fabrication of mortar and plaster, and will one day lead to the production of the finer qualities of glass.*

The extraordinary crops of grain and potatoes every where obtained from the prairie lands, induced me to submit a portion of the soil to chemical analysis. The sample was taken from eight inches below the surface, and after being thoroughly dried by several weeks' exposure to the air, it afforded the following result on one hundred parts.

Water of absorption, - - - -	8.50
Organic matter, - - - -	9.50
Silica, - - - - - - -	70.00
Alumina, - - - - - -	7.50
Carbonate of lime, - - - -	1.50
Per-oxide of iron, - - - -	1.00
Carbonate of magnesia, } Sulphate of potash, } - - -	traces.

In depth and fertility of soil, the Illinois prairies are probably unsurpassed by any tract of country in the known world. Fields near Alton have been planted with Indian corn for fourteen years in succession, without the addition of manure, and still continue to yield an abundant crop. The farmer in this region, moreover, enjoys a great advantage in the boundless extent of cleared land within his reach, which permits him on the exhaustion of tracts long under tillage, to bring into cultivation fresh fields, and thus to allow those which are exhausted to recover their strength, by enjoying a fallow. Occasionally also, where the soil is light, as on the Illinois bottoms, near Buffalo rock, gypseous marls, like

* A variety of limestone occurs adjoining the canal, a little east of Camp-rock, well suited to the fabrication of water-cement. The precise locality may be learned on application to Mr. Dixwell Lathrop, of Rockwell, a gentleman whose public spirit and intelligence render him of essential service to the region in which he resides.

those of the Swanson ravine and Vermilionville, may be employed with great advantage.

Already an active and intelligent class of emigrants is finding its way into this most inviting region, and is beginning to reap its advantages. A population of several hundred is scattered over the prairie lying a few miles to the north of Rockwell, where but a few years ago the white man was almost a total stranger. Nor can it be doubted, that as soon as the Michigan and Illinois canal is completed, a fresh impulse will be given to the country, and a speedy development of the resources we have pointed out, ensue.

ART. XIII.—*Calstronbarite, a new Mineral Species;* by CHARLES UPHAM SHEPARD, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

THE mineral here described was received several years since from Messrs. GEBHARD & BONNY, of Schoharie, (N. Y.) along with specimens of Strontianite, which were noticed by me at that time in an article published in this Journal.* I then regarded the subject of the present notice as heavy spar. Having had occasion however, within a few days, to re-examine these minerals, and meeting with more distinctly crystallized fragments than any hitherto observed, I discover the supposed heavy spar to be a new species, and one moreover which offers in its chemical constitution a very remarkable exception to any saline compound as yet known to exist in the mineral kingdom.

Mineralogical Description.

Massive, in broad, straight, lamellar masses. Primary form, right rhombic prism. M on M$=102° 30'$ to $103°$.

Cleavage, M on T perfect; the latter more easily obtained than the former.

Lustre, vitreous to resinous. Color white, inclining to gray, rarely exhibiting a tinge of reddish brown.

Streak white. Translucent.

Brittle. Hardness$=3.25$. Sp. gr.$=4.20$ to 4.22.

* Vol. XXVII. p. 363.

Chemical Description and Analysis.

When heated before the blow-pipe, it emits a phosphorescent light, and fuses into a white porcelainous mass, which on being laid upon moistened turmeric paper, imparts to it a brown stain. It is partly soluble in hydro-chloric acid with effervescence: and the solution, on being treated with alcohol and set on fire, burns with a scarlet-red light. The nitric solution, on evaporation to dryness, again becomes moist after a short exposure to the air.

A portion of the mineral, in the state of an impalpable powder, was digested in hydro-chloric acid, so long as any matter continued to be taken into solution. The undissolved portion was separated from the fluid, and after careful washing with warm water, was dried and ignited along with powdered charcoal in a porcelain crucible, for one hour. Boiling water was affused, and the clear yellow solution of hydro-sulphuret separated by the filter from the unconsumed charcoal. Hydro-chloric acid was added to one portion of the solution, and after partial concentration by boiling, alcohol was added. It burnt without any indication of the presence of the chloride of strontium. The remainder of the hydro-sulphuret was decomposed by nitric acid, and the solution evaporated to dryness. A minute scale of the salt was added to a solution of sulphate of soda. It instantly produced a cloudiness, nor was the precipitate re-dissolved on the addition of more water. The solid nitrate (obtained by evaporation) moreover, remained exposed to the air for twenty four hours, without sensible deliquescence.

It hence appears that the sulphate contained in the mineral, is neither (wholly nor in part) that of strontita, or lime. The specific gravity of the mineral, taken with the crystalline form it assumes, can leave no doubt of its being sulphate of baryta. We have seen above, that carbonic acid, lime and strontita, are also constituents of the mineral. The quantitative analysis was conducted as follows: the carbonates were dissolved out by nitric acid. The insoluble sulphate was washed, heated to redness, and weighed. The nitric solution was evaporated to dryness and treated with alcohol, having a specific gravity 0.812. The alcoholic solution was evaporated to dryness, and the nitrate of lime decomposed by a white heat. The nitrate of strontita, still moist with alcohol, was introduced along with the filter into a small platina crucible and ignited, whereby it was converted into carbonate of strontita. The results obtained were these:

Sulphate of baryta, ...	65.55
Carbonate of strontita, ...	22.30
Carbonate of lime, ...	12.15

So close is the approximation of these numbers to what would be afforded by a definite compound of two atoms of sulphate of baryta, one atom of carbonate of strontita, and one atom of carbonate of lime, that we are fully entitled to consider this as the constitution of the mineral. The analysis, corrected by the atomic theory on such a supposition, will give the following view, as the more exact composition of the substance under consideration:

Sulphate of baryta, ...	65.22
Carbonate of strontita, ...	20.61
Carbonate of lime, ...	14.27

The chemical sign of the species will therefore be $2\dot{Ba}\dddot{S}+\dot{Sr}\ddot{C}+\dot{Ca}\ddot{C}$.

The trivial name alludes to the three bases entering into its composition. In the natural system, it falls to the genus *Halbaryte*, and I denominate it, specifically, ***Polyhalous***, from the number of salts it contains.

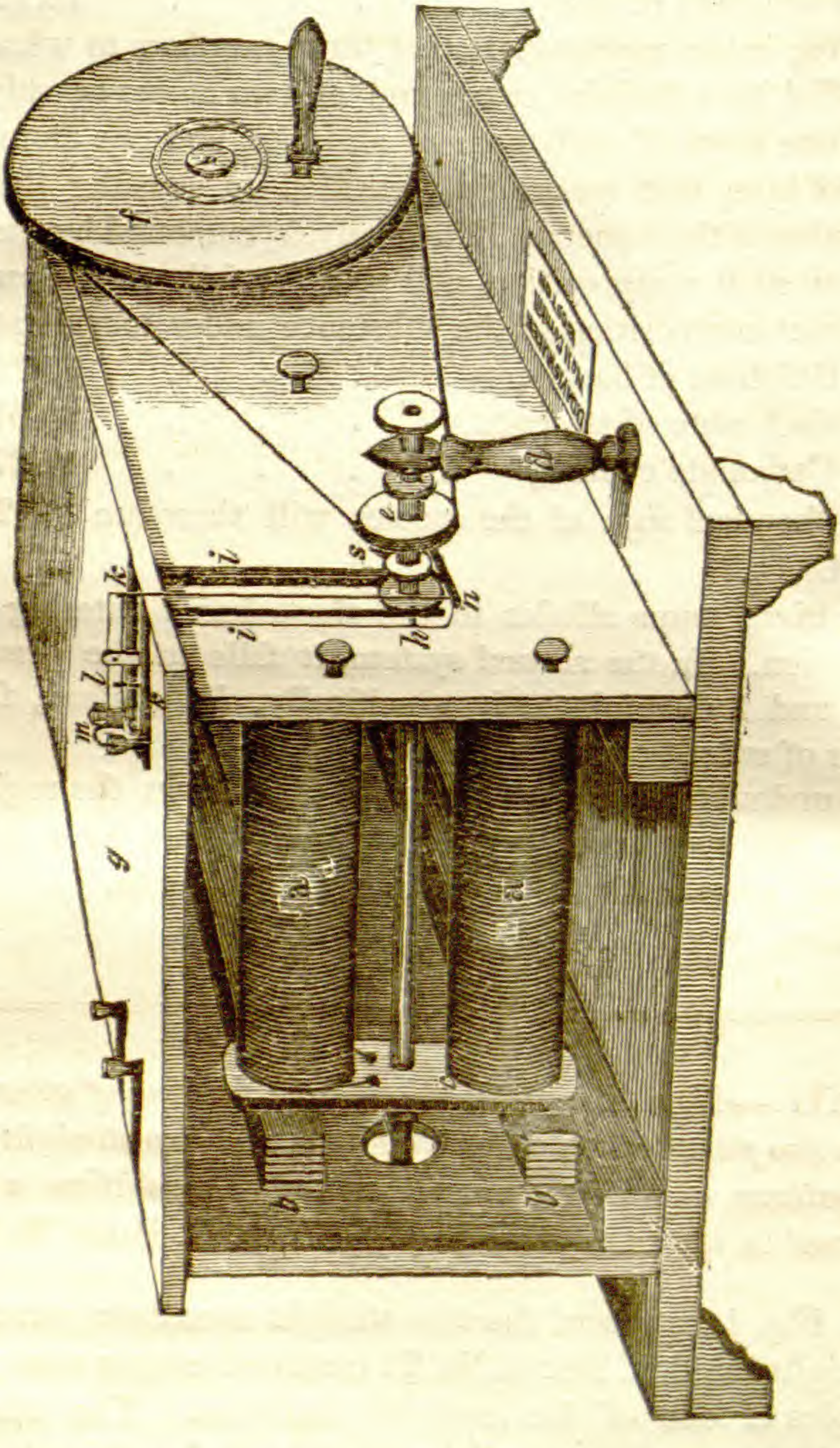
It is undoubtedly a very common mineral in the region from whence my specimens were sent; and occurs in a secondary limestone, associated with crystallized strontianite.

Charleston, (S. C.) Feb. 21, 1838.

Art. XIV.—*New Magnetic Electrical Machine of great power, with two parallel horse-shoe magnets, and two straight rotating armatures, affording each, in an entire revolution, a constant current in the same direction;* by Chas. G. Page, M. D.

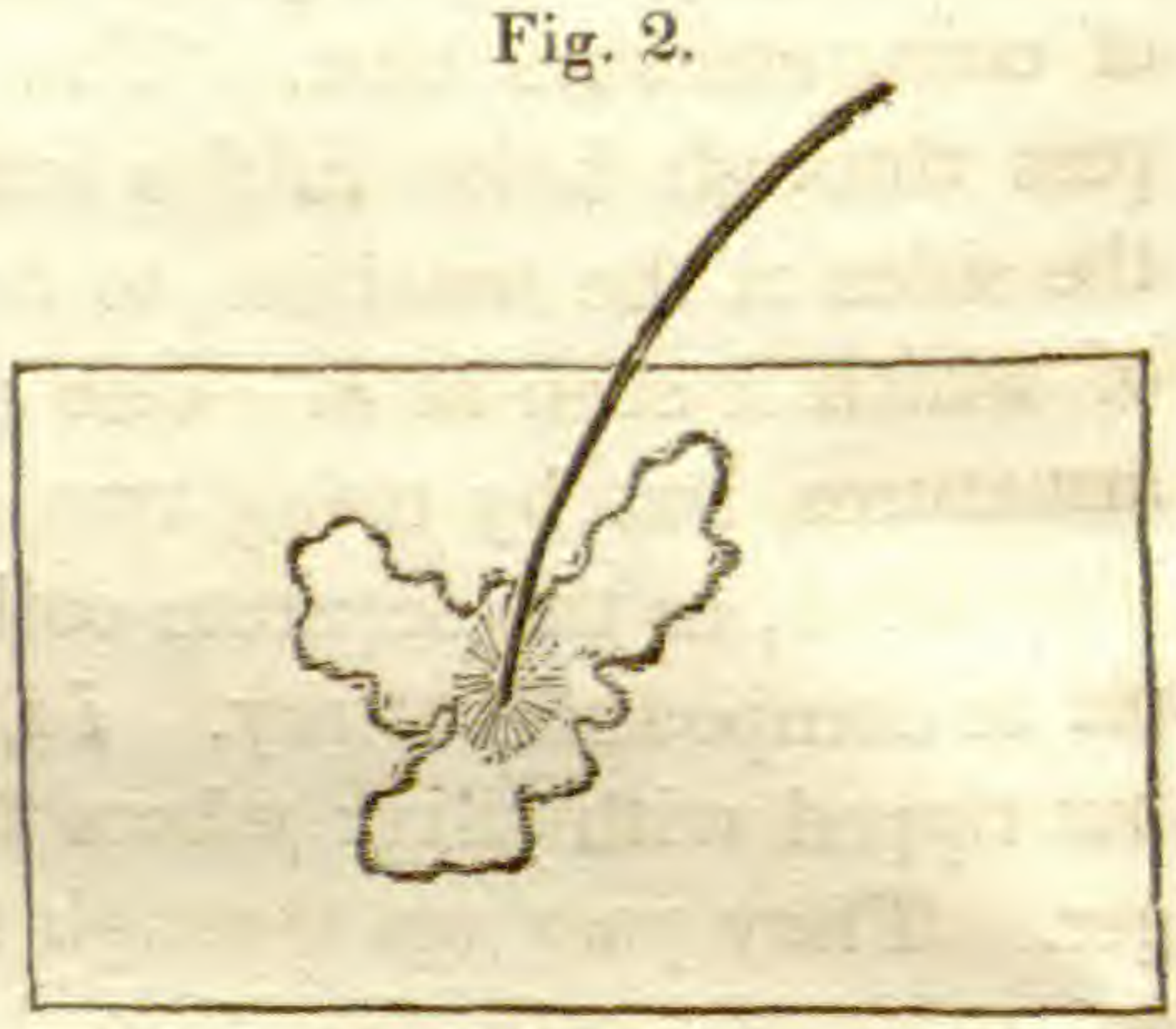
a a, Fig. 1. represent the two straight armatures, covered each with eight hundred feet of No. 20 insulated copper wire; *b b*, the two poles of one of the magnetic batteries. The other horse-shoe magnet, exactly parallel and opposite to this, is screened from view by the frame work of the machine. Its poles are the reverse of the former. *c*, is a strong brass strap, for securing the armatures to the shaft. At the other extremity of the armatures, is a similar one, fastened tight to the axis. The strap *c* is held firmly in its position by a nut, but movable, so that the armatures may be removed at pleasure. *d*, is a strong brass pillar for supporting the axis, which turns on centres, secured and adjusted

Fig. 1.



by nuts and milled head screws. There is a similar pillar at the other end of the axis, on the opposite side, but concealed from view by the body of the machine. The magnetic batteries are also secured to the frame by strong brass clamps, and adjusted by milled head screws. *e*, is the pulley wheel, and *f*, the multiplying wheel. *g*, the top board, is secured to the frame by screws, and answers as a convenient table for experiment. The magnets are sixteen inches long, the armatures ten inches, so that the whole machine occupies but little room. The alternating currents, from the semi-revolutions of the armatures, are converted into a current of the same direction, by the application of my *pole changer.* This simple contrivance, beautifully applicable to the magneto-electric, as well as to the electro-magnetic machine, will be found fully described in Vol. xxxiii. No. 1. p. 190, of this Journal. It consists merely of two insulated, metallic, cylindrical segments, secured on the shaft, and two stationary metallic tangent springs for conductors. Silver, about the purity of coin, answers best. The wires from each of the armatures, pass through holes in the brass straps, and through openings in the sides of the machine, to be attached to the pole changers, one of which is seen at *h*. One pole changer would suffice for both armatures, but by using two, the experiments may be considerably varied, as the separate coils may be combined, to form a simple or compound battery. *i i*, are the tangent springs of copper, but tipped with silver where they rest upon the silver pole changer. They pass up through the top board of the machine, and are soldered respectively to the brass straps *k k*, into which are screwed the mercury cups, one of which is of glass for exhibiting the spark, combustion of ether, alcohol, oil, &c. These cups represent the two constant poles of the revolving coils. The circuit is completed and broken by the rise and fall of the curved wire *m*, attached to the little lever *l*. At *l*, the lever is pulled down by a spiral spring. At the other end is fastened a string, which passes down to the lower lever, *n*. This is worked by the revolving pins *n s*, attached to a movable ferule on the shaft. The pins *n s*, are themselves binding screws, so that the ferule may be adjusted in any position, and the circuit broken at any required time. This electrotome, as it may be called, is removed when decompositions are performed, and the platinum wires are inserted into the mercury cups. The machine works equally well, turned either way. I have not yet had opportunity to measure the rate of decomposition of pure water, but it is certainly as rapid as from one hundred pairs of galvanic plates. Pure water is rapidly decomposed when the platinum wires are ten inches apart. A few turns of the wheel furnish mixed gases enough to make a smart explosion. A solution of sulphate of soda in cabbage water, contained in separated glass cells, submitted to the action of the machine, gives immediately the characteristic changes of color by decomposition ; reversing the motion of the wheel, the reverse change takes place. The light from charcoal points is insupportable. Plumbago gives an intense light. The metallic leaves burn with splendor. When a wire is suddenly withdrawn from one of the poles or brass straps, a bright spark is obtained, *half an inch* in length. When the circuit is broken from a smooth and clean metallic surface, an entirely new and beautiful appearance presents itself. A diffuse, irregular, nebulous spark, darts along the surface, (as seen in fig. 2,) sometimes in several directions at once, to the distance of half or three quarters of an inch. It succeeds with all the metals yet tried, but best with a piece of iron finely striated with a smooth file. When the lever trip is worked, the secondary current frequently plays with an intense green light, across the separations between the pole changers. The shock from the direct current is uncomfortable with dry hands; but when the secondary current is used, it is painful to touch the poles, even with the fingers. It causes the gold leaves of the electroscope to diverge strongly, without the aid of a leyden jar, or extended, insulated metallic surfaces. It charges a leyden jar at every touch. A charcoal point on the knob of the jar, affords a bright light at every touch. I have some time since shown, that the shocks and decompositions produced by the secondary current of flat spirals and helices in connexion with a single pair of plates, were greatly increased, if the surface of the mercury, (or solid conductor,) from which the circuit is broken, be covered with pure water or naphtha. I have since found that oil gives a far greater increase than either. The rationale is now obvious. When the battery circuit is completed, (as shown by Faraday's discoveries of volta-electric induction,) a feeble secondary current flows in a direction opposite to that of the battery. When the

Fig. 2.



circuit is broken, a powerful secondary rushes in the same direction with the primitive battery current. Hence the bright spark is occasioned by the passage of the secondary through the heated air, occasioned by the combustion of the mercury. Now, if the surface of the metal is covered with a non-conducting liquid, such as oil, the circuit is broken with precision, while an obstacle is offered to the consequent and secondary current, and the greater part of it rushes through the body, or whatever conductor joins the extremities of the coil. The application of this fact is of great value in the use of the magneto-electric machine. If a drop of oil be put upon the break piece of the ingenious machine of Clarke, its power will be greatly increased, while it preserves a good contact by saving the metals from oxidation. I find also, that if the stratum of oil be very thin, the spark is more brilliant than without it, being partly due to the combustion of the oil. The same is true also of charcoal points, when used with the deflagrator or magnetic electrical machine. It will be seen at once, that the gain of power in this new magnetic electrical machine must be very great. I notice in the last No. of this Journal, that Clarke's machine has on one armature four thousand five hundred feet of wire, whereas on one armature of this machine there are only eight hundred feet. The source of this superior action, is chiefly the use of the straight armature, instead of the revolving horse-shoe. There is no advantage in covering a horse-shoe (for electro-magnetic or magneto-electric purposes) beyond the straight portion. Hence the piece of iron is longer than necessary for the full and ready production, and neutralization of the magnetic forces. The straight armature is covered through its entire length, and covered with ease and precision in a lathe.

On a new compound electro-magnet, for the production of the magnetic electrical spark, and also for attractive force.—The following positions, I think, may be considered as well established by experiment. 1st. Very long and large bars of soft iron, even with a proportionate battery, acquire a comparative feebler magnetic intensity than smaller bars. 2d. That long and large bars of soft iron, once charged by a battery, retain a greater degree of magnetic power than smaller ones. The great magnet lately constructed by Dr. King of this city, (Boston) in imitation of Prof. Callan's magnet, affords convincing proof of these facts. This magnet is made from a bar of two and one half inch iron, and fourteen feet long. Its lifting power is about one thousand five hundred pounds, and when the battery and armature are removed, it retains a permanent lifting power of fifty pounds. Struck with this curious fact, I was led to the construction of the compound electro-magnet. My first experiment was made with three separate layers of coiled wire round a wooden spool ten inches long, with a bar of soft iron enclosed. This was connected with two pairs of plates and the spark and shock observed. The bar of iron was then removed, and a bundle of annealed large iron wire, introduced in its place. The sparks and shocks were increased to a surprising degree. I then took a bundle of smaller wires four inches long and wound them with only two layers of continuous wire. The spark from this was as intense as that given by the large bar in the spool. I next took seven pieces of good hoop iron, well annealed, one inch wide, one fourteenth of an inch thick and eight inches long. These were firmly rivetted together, and the angles of the compound bar thus made, were rounded to prevent cutting the wire. Four layers of coiled wire were then wound upon it, and their ends attached to two connecting wires. Nothing can be imagined more intense and beautiful than the sparks produced by this little compound magnet. When a piece of iron is burned with it, the ignited particles are frequently thrown off, the distance of two feet, and occasionally fall to the floor. For its size, it is the strongest electro-magnet I have ever known, and when the battery is withdrawn, there is not magnetism enough retained, to affect a very delicate needle. From this perfect neutralization of power, arises in great measure, the intensity of the secondary current. The neutrality is partly due to the reduced size of the bars, but chiefly to the action of their similar poles upon each other, when the exciting cause is withdrawn.

Fig. 3.

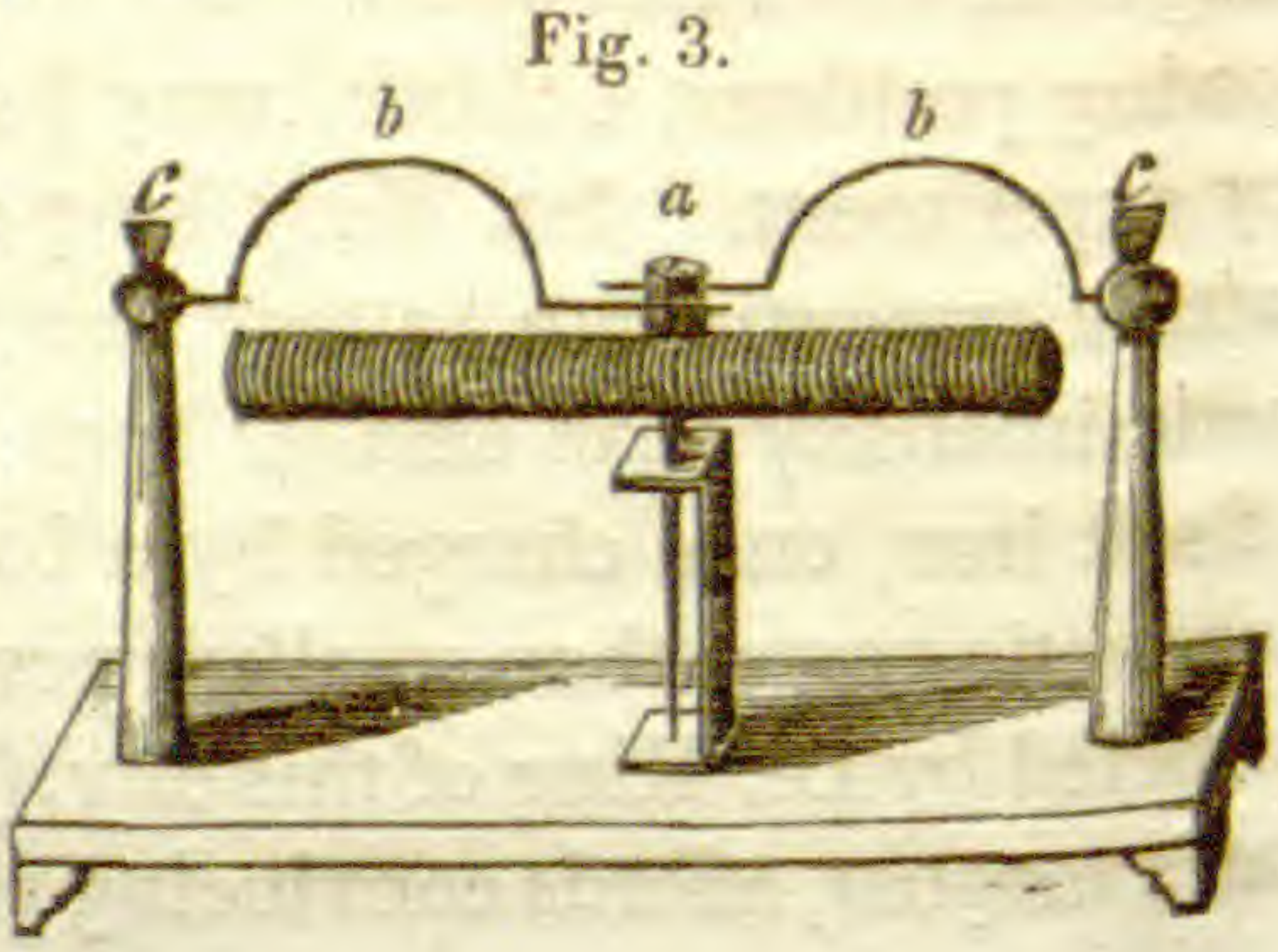


Fig. 3, represents a small electro-magnetic bar, mounted for rotation, with my pole changer attached, which is shown at *a*. *b b*, are the conducting tangent springs; *c c*, mercury cups for connexion with the battery. No stationary magnets are here used, the instrument being made with such delicacy as to revolve by the earth's magnetism. Placed upon the top board of the machine, the connexions being made, it revolves rapidly by the attractions and repulsions of the upper poles of the large magnets underneath.

A small electro-magnet, charged by the three inner coils of one of the armatures, sustained permanently ten pounds, while the machine was in action.

Fusion of iron filings.—When a wire from one pole of the machine was placed in a heap of fine iron filings, and a bunch of these raised by a magnetic bar connected with the other pole, the connecting shreds of filings, sometimes an inch in length, became intensely ignited throughout, fused into a mass and fell off, leaving frequently a globule attached to one of the poles, which glowed for a time after the contact was broken, and then exploded, as is seen with particles of iron burning in oxygen. This curious experiment succeeds best, when the filings are held between two opposite poles of magnetic bars, connected each with the poles of the battery.

Art. XV.—*On the Dry Rot;* by Phinehas Rainey.

Middletown, (Conn.) March 22d, 1838.

TO PROF. SILLIMAN.

Sir—Permit me through the medium of your very valuable and widely circulating Journal, to lay before the public the following facts and observations in relation to the *dry rot* in timber.

It is matter of history, that the timber of the ancients lasted some hundreds of years longer than that of the moderns, and there is no record that their timber was subjected to any artificial process to make it durable. It is therefore probable, the reason why the dry rot exists to such an alarming extent in the heart-wood of the timber of the present day, is to be found in the season of cutting the trees. It is probable that the present general practice of cutting timber in the winter was avoided by the ancients, and that it originated in England, when the botanical theory, that the sap of trees is in their roots at that season of the year, was first promulgated.

It is true, that when trees are cut in the winter months, the alburnum will *not* be affected by the dry rot for a great number of years afterwards, and indeed I do not know if it be removed from the heart-wood, that it ever would be affected by that disease in its proper type; and hence the origin of the delusion, and of consequence the practice above alluded to. But in this case, the deadly disease is lurking in the heart-wood, and will, as assuredly as time rolls on, burst forth and destroy its texture in the course of about eight years; and hence the destruction of life and property, and the annual complaint from our government ship-yards. I was once a devotee to the cutting of timber for vessels in the winter, until the following circumstances led me to renounce this ruinous practice.

It was the general custom here, to cut timber for vessels in the winter, but notwithstanding, they went into decay, and wanted repairing in about seven years, or from that to eight, while some of them lasted twelve years. I ascribed this variation in their durability to the fact that the cutting of the timber was often commenced in October, and then continued through the intermediate months into March. I therefore concluded that the right season was in December, when I supposed that the sap was certainly in the roots, and if cut in that season, I believed it would leave the deadly poison in the stump; of consequence, the body and branches would be entirely free from its influence, and I therefore came to the determination to carry this opinion into practice the first opportunity, and one soon occurred.

In 1810, I was concerned in the building of a small freighting ship, of which I was the sole conductor, from her keel until she was completed and ready for sea. According to my previous determination, I commenced the cutting of the timbers for her in the early part of December, and continued it into the first week of January. By so doing, I expected to produce the very best ship for durability on the Connecticut river, where there were then numerous vessels building. The timber selected was white oak, and white chestnut. The vessel advanced, and in April it was found that three of the quarter top timbers were wanting, and (as very crooked pieces were required for these) I was obliged to go into the woods and have them cut. Some time in May, it was found that the stick designed for plank-sheers (this was very large, and intended to make the whole that was wanted) would not answer the purpose, except that it was barely sufficient to go around the bows, the other part being badly rent, and of course was rejected. I therefore went into the woods a second time, when the leaves were full grown and the bark would peel, and had two thrifty white oaks cut for the after pieces. These timbers were put in immediately, and so were the plank-sheers, without any seasoning whatever, and the room between the timber above the air streak was filled with salt, which was supposed to be a preventive against the dry rot. The workmanship was of the first order.

The vessel was launched, and completed in July, 1811. That autumn she went to sea, and after the declaration of the war of 1812, she came to Middletown, and was laid up here until the peace of 1815. In that spring, when she was to be fitted out again, it was found that she must be repaired in her hull; and on opening her, it was perceived that the dry rot had made such destruction among her timbers, that it became necessary to build her anew from her middle wale up. But the three quarter-timbers spoken of, which had been cut green, were sound, and appeared new, although their neighbors on each side of them, were destroyed by the disease; and it is a remarkable fact, that the spikes, when pulled out of them, were bright, and appeared new, but those parts of them which came in contact with the outside planks, (which were made from timber cut in December,) were badly oxidated, so much so, that they were reduced in size nearly one quarter. The plank-sheers forward, which, it will be remembered, were cut in December, were destroyed by the disease, but the after pieces were sound and dry, and the under sides appeared like new timber seasoned in the shade; and what is remarkable as to them is, that although some of the timbers on which they rested were so decayed that they might be picked to pieces, yet there was not the least appearance of it on them, which shows, that although surrounded by corruption, they were themselves, at least up to that period, incorruptible. Thus it can be seen, as respects this vessel, that not only the season of the year, which in the popular opinion is the best to cut timber in, for the purpose of making it last well, was strictly adhered to, but also the precautionary measure of applying salt, which is, even at this day, thought to retard the progress of the disease.

Although it was not thought necessary at that time to repair this ship below the middle wale, yet I have every reason to believe that the poison had begun its work in her timbers, from light-water mark to her top-side, for in 1816 or 1817, in a perfect calm she sank at sea, a poor miserable decayed hulk, a melancholy comment on the folly of cutting timber for vessels in the winter months. By inquiry since, I have always found, that of those vessels that last the longest, the timber of which they were constructed was cut the farthest from December.

The facts in this case entirely changed my opinion. Before, I thought, because it was the general practice, that the winter months were the best season to cut timber in; now I began to reason, to examine, and to compare. I fully believed that the sap was the cause of the dry rot, and wherever that was stored away, at the death of the tree, there would it make its first attack; I doubted, however, the botanical theory, that it is principally in its roots in the winter, and there protected from injury by the frost; for I could not clearly see how the roots of the birch, beach and sugar maple, (although the quantity they will bleed in a season, is partly accounted for in their being supplied by the fibre roots,) could contain their sap; and if they could, how it could be protected from the frost there, any more than in any other part of the tree, when not more than one tenth part of the roots were below the frost. I was therefore determined to ascertain, if possible, where the sap reposed in trees, at different seasons of the year.

Accordingly, having cut a small oak staddle, on or about the twentieth of June, 1815, I placed several pieces of it in the fire-place, and put fire under them; after a little while, there appeared at the ends of the sticks a wet circle, describing the exact thickness of the alburnum, and when they became considerably heated, the steam rushed with violence from the tubes of the alburnum, and there was but a slight appearance of vapor over the surface of the heart-wood. On or about the same day of the month of December, of the same year, I had another small oak staddle cut, and went through with the same process with several pieces of it, and when they began to be heated, the whole surface of the heart-wood, except a small circle enclosing the pith, was wet, but the alburnum was dry, and when they were fairly heated through, the steam rushed with violence from the tubes of the heart-wood, although the whole quantity that escaped was not so large as in the other case. 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 first experiment shows plainly, that the sap is in the tubes of the alburnum in the summer, and I believe this accords with the present theory in botany; and I believe also, that it is conceded by botanists that the sap is the cause of the *dry rot;* then why was the practice of cutting timber in the winter ever introduced, except for the purpose of economy in saving the alburnum from the rot?

In the second experiment it can be clearly seen, that the doctrine of sap being principally in the roots of trees in the winter, is false, and therefore should be discarded for the mischief it has already done, and the truth should be established, which is, *that in the winter the sap is in the tubes of the heart-wood of the whole tree, roots, body, and branches, and is there protected from injury by the frost.* By what process it gets there, and how protected, is perhaps yet veiled in mystery; but all must confess, that it is conveyed there by a natural law, and thus protected from injury; the beneficent design is too obvious to be attributed to any other than Almighty power.

At the period I was strenuously advocating the doctrine of cutting timber in the winter, I had a small apple-tree which had been engrafted with a choice fruit, and had been growing perhaps seven or eight years. There was one limb on it which I did not like, because it was growing in a wrong direction, and therefore I took it off in December, because of course I did believe the sap to be then in the roots, and therefore at this season there would none of it be wasted or taken away with the limb, and of consequence the branches left would receive a greater proportion of nourishment in the spring. After the occurrence of the circumstances before detailed, I examined the tree, and found that the part or stump of the limb which remained within the

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* It will be remembered that the sugar maple is always tapped at the close of winter, and first dawning of spring, when there are sunny days and frosty nights. —Ed.

surface of the body, was affected by the dry rot in its purest type. I removed this with my knife, and found that the disease had made its attack on the body of the tree itself. The tree, after the limb was taken off, became sickly, and its fruit, after it began to bear, was imperfect.

I would here observe, that it is the common practice, when people cut the timber of a house frame, to do it in the winter, because, as they think, it will be more durable; but they will not trim their trees at that season because they know by experience that they will contract the rot, and therefore they do it in the spring. What a strange oversight! But Doctor Ives, senior, of New Haven, goes even farther; he trims *his* trees in June, and thinks they do better at that season of the year because the wounds heal quicker. This is right, for as the cause of the disease is *not* in the heart-wood at that season, so the remaining stump, being all heart-wood, can never be attacked by the disease, and therefore the wound will heal quicker; but if it is done in December, the cause of the disease *is* in the heart-wood at the death of the limb, and as the stumps cannot be removed, the consequence is that the disease attacks and very soon destroys *them*, and therefore the wounds will never heal. Although trees thus situated, may, by their abundant foliage, their extended branches, and their smooth and comely bodies, appear to be in perfect health, (which is sometimes the case,) yet they are doomed trees, for the canker having entered into their organization, is preying upon their very vitals, and will sooner or later prostrate them in the dust. If any accident should happen to a limb so as to break it off in the winter, no matter how small, if it be connected with the main pith of the tree, the effect would be the same. And hence the origin of what the carpenters call *punk knots*, that so often appear in our most valuable white pine mast sticks, and the indications of which on the outer surface is many times so minute as to deceive the most vigilant eye, but when perceived and traced, will lead to a mass of decay around the region of the pith.

When I have known the period at which certain trees have been cut, and also their locality, I have afterwards, year after year, examined their stumps, and watched their decay, and have invariably found, that of those of them which were cut in the winter, the disease first made its appearance in the heart-wood, and continued its ravages until that was destroyed, and up to that period the alburnum was comparatively sound. And of those that were cut in the summer, the disease first made its appearance in the alburnum, which, in many cases, after a few years, entirely disappeared, but the heart-wood remained sound and dry. And here let me observe, that in the examination of this description of timber, I have always found it sound and dry, which leads me to believe that this is owing to the peculiar state of the heart-wood at the time of the death of the tree, and therefore it is more impervious to water, which of itself, waving every other consideration, would make it more durable.

Our woods afford many facts which, if rightly examined, would go to show that the doctrine I have advanced is the true one. Trees may be found uprooted and lying prostrate, from which the alburnum has disappeared in consequence of dry rot, and yet the heart-wood remains sound; stumps of dry limbs are observed projecting from aged living trees, which from appearance have been in that situation for ages, and from which the alburnum has also disappeared, yet the heart-wood will be firm and sound; trees are seen standing erect, on the alburnum of which the dry rot seems to have exhausted all its power, and caused it also to disappear, but it had no power to act on the heart-wood; and by their dusky and ragged appearance such trees seem to have been in that situation for a great number of years, and thus it appears that time only was slowly decomposing their outer surfaces, for if examined, it will be found that they are sound and dry within, and much harder than the same kind of timber seasoned in any other way. Can there be any doubt as to the fact that these limbs and these trees received their death in the summer? Others also are found lying prostrate, with the heart-wood entirely destroyed by the disease, yet the alburnum is in a tolerable state of preservation; others present nothing but masses of decay, and in the bodies and limbs of others, holes will be perceived from which once projected healthy branches; and to one that is experienced in timber, these are sure signs that death has entered into their composition, however otherwise their appearance might indicate a healthy state. These trees and these limbs received their death wounds in the winter.

There are numerous facts in the most common transactions of life that will sustain me in my position. I believe that the general practice throughout the northern and middle states is to peel such trees as are to be manufactured into ship plank; by saving the bark, this probably makes the business more profitable than it would otherwise be. It is invariably the case, that by the time the planks become thoroughly seasoned the alburnum becomes so injured by the dry rot as to be unfit to be used; and for my own part I never saw any timber of this sort where the heart-wood was affected at all, unless the tree had contracted the disease before its death. Now I appeal, for the truth of these assertions, to all the experienced ship-carpenters who are in the least acquainted with this kind of timber. The season of peeling is from the third week in May to the second week in June. It is not probable that all the timbers required for a seventy-four, or indeed any other public vessel, are cut in the compass of any one month, but that they commence perhaps in October, and continue the cutting into April, and sometimes into May, and in cases of great emergency, into June. Then, if I am right in my views, various periods must elapse before all the timbers will have been attacked by the disease; and when the planks are taken off from any one of them preparatory to their being repaired, do not the timbers present that appearance? Are there not those on which the dry rot has exhausted all its power and finished their destruction, and others which are less decayed, others not so much? Indeed, the disease can be traced until you find those which seem to defy and continue to defy its energy, even after the vessel has undergone repeated repairs, and these circumstances occur too, even after the timbers have been subjected to some artificial process to make them more durable.

The following is a case in point. In the North American Review, No. xcv. for April, 1837, pp. 343–44, in the article on the Sylva Americana, the following passage occurs. "The white oak was largely employed in the frame of our favorite frigate (the Constitution) which was built forty years ago. In the course of the very thorough repair to which this vessel was lately subjected, many of the white oak timbers of her frame were found in excellent condition; and it is stated on the best authority, that in several instances the timbers of this description were sound, while others by their sides, of the southern live oak, had decayed. Now the superiority of the live oak, in point of durability, over the oak of any other country, has never been doubted." Why did not all the white oak timber last forty years, if there had not been some variation of the season of cutting them? and so with the live oaks.

It is a well known fact, that the building of the Constitution commenced when we were on the eve of a maritime war with France, or it had already commenced, and therefore we may suppose that the completion of the ship was hurried; and that her frame did not all arrive from the south in time, so that they were compelled to employ the white oak in her construction: probably the season in which it was cut was not much regarded, and therefore some of her white oak timber lasted forty years.

I saw in one of the Reviews of the day a circumstance of this kind, although I cannot now give the reference. In a mine, I believe in one of the German states, the timbers made use of to support the roofs of the galleries, were in a few months destroyed by the dry rot, and this could not be obviated by every experiment that was tried, until they made use of the locust. The effect was accounted for in this way: the dry rot, it is true, destroyed the alburnum immediately; but the decayed alburnum answered for a coating to defend the heart-wood from its influence. If this be the fact, why did not the decayed alburnum of the other timber answer the same purpose? But however, if the histories of those locusts were reverted to, it would most probably be found that they were killed some time in the summer; and it will also be found that if the decayed alburnum be not removed it will generate another disease, which in some respects resembles and is very often taken for the dry rot.

Numerous other instances can be brought to bear in this case. Farmers cut their rails in the summer, when the bark will peel, and they last from fifty to a hundred years. They account for the fact in this way: if they cut them in the winter, the bark will stick to the rails, and after a little while, the water gets under it and causes them to decay sooner. On the contrary, they cut their posts in the winter; probably this is done for the convenience of cutting holes in them at that season, and although their rails last so long, yet their posts begin to decay in about seven or eight years, according to the soil in which they are placed. When from necessity they are obliged to cut a few posts in the summer, (with the expectation however that they will soon decay,) if they last thirty or forty years, (and there are instances of this kind,) they speak of it as a very extraordinary circumstance, but never inquire into the natural cause, nor alter their practice. There are other instances of the extraordinary longevity of timber; wooden abutments to bridges, pumps, piles, foundations of wharves, coffer-dams, &c., a full notice of which would fill a volume, all go to show that there is a season in which to cut timber that will cause it to last for years beyond what it now lasts; and that there is a season in which to cut it, when it will not last over eight years, notwithstanding any artificial process through which the timber may pass.

Immersion in water was one process, that was thought good to make timber more durable, and which was practiced by the British government for a great number of years, and followed by that of the United States, until it was exploded; and according to the English writers on the subject, the life of *their* oaks averaged only about nine years, and that of our own favorite live oaks about the same period. Salt is one of those substances that in the popular opinion is good to make timber more durable, and hence the room between the timbers of every new vessel built by the government, is filled with it. But notwithstanding this, they have to undergo repairs in their hulls in about eight or nine years. So it has been with every artificial process, and so it will be until nature is more consulted, and her dictates more regarded.

Nature no doubt was the preceptor of the ancients, and particularly the Romans, who, it is said, girdled their trees, and let them stand until they were seasoned. Is not this more in accordance with the dictates of nature, than to place timber under water, and let it lie there for eight or ten years, to have its tubular fibres swollen and distended to such a degree as to destroy its elasticity and its firmness, and thereby prepare it for a more rapid decay? And what was gained by that practice? Truly nothing; for, eight or ten years was its life, before immersion, and it is no more than eight or ten years, after its immersion; and in what consists the value of salt, which only cools the outside surface, and therefore keeps it sound, but within, the disease is raging with redoubled violence. The only question is, when *did* the ancients girdle their trees? Was it in the winter? If any other proof is wanting, to show that they did not do it at that season, it 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. I think therefore, that we may fairly conclude that the Romans girdled their trees in the summer; and further, that they let them stand until the dry rot developed itself in the alburnum.

If the timbers in ancient buildings were examined closely, the season in which the trees were killed may be pretty correctly ascertained, for if cut in the summer, the powder-post will invariably be found on the alburnum, and if that has disappeared, there will be always some appearance on the heart-wood, that will show that the disease has been there, but never within its surface, and the same is true as regards the dry rot. The result of the following experiments will prove these facts. Cut two saplings, (no matter how small, if there be any heart-wood in them,) one in June, and the other in December. Take one piece of a convenient length from each, and put them into the garret, and one from each and put them into the cellar. In about three years it will be perceived that the powder-post has appeared on the alburnum of the one cut in June; and in the heart-wood of the one cut in December, of those in the garret; and that the dry rot has made its appearance on the alburnum of the one cut in June, and in the heart-wood of the one cut in December, of those in the cellar. By these experiments it can also be seen, that the cause which produces dry rot, under other circumstances will produce powder-post.

Although it is my opinion that June is the best time to cut timber to make it last the longest, yet it is probable that there would not be much difference in its lasting, if it be cut in either of the summer months. But there is a period in which, if timber is cut, the dry rot, or under other circumstances the powder-post, will appear both in the heart-wood and the alburnum, at the same time, although I have seen but few cases of it, and in those cases I had no knowledge of the time of the death of the trees; but I judge it is either late in the fall, or early in the spring, from the circumstance of the bark being closely attached to the alburnum.

It would be satisfactory to know the exact period when the tree was killed, from which the block was taken that is now undergoing the severe ordeal of the fungus pit at Woolwich, England; and if that cannot be ascertained, whether the dry rot first made its appearance in the alburnum or the heart-wood, of its fellow that was destroyed by it; and also to have a block taken from a perfectly healthy tree killed in June, with the alburnum removed and the surface of the heart-wood left perfectly smooth, and without any seasoning put into the pit.

ART. XVI.—*Additional Observations on the Shooting Stars of August 9th and 10th*, 1837; *communicated by* EDWARD C. HERRICK.

SINCE the last number of this Journal was printed, circumstances have prevented me from making any further search for August meteoric showers. Many more doubtless remain to be discovered, but the work of bringing them to light must be left to those who have access to libraries more extensive than this city contains.

In a postscript on p. 364 of the last volume, reference was made to Mr. R. W. Haskins's translation of the Report of M. Arago, (given in the *Comptes Rendus*,) concerning the meteors seen in August in various parts of Europe. The following is an abstract of that part of the Report which relates to the year 1837.

"*Paris*.—M. Arago's eldest son and one of his friends, counted in one hour, beginning 11*h*. 15*m*. P. M. of August 10, one hundred and seven meteors. From 0*h*. 57*m*. to 3*h*. 26*m*. A. M. of the next morning, (August 11,) MM. Bouvard and Laugier saw one hundred and eighty four meteors. The majority of all these radiated from the constellation Taurus.

"*Chateauroux*, *France*, N. lat. 46° 48′, E. long. 1° 40′.—M. de la Tremblais, travelling in an open carriage, from 10*h*. to 10*h*. 35*m*. August 9, saw *thirty* meteors. He noted but a small portion of the whole number visible. About 10*h*. P. M. August 10, he saw five or six meteors in fifteen minutes."

To the foregoing facts, I am happy to add the following important document, which was given me by my friend Mr. Samuel St. John, soon after his recent return from Europe. It will be noticed, that the observations which it contains, (made by himself and Dr. Parker,) relate to the night of the 9th of August. As M. Arago makes no mention of any meteoric display at Paris on that night, it may be presumed that the sky there was overcast at the time.

"While travelling in Switzerland, in August last, (1837,) in company with Dr. Willard Parker, of Pittsfield, Mass., I had the pleasure of witnessing a remarkable exhibition of *shooting stars*. The phenomenon excited in us unusual interest, but our situation rendered it impossible to observe with as much accuracy and fullness, as we desired. The following is a brief account of our observations.—On Wednesday, the ninth of August, we started from the town of Sion, (Canton of Vallais,) about eight in the evening, seated with the *conducteur*, at the rear of the Diligence, on the outside. On leaving the town, we found the sky entirely clear, and meteors falling in very unusual numbers. Our attention was much attracted by the display, and at five minutes before nine, (by my watch,) we began to count the meteors as they appeared, and continued counting until we had enumerated *three hundred*, when I found the time to be fifteen minutes before eleven, P. M. Here we ceased to count; but from this hour until our arrival at Martigny, at five minutes before 2 A. M. of the next morning, (August 10,) the meteors were apparently no less abundant than while we were counting. Both of us commonly looked at one and the same quarter of the heavens, and I think that we did not in the whole, see a greater number of meteors than a single observer, directing his attention to one and the same quarter of the sky, during that period, would have noted. The part of the heavens towards which we looked, was chiefly the N. N. E., taking in about 30° on each side of that point, but occasionally we included some of uncommon splendor, falling in other quarters of the sky. We remarked that many more appeared on the eastern than on the western side of this point. About one third of the meteors exceeded in apparent size, stars of the first magnitude, and most of the larger sort left behind them trains of sparks. The meteors were mostly of a brilliant white color; many however, were of a reddish hue and some showed a slight tinge of green.

"On our arrival at Martigny, we went to bed, and saw no more. The night of Thursday, 10th—11th August, when according to the report of M. Arago, unusual numbers of meteors were seen at Paris, we spent at the village of Chamonix, (Chamouni.) During the evening, the sky was much clouded, and a severe thunderstorm passed over;—of course no observations on shooting stars could be made. We retired as early as 10 P. M., and I do not know whether at a later hour any observations on meteors were made at that place."

It appears from the above, that in Europe, at least, the meteoric shower of August, 1837, was more abundant on the night of the 9th, than on the night of the 10th. At Paris on the 10th, two observers saw 107 meteors in an hour; while on the 9th, in the

Canton of Vallais, (Switzerland,) two observers, in circumstances much less favorable, saw 160 per hour.

The evidence at present before the public is scarcely sufficient to decide whether in general the August meteoric shower occurs on the night of the 9th or of the 10th of that month;—the date being reckoned according to the time of Western Europe or of the United States. During the present period, the night of the 9th will probably be found to be nearest the maximum. On leap-year, for obvious reasons, the meteoric showers may be expected to happen at a date somewhat earlier than on the common years succeeding.

The paper on ancient meteoric showers, promised on p. 358, of the last volume, will be completed as soon as practicable. It now comprises fifteen instances, viz. Ante C. 25, 29, A. D. 531, 744 or 747, 764, 901, 902, 935, 1094, 1095, 1096, 1099, 1122, 1202, 1243. To determine the precise dates of all these, according to the Gregorian or any other Calendar, requires much time. It appears certain, that some centuries since, the April and the August meteoric showers occurred at a date several days earlier, and the November shower several days later, than they do during the present period.

Since the preceding was written, I have received from Mr. R. W. Haskins, of Buffalo, (to whom the public are much indebted for his frequent communications through the *Daily Commercial Advertiser* of that city, of the earliest French intelligence regarding meteors,) his translation of M. Arago's Report to the Academy of Sciences, Oct. 16, 1837, on the meteors of November and of August. The details of the latter there given, in a letter from M. Wartmann, of Geneva, do not materially disagree with the facts above stated.

I have space only for the following particulars. On the night of Aug. 9, 1837, two persons on an excursion to Chamonix, saw from 9*h*. 30*m*. to 10*h*., more than forty meteors of great brilliancy. At Geneva, on the same night, from 9*h*. to 12*h*., eighty two meteors were seen. At 10*h*. they fell rapidly, and seemed to radiate from a point between β Bootis and α Draconis. Twenty miles from Geneva, the meteors were seen in much greater numbers.

New Haven, Conn., March 16, 1838.

MISCELLANIES.

GEOLOGY.

1. *Outlines of Geology, prepared for the use of the Junior Class of Columbia College;* by Jas. Renwick, LL. D. Prof. of Nat. and Exp. Philos. and Chem.: large 12mo. pa. 96. Printed by Henry Ludwig, 1838.

The author divides his subject under,

I. Physical Geography—which inquires into the form and external characters of our globe.

II. Geognosy—which examines the nature and relative position of the materials which compose its external crust.

III. Geogeny—which investigates the manner and order in which these materials have assumed their present position.

Physical Geography is treated under the following heads:

1. Of the figure and density of the earth.

2. Of the temperature of the crust of the earth.

3. Of the distribution of land and water on the surface of the globe.

4. Of the inequalities of the land.

5. Description of the two great continents.

6. Of rocks and fossils.

Geognosy.—The formations are divided as follows:

Modern formations, under six orders. I. Alluvial. II. Chemical. III. Diluvial. IV. Volcanic.

Ancient formations are either stratified or not. Stratified formations are included under five orders: I. Superior. II. Supermedial. III. Medial. IV. Submedial. V. Inferior.—Ancient rocks not stratified are included under six orders: I. Granitoid. II. Porphyritic. III. Ophiolitic. IV. Trachytic. V. Trap. VI. Volcanic.

Geogeny is not divided, except under paragraphs and pages. Of the latter there are 18; of the former, 20.

Physical Geography occupies 25 pages, and 54 paragraphs. Geognosy, 53 pages, and 139 paragraphs.

It will be seen that the above scheme covers the whole subject. To give even its outlines within the limits of 100 pages, requires of course great condensation. This has been effected by

Prof. Renwick, whose established character would lead us to expect what we actually find, not only precision and perspicuity, but also a graduated reduction of this great subject to a proportional scale, so as to preserve the harmony and distinctness of the parts, while there are citations of well ascertained facts sufficient to excite interest, and create conviction. In connexion with a course of lectures, properly illustrated by specimens and drawings, this elegant little work must prove extremely useful, as it may be said to be truly classical in its character; and we have no doubt that, for the classes of other institutions than the one for which it was prepared, and even for intelligent popular audiences, it may prove a valuable substitute for the larger geological treatises.

In relation to a work in which we find so much to approve, we have no disposition, as there is no occasion, to criticise; but we will state a few queries and suggestions, that have occurred to us during the perusal, and should the respected author see fit to answer them, the pages of this Journal are at his service.

With respect to the heights of mountains, we would inquire for the authorities that give an elevation to Nevado de Serata in Peru of 25,250 feet, and of Illimani 24,000; and more especially, we inquire in relation to the height of the mountains near the sources of Columbia, which are stated to yield very little to those of the Himmalaya peaks. This last statement is based upon the observations of the surveyors of the Hudson's Bay Company, but not having seen the details, we are not informed whether they are trigonometrical or barometrical, or if accurate observations have not been made, we should like to know upon what probabilities the conclusions are founded, and we are persuaded it would be gratifying to the public to be more fully informed. It has been heretofore supposed that Mount Washington, in New Hampshire, is the highest land in North America this side of the Rocky Mountains, and of Mexico; and in a recent ascent up the former mountain we have supposed this to be true, (see pa. 80 of this No.) We are not informed by Prof. Renwick what mountain in North Carolina is 7000 feet high, and on what evidence the conclusion rests. In relation to iron, which is mentioned as the only metal found in quantity in alluvial formations, it may be asked whether the alluvial gold of Africa, and of the middle geological region of the southern States, as well as of other auriferous regions, and the deep beds of stream tin of Cornwall, do not form an exception to the universality of this statement? With respect to *extinct* volcanoes, the word is not, it is true, used by writers very definitely; but we have been accustomed, with Dr. Daubeny, to regard all volcanoes as active which have been eruptive within the limits of history, or of credible tradition; neither of which will apply, for example, to Auvergne.

With respect to the coal formations, we believe that the existence in certain situations of marine shells, if not of marine plants, is admitted, implying perhaps only an estuary or occasional flooded or sea shore communication with salt water, while all agree that terrestrial organic forms are almost the exclusive ones in these deposits.

2. *Geological Reports.*

To those of us who were among the pioneers in American Geology, who began to observe and enquire when there were few or none to lead and direct; who looked out on the solid world with inquisitive, but with almost despairing gaze, since none could tell us what we saw, and there scarcely existed even the rudiments of cabinets to aid our enquiries—it is most gratifying to see, that the first third of the present century has brought into the field a phalanx of explorers in geology and natural history, respectable indeed for numbers, but still more respectable for knowledge, zeal, perseverance and success. The general government has prompted various explorations in its unappropriated wilds; companies and individuals are appealing to geologists to examine their mines and various supposed or real treasures, and several of the States have, by law, provided for an accurate reconnaissance, or a detailed and generalized survey of their respective territories. From the Canadas we have many interesting observations, chiefly by gentlemen connected with the British army, or in the civil service; Nova Scotia was explored some years ago by Dr. Jackson and Mr. Alger; Dr. Jackson is now executing the geological survey of Maine; Massachusetts has been fully described and delineated by Prof. Hitchcock, and Connecticut by Prof. C. U. Shepard and Dr. Percival.* Ver-

* The report of the latter, although drawn up, is not yet published; that of the former was cited in our October No. (1837.)

mont, New Hampshire and Rhode Island,* among the New England States, have not yet acted, but we trust they will ere long follow the example of their immediate neighbors, as well as of the more remote sister States. New York, New Jersey, Pennsylvania, Virginia, Maryland, Tennessee, Michigan and Indiana, are now in the full career of successful investigation under able corps, or able individuals, whom we have either already named, or expect to name in appropriate notices. Kentucky has taken the first step in authorizing a reconnaissance, and making a commencing appropriation of money, while the movements and demonstrations by colleges and other institutions, and the current of remark in the prints and in conversation, indicate a state of public feeling which almost assures an extension of geological exploration, as well as of kindred research in other departments of natural history, which we may confidently expect will eventually pervade the American Union. The popular sentiment, influenced by individual cupidity, or more enlarged views of public advantage as regards physical resources, is raising this subject almost above the contentions of party, and is almost a solitary point of agreement among those who can agree on nothing else. Almost half the States in the Union have authorized surveys by law, and the number will doubtless be yearly augmented.

In this view, science (not regardless however, of positive advantage to individuals or the community in gainful discoveries) still exults more peculiarly, in the extension of her sway, and in the discoveries that are constantly made, thus extending or correcting our elementary knowledge. The outlines,† once ably and correctly drawn, the fillings up will be always in progress, until detailed descriptions of particular districts, and even of individual mines and quarries, will accumulate in the treasuries of local and economical geology.

* Notwithstanding many valuable observations made in each of these States, and published by various individuals. Prof. Olmsted, now of Yale College, then of the University of North Carolina, Chapel Hill, deserves to be mentioned with honor, for having several years ago, brought to light many very interesting and valuable facts respecting that State. We have also various reports on the Gold Regions of the southern and southwestern States, and many other detached facts and observations from States and Territories not hitherto explored by public authority; and of these, not a few may be found recorded in the various volumes of this Journal.

† The services of William Maclure on this subject, will never be forgotten.

Drawing near to the limits of our time and space, when very recently most of the geological reports of the season came in, we shall give them such notice as may be in our power. In Vol. xxxii. No. 1, several of the geological reports were mentioned one year since. We have not received the continuation of all of them; those of Maine* and New York, of Maryland and of Virginia, for the present season, have not been received, while those of Ohio, of Pennsylvania, of Indiana, of Michigan, and of Tennessee, are before us.

Tennessee—4th Report, by G. Troost, M. D., Geologist to the State, Prof. of Chem. Min. and Geol. Nashville University, Member of the Geological Societies of France and Pennsylvania.

This report is confined chiefly to the rock formations of the district of Ocoee, of which a colored map and section are given on a scale of 21 inches by 19. This district lies in the S. E. angle of Tennessee, touching Georgia on the S., North Carolina on the N. W., the Tennessee river, the Hiwassee river and ranges of mountains.

Dr. Troost gives a preliminary sketch of elementary geology, with occasional illustrations from local facts, which occupies about half the report. He informs us, that in Tennessee there are no strata between the coal and the marl or green sand of Europe; all the intermediate sandstones, oolites, &c., which make so great a figure in England, are wanting in Tennessee, and it is not certain that they have been found any where on this continent. The order of arrangement exhibited in the section presented by Dr. Troost, is, beginning below, primordial rocks, grauwacke, mountain limestone, coal measures. It appears that in Tennessee "the grauwacke series is overlaid by an immense deposit of sandstone, which forms isolated ridges and mountains," unstratified so far as appears, color gray, and no organic remains; this rock he regards as equivalent to the old red sandstone of European geologists.

The carboniferous or mountain limestone is the most extensive of the rocks of the western country, and the most replete with organic remains; there are many varieties of rocks connected with it, and next above lie the coal measures, composed chiefly of strata of coal, sandstone and shale, with large deposits of argillaceous iron ore.

* A partial report of some important facts in Maine, is given by Dr. Jackson in our last number.

The rocks in the Ocoee district are arranged in the order named above. The glossy aluminous slate it was found had been mistaken for plumbago; but near the same place (Citico creek) there is a bloomery for iron, and decisive indications of iron ore; the bloomery is supplied chiefly from banks about two miles off. Tellico river rolls in constant rapids, in its course towards the Tennessee, and forms a cataract about two hundred feet high, and bears along gold and other valuable minerals. Dr. Troost was present in 1831, when gold was found there for the first time; the quantity hitherto found is small, quantities being derived as is supposed, from the primary mountains of North Carolina, whence the Tellico comes. Dr. Troost thinks there is much less gold in the Ocoee district than has been generally imagined; still there were parties of diggers that sustained their rights by force, and the usual delusion prevailed of inferring ores from Jack with the lanthern and other lights being seen, and from explosions being heard; and the divining rod (a forked twig of hazel or peach tree, which, as they assert, turns in the hand of the adept when he approaches the hidden treasure) was much relied upon. Carnelian has been found among the transported ruins of the Tellico, and good roofing slate and ornamental marbles abound in East Tennessee.

Dr. Troost has made a valuable collection of organic remains, and his report contains in a note an important catalogue of them. His name is sufficient authority for their accuracy.

Pennsylvania.—The second annual report, by Prof. Henry D. Rogers, State Geologist, presents the following divisions of the subject: Of the seat of the operations of the survey—Mode of conducting the geological observations—An outline of the geological structure and mineral resources of the north-eastern half of the Appalachian region of the State.

Formation No. I.—Sandstone of the South Mountain.

II.—Limestone of the Kittatinny Valley.

III.—Slate of the same valley.

IV.—Sandstones and conglomerates of the Kittatinny or Blue Mountain.

V.—Red and variegated sandstones and shales of the valley N. W. of the Kittatinny mountain, and of Montour's ridge.

VI.—Blue limestone along the northern base of the Kittatinny mountain, and along both sides of Montour's ridge.

VII.—Sandstone of the first ridge north of the Kittatinny mountain.

VIII.—Of the olive colored slate of the valley between the Kittatinny and second mountains.

IX.—Red sandstones and shales of the S. E. slope and base of the Alleghany mountain.

X.—Sandstones and conglomerates of the Second mountain, and of the S. E. summit of the Alleghany.

XI.—*Red shale of the anthracite coal regions.*

XII.—Conglomerates and sandstones immediately below the coal measures of the anthracite, the Broad Top and the Alleghany coal region.

XIII.—The anthracite coal measures.

General observations and concluding remarks.

This survey is detailed, both topographically and geologically, and we doubt not it is exact. Prof. Rogers has, in the main, avoided theoretical speculations, and comparisons with European systems and equivalents, wisely reserving these things for his general digest when his labor is through. Still, his remarks upon the anthracite coal beds furnish some bold and decisive speeculations as to elevations and other movements, which, however startling they may appear to an uninitiated mind, are without doubt founded in sound principles of geological dynamics, and we believe are substantially true. Having had some opportunity to examine parts of those vast coal fields, we have seen enough of the evidence of the exertion of irresistible, elevatory, disrupting and compressing or sliding forces, to convince us that no assumptions of that nature are in this region in the smallest danger of being extravagant; and it remains only to infer by just induction from the phenomena, the particular modus operandi in which the power has acted to produce its indubitable effects. Prof. Rogers has been zealously and efficiently assisted in his labors by Messrs. Samuel S. Haldeman, Alexander M'Kinley, Charles B. Trego, and James D. Whelpley, and in the chemical department by his brother, Dr. Robert E. Rogers. The sub-assistants were Messrs. Alfred F. Darley, Edwin Haldeman, Horace Moses, and Peter W. Schæffer. This able report is comprised within ninety three pages, and is furnished with a glossary, and a shaded sectional arrangement of the strata, in the following ascending order, beginning upon the common basis of the primary rocks. The contents of each particular formation are given in the descending order.

I.—Compact white sandstone—1000 feet.

II.—Blue limestone, with beds of chert, and a few fossils—6000? feet.

III.—Roofing slates, dark slates, and argillaceous sandstones, a few fossils, bed of limestone—6000 feet.

IV.—White sandstone, fucoides—1800 feet.

V.—Red and variegated (fossiliferous iron ore,) shales and sandstones (fucoides)—3000 feet.

VI.—Blue argillaceous limestone (fossils)—900 feet.

VII.—Coarse white sandstone (cavities of fossils)—700 feet.

VIII.—Olive colored slate, and gray argillaceous sandstones—5000 feet.

IX.—Red shales, and red, gray and buff colored argillaceous sandstones, a few marine fossils—6000 feet.

X.—Sandstone and conglomerate—2000 feet.

XI.—Red shale, thin calcareous conglomerate—3000 feet.

XII.—Siliceous conglomerate—1400 feet.

XIII.—Coal measures, consisting of seams of coal, dark shales, argillaceous sandstones, and siliceous conglomerates; vegetable fossils—6750 ? feet.

Total thickness in feet—42,550, or over eight miles of exterior crust, stratified on the primary.

Michigan.—Report of Dr. Houghton, 37 pages.

This young State has set a laudable example, in ordering a geological survey, under Dr. Douglass Houghton, which he has carried on with peculiar zeal, considering especially the great physical difficulties of a country, much of which is still in a state of nature. The State is in its infancy, and although rapidly filling with an intelligent population, it is still, with the exception of a few counties, only sparsely peopled by those who have been too much occupied with more urgent necessities, to give even a moderate degree of attention to the mineral objects around them ; for this reason, the amount of local information imparted by the people was limited, and not always free from error. Dr. Houghton remarks, that there are on the peninsula no mountain chains, no lofty mural precipices, or deep valleys, where a glance will reveal the structure, and even quarries of stone (for there are very few on the surface) have been scarcely opened. To those parts of the State which are geologically the most important, there are no avenues, except by the streams and the trails of the Indians. "The ascent of a rapid stream by a canoe (the only feasible mode of travelling, and the only manner by which examinations can be satisfactorily conducted,) is attended by fatigue, labor and hardships, of the most severe kind. Wading the streams by day, and annoyed by musquetoes at night, separated for weeks together from all society, were it not (he remarks) that the mind is completely occupied in the contemplation of objects, which, from their symmetry and beauty, furnish a constant mental feast, there would be nothing which could possibly compensate for the hardships endured." In addition to these difficulties, which are not easily conceived of by those who explore a country full of conveniences and comforts, we are sorry to learn, that "the appropriation for the past year has not been sufficient to cover the *travelling expences* of those engaged in these arduous duties." This ought not so to be, and if we had cause, on a former occasion, to enter our protest against the narrow provision made for a similar duty in the most powerful and opulent State in the Union, we need not so much wonder at the caution of a young State, which however, we trust will prove by an enlarged appropriation, that she is not behind in liberality and justice, especially where they are so well deserved as in the present instance.

The rocks of the peninsula of Michigan consist, "for the most part, of nearly horizontal strata of limestones, sandstone, and shales, giving character to a beautifully varied succession of hills and valleys, as also to a soil admirably adapted to agriculture." That part of the State bordering on Lake Superior, presents occasionally primary and trap rocks, forming mountain chains, with strong marks of disturbance since the deposition of the red sandstone.

The divisions of his subject, stated by Dr. Houghton, are as follows:—Upper sandstone of the peninsula; gray limestone; lower sandstone, or grauwacke group; coal; gypsum; brine springs; clay; sand; bog iron ore; mineral springs. The sandstone belongs to the carboniferous series; the rocks appear to have been shattered, as if by convulsions, their ruins forming deep loose masses, and being mixed with the soil. Shale is found mixed with fragments of coal, and occasionally containing thin seams of it.

In the counties of Ingham and Eaton there are thin beds of coal from half an inch to three inches, and even one foot in thickness, and near Corunna were seen numerous indistinct impressions of plants, with small pieces of coal, retaining the ligniform structure, but perfectly carbonized. Loose pieces of coal are found quite universally in excavating around most of the counties bounding the coal formation; and on Grindstone creek there is found a bed, having an average thickness of eighteen inches, and not exceeding two feet at any point. It is expected that a canal will cross the coal formation at a point where there is reason to hope that beds of coal will be brought to light. In the carboniferous limestone underlying the coal, are found sulphate of strontia and sulphate of baryta, brown spar, hog-tooth spar, gypsum, &c. The red sandstone of the graywacke group rises at the pictured rocks on Lake Superior, in a mural precipice of two hundred to three hundred feet high. Gypsum appears above the surface, and probably exists in large masses in Kent county.

There are numerous salines and salt springs in Michigan, and a copious table is annexed, exhibiting their contents, and comparing them with those of salt waters in New York, Ohio and the Atlantic; it is obvious from this comparison, that the salines of Michigan may hereafter prove very valuable, but as yet they have been little developed. The temperature of the different springs was from 48° to 51° Fah.,* while that of fresh water in the vicinity was usually about 50°. In Michigan, as elsewhere in the west, the Indians were acquainted with the salines, and extracted the salt in a rude manner. The wild animals also found their way to these licks, (as they were called,) and their paths often gave the first information of the existence of the springs.

Nearly the whole western coast of the peninsula next to the lake, is bordered by a succession of sand dunes or hills of loose sand, not unfrequently attaining a considerable altitude, partly naked, and in part covered by dwarf pines and cedar, and should these be thoughtlessly removed, the sands might drift, and prove a serious evil.

Marls are common, especially in the northern parts of St. Joseph's, and the adjoining counties. Bog iron ore exists in vast quantities near Kalamazoo and Detroit, and other places. There are sulphureous springs in Monroe county; and near Havre there is a spring of this description, whose circumference is one hundred and fifty feet, its depth thirty five, and the stream is sufficiently copious to turn a mill.

Topographical maps of the several counties are in the course of preparation, and the geological survey will be prosecuted, we trust, with vigor and success.

In addition to Dr. Houghton, the corps consists of Ab'm. Sager, principal assistant in Zoology and Botany; S. W. Higgins, Topographer and Draftsman; Columbus C. Douglass, Sub-Assistant; Bela Hubbard, Sub-Assistant; William P. Smith, Sub-Assistant, in charge of Mechanical Zoology.

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* In one case, 46°.

Indiana.—Report, by David Dale Owen, M. D., Geologist of the State, 34 pages.

Divisions of the subject.—An introductory Address to the Legislature of Indiana—Leading principles of Geology—Plan of conducting the Survey—Summer Survey south of the national road—Fall Survey north of the national road—Remarks on the mineral deposits, soil and growth, peculiar to the different strata, south of the national road; north of the national road—Practical inferences—Appendix.

The survey, hitherto made, has been general, the object being to gain a clear and connected idea of the whole, before examining particular places, in detail. It was ascertained that the order of superposition of the strata was the same as in many other and distant parts of the western States, and that the characteristic fossils of each series of strata agree in a remarkable manner with those found in the corresponding strata throughout the western States.

Mr. Owen finds that the entire western portion of Indiana is rich in coal, which, as the forests are fast disappearing, must become of the greatest importance. This fact cannot fail to arrest the attention of the legislature, and of the people; and as a proof of the importance of geological knowledge, he cites the instance of an expensive, but fruitless, exploration for coal near Baltimore, in a situation where a well instructed geologist would never have looked for it, as the formation was too recent, and the substance discovered and mistaken for coal, was lignite. As evidence of the importance of correct geological knowledge, he justly cites other instances of the natural associations of minerals; for example, of the oxide of tin, with primary rocks, and its absence from more recent rocks. The dip of the strata in Indiana is such, being to the east, as to place the coal on the top of the formations towards the western part of the State, and down the Ohio; except the diluvium, it is the newest formation; while up the Ohio, or east, we constantly arrive at older and older strata.

Mr. Owen gives a clear statement of the sub-carboniferous rocks, among which he names a limestone, having an oolitic structure, "composed of egg-shaped grains, like the roe of fishes;" this is of course, geologically, a very different rock from the oolite of Europe, whose position is far above the coal formation. Next below, is a siliceo-calcareous rock, containing marine remains of the coralline family. Lower down, is a bituminous aluminous slate, sometimes mistaken for a part of the coal series, but no coal is ever found beneath it.

Still lower down, the rocks are very fossiliferous, and among these rocks is a good hydraulic lime. There is a very good burr stone, almost entirely made up of a series of fossil corallines, often cased in a sheath of drusy crystals of quartz. These burr stones have served well as mill stones. The lowest limestone beds are exceedingly rich in fossil shells and corallines; the rock is of a gray color, and when polished, forms a marble, adorned by the organic remains. Near Indianapolis, and the great national road in that vicinity, the rock formations are covered by diluvium, so thick that the deepest wells have not penetrated through it: the same is the fact on the north side of the national road.

It appears that bowlder stones of primitive rocks are numerous in Indiana, especially in the northern and prairie region of the State; they are called by the expressive name of lost rocks, also gray heads, and negro heads.

The northwest corner of Indiana is bounded by Lake Michigan, which in this part has for its bed a stiff tenacious clay, and still the water is so clear, that the fish, as in Lake George, can be seen, in calm weather, at a great depth. The southern boundary of the lake is composed of rolling ridges of siliceo-calcareous sand, and it is remarkable that this sand, taken from thirty or forty feet deep, will produce excellent potatoes, water-melons and pumpkins: wild rye, six feet in height, and rank grass, are said to have formerly grown at the top of the sand knobs, sixty or seventy feet high: the mixture of the lime with the sand accounts for this fertility. South of the national road, is found the compact hydrated brown oxide of iron, of good quality: some of it is in a conglomerate state, made up of fragments of the ore. There is also carbonate of iron.

At Troy is found a valuable material for pottery—the potters call it marl—Mr. Owen, clay slate (slaty clay? Ed.) It is hard when first dug, but crumbles on exposure to the air. This furnishes the raw material for the fire-brick, and saggers for a manufactory of queen's ware and porcelain; the clay for the latter is brought from the clay banks on the Mississippi, (erroneously called the chalk banks,) and near to the manufactory, there are good beds of potter's clay for the more common ware. Coal exists abundantly in the vicinity in several places, and some of it (on Deer creek, near Troy) is cannel coal. A party of forty potters from Staffordshire, under Mr. Clue, and a company formed in Louisville, have already begun this important manufacture of stone ware, and the first kiln was burning in June, 1837. Carbonic acid exists abundantly in the waters of this country; much iron and lime are held in solution by it, and again deposited as the carbonic acid evaporates, the former as bog iron, which in one place (Mishawakee) is fifty or sixty yards wide, and from seven inches to three feet deep, and so firm as to require an iron bar to raise it. The lime is deposited as tufa, and it is a curious fact, that, as the limestone rocks are buried deep under diluvium, and are therefore in a great measure inaccessible, the inhabitants resort to the calcareous tufa and calcareous bowlders, for materials to afford quick lime by burning.

Mr. Owen justly concludes that three geological formations exist in Indiana.

1. A bituminous coal formation, occupying that portion of the State west of the second principal meridian.

2. A limestone formation, (similar to the mountain limestone of European geologists,) prevailing in the counties east of that meridian.

3. A diluvium, consisting of deposits of clay, sand, gravel and bowlders, overlying, and in many places covering up, the two other formations, to a greater or less depth, particularly in the northern part of the State.

He infers on unanswerable grounds, that Indiana was long under an ocean, which furnished the innumerable marine organized bodies, found in such profusion enclosed in the solid rocks, especially the lower limestone.

There are some very judicious remarks on the useful materials found in the State, and on the nature of its soils, and the causes of their great fertility. This is attributed to the position of Indiana, near the middle of the great valley of North America, which has been the receptacle of a vast variety of the ruins of rocks, of many formations, thus affording the requisite materials for the best soil, among which lime, clay and sand, are conspicuous, with a portion of iron, and abundance of carbonated calcareous waters, and better materials could not be desired, especially for the growth of wheat, and of other grasses. The report is concluded with suggestions as to a future detailed survey, which, as they are (like the entire report) marked by much good sense and correct knowledge, ought to command, and we trust will secure, the attention of the legislature and people of Indiana.

Ohio.—First annual report on the Geological Survey of the State of Ohio, by W. W. Mather, principal Geologist, and the several assistants; 134 pages with a map and sections. Columbia.

The extent of this exploration and the diversity of objects which it has embraced, will be best understood from the divisions of the subject which we annex, made up from the contents and index; and the names of the gentlemen who acted as assistants, will appear in connexion with the contents of their several reports.

Prof. Mather's Report.—General considerations.—Coal, quantity, its practical value compared with Charcoal for furnaces, annual prospective consumption of it, means of motive power inexhaustible.—Iron Ore, extent.—Iron trade, reduction of iron ores. Limestones, extent and uses, marbles, galena and fossils.—Sandstones, importance for public works, uses and export.—Clays, uses for bricks, pottery, &c.—Peat, varieties and uses.—Soils, productiveness, texture, substrata, drainage, and composition.—Mineral manures, limestone, gypsum, marls and lime.—Mineral springs, salt springs, petroleum.—Alluvial action on the Muskingum and Ohio, on the Lake coast, at Fairport, Chagrin, Cleveland, &c.—Analysis of coal and ores, coal for smelting, manufacture of coke in Ohio, used in high furnaces.—Importances of determining the dip.

Dr. Hildreth's Report.—Introductory remarks, coal fields of Great Britain, extent of coal in Ohio.—Rock strata above the buhrstone.—Buhr-stone, range and extent, value and importance, quality and character, French buhr compared with the Ohio buhr, mineral contents of the calcareo-silicious rock, agricultural character of the Buhr-stone region, iron ore with the buhr-stone, strata between the buhr and upper fossiliferous limestone.—Upper fossiliferous limestone, range and extent.—Strata between the limestone and Pomeroy coal beds.—Pomeroy coal beds, range and extent, fossils which accompany them, agricultural character of the region.—Strata between the Pomeroy coal and limestone coal.—Limestone coal, range and extent.—Limerock, non-fossiliferous.—Stone marls, range and extent of lime and marls, agricultural character of the region.—Fossil fresh water shells, fossil contents of red shales.—Upper bed of coal.—Coarse sandrock and conglomerate, their grottoes and caverns.—Upper series of sandrocks.—Salt springs and their early history, salt manufacture, remarks on the salt producing rocks.—Quartz or calcareo-silicious rock.—The Scioto salines, early legislation on the Ohio salines, Muskingum salines, Gallipolis salines, leading creek salines, Hocking valley saline, Muskingum valley saline.—Number of salt wells and manufacture.—Petroleum and carb. hydrogen gas.

Prof. Kirtland's Report.—Introductory remarks.—Advantages of the survey and from the study of botany.—Economical importance of zoological knowledge.—Coloring materials from vegetables.—Importance of our native plants.

Prof. Briggs's Report.—Reconnaissance of country between the Scioto and Hocking rivers.—Geological sections.—Aspect of the country.—Importance of the hilly character of the country.—Mineral deposits and dip, mode of determining the dip.—Groups or sub-divisions of rocks.—Limestone district, uses for marbles, building, &c.—Slate described by Mr. Foster, minerals in the slate, alum, copperas, gypsum, &c., mineral springs and bog-iron.—Waverly sandstone series.—Conglomerate.—Lower coal formation, sandstone, shales, limestone.—Coal of Hocking valley, Jackson, and adjoining counties, its quality in the lower series, between Scioto and Hocking.—Iron ore, furnaces of Scioto and Lawrence, construction of furnaces, roasting and smelting ore, iron ore of Jackson county, prospective iron manufacture, lead and zinc ores, salt wells, their geological position.—Fossil bones.

Col. Whittlesey's Report.—Original surveys, highways, character of the country, Ohio and Scioto rivers, streams, Jackson county, salt springs, timber, ancient works, change of names, Virginia military reservation, untaxed lands, military bounty lands. Western reserve, unsurveyed shore, geological queries, glossary of geological terms.

As in the case of Pennsylvania, the very extent and variety of the research, almost preclude the attempt to give even a general notice of the principal facts, and if we seem to give greater prominence to the newer states, it is because they are less known, and also because copious details concerning the geology of Pennsylvania and Ohio, have been already given, in former volumes of this work; of the coal and salines of Ohio, by Dr. Hildreth, and of the coal in two principal districts of Pennsylvania, by the Editor of this Journal, and the Rev. George Jones. Our limits, also, warn us to be brief, and we may expect a better consummation from the gentlemen themselves, when their labor is accomplished.

We have also another reason for brevity in the case of the Ohio report; for just as this number of the Journal is about closing, we have received an analysis and review of that report—too long and too late for the present number, but which will appear in our next.

If we have any thing to add to the review, we shall not therefore anticipate it now. In concluding, we have only to say, that both Pennsylvania and Ohio, are states whose territories are stored in abundance with the principal substances most necessary to man; coal in its most important varieties, salt, limestone, iron ore and many other things. Ohio, is eminently a vast region of organic remains, and even its human antiquities, arrest the attention of the geologist as well as of the antiquary. Both States are in the course of survey by very able men, but we are extremely sorry to see that Dr. Hildreth, who worked early and almost alone—who worked hard, and who worked well, has withdrawn from the survey, and we are still more sorry to observe that ill health is the cause; for his country's sake and his own, may he soon be well again!

Dr. Locke, by reason of absence in Europe, did not perform the duty assigned to him.

By a letter from Columbus, we regret to learn, that the survey is just suspended, and party grounds are assigned as the cause! On such a subject, there should be but one party. The noble State of Ohio, must and will vindicate her honor and her interest by resuming and finishing this great work, so ably begun and carried forward with so much spirit and success!

3. *Fossil Fishes.*—It is very generally known at the present day, that fossil fishes abound in the sandstone formation of the Connecticut river valley. As the study of these fossils, in connection with the rocks in which they are imbedded, has become a science of daily increasing interest and importance, it seems desirable that every one should contribute what local and practical information he may possess, in aid of this important object.

Prof. Hitchcock has particularly described localities in several towns of Massachusetts; but, so far as I know, he has only occasionally alluded in general terms to the occurrence of ichthyolites at Middletown, Ct. One of the earlier numbers of this Journal contains a brief account of some specimens procured at Westfield, the western parish of Middletown, from a pit excavated some years ago, with the delusive expectation of finding coal. But the notice states that they were taken up many feet below the surface, and in such a situation as would render it impossible to obtain more, unless the mining operations should be resumed. Fortunately for science, a much more favorable locality has since been opened in the vicinity, from which the fish impressions may be obtained in almost any quantity, with but little exertion. Fossils of the same kind are also procured in Middlefield, the adjoining parish, at a locality which has been known for several years.

Having in the past year visited both these places repeatedly, I submit the following remarks, which may be interesting to geologists.

The Westfield locality is situated about three quarters of a mile in a north direction from the Congregational church, in the bed of a small stream, which becomes nearly dry in the autumnal months,—the most favorable season for procuring the fossils. The operations of previous explorers are observable for several rods down the stream; but the peculiar site which seems to afford specimens the best defined, in the greatest abundance, and with the least labor, is just west of a large spring, in the channel of the brook. The impressions found here are usually so indistinct as to render it difficult to recognize the minute characters by which species are usually distinguished. In a paper recently read before the Lyceum of Natural History of New York, Mr. J. H. Redfield has offered names for two varieties, common to this place and Middlefield: one of these he calls *Catopterus gracilis*, and the other, *Palæoniscus latus*. Without doubt, other species, if not genera, will hereafter be recognized. A single individual, of extraordinary size, which it seems difficult to refer to either of the above genera, was obtained here last season, and is now in possession of Mr. Jennings, a young gentleman of the Wesleyan University. The rays and scales are not sufficiently well defined to admit of a correct and precise description. The following are some of the dimensions, as found by accurate measurement, viz. Breadth of caudal fin, $3\frac{1}{2}$ inches; length of anal fin, $3\frac{1}{2}$; length of dorsal fin, $2\frac{1}{2}$; greatest breadth of body, 4 inches; least do. $1\frac{3}{4}$ inches. The head and anterior portion of the body are wanting, the specimen being broken off near the base of the dorsal. Probably the whole length was not less than 16 inches. The stone in which the fishes occur, is a hard and brittle slate, or bituminous shale, interstratified with sandstone, and bearing some traces of vegetables converted into coal. A few indistinct specimens of a fossil, bearing a strong resemblance to the eel, have recently been discovered; but perhaps they will be referred to the family of flags. Visitors will find it necessary to obtain permission of the female proprietor.

The Ichthyolites of Middlefield are found on land of Mr. George Miller, at a spot locally known by the name of "Saw-Mill Hollow," near the Durham line, about four miles S. S. W. from the city of Middletown. The strata of slate bearing the impressions, have a thickness of six or eight inches, and are situated near the bottom of a narrow ravine, excavated by a small stream which falls over the ledges, and affords a beautiful piece of scenery. Specimens are not so easily procured here as at Westfield, but they are far more perfect, both in vividness of color and distinctness of impression. The most delicate parts of the fins and scales are almost invariably preserved. It is very rarely that any vestige of bones is met with in that part of the body covered by scales; but traces of them about the head are not uncommon. It is no unusual thing to find impressions perfect in every part, with the exception of a fin, or a portion of the tail, or a narrow strip along one side of the body, which are sometimes seen lying at the distance of two or three inches, and sometimes are removed by greater intervals. Not unfrequently the fish appears to have been entirely decomposed previous to its becoming fixed in its stony bed, so that the rays and scales are scattered in all directions over a space of one or two square feet, no two of the scales, perhaps, being observed in connection. The slate, upon which the impressions are found, is very strongly impregnated with bitumen, and occasionally presents thin layers of calcareous spar. It occurs in every variety of texture, from the finest clay up to the coarsest conglomerate; though no ichthyolites are seen except on three or four of the darkest colored and most delicate layers. Below the fish strata, as well as above, the slate, well characterized, is several feet in thickness; after which, it passes gradually into sandstone.

The erroneous opinion, somewhat extensively circulated, of this locality being exhausted, probably arose from the difficulty experienced in excavating the rock, which, owing to its peculiar position, is not so easily quarried as that of Westfield. But if visitors go adequately prepared, and with a proper guide, and commence operations on a scale sufficiently extensive, little difficulty will be experienced. The most proper course to be pursued is, to pry out the rocks which have been loosened by the ice of the preceding winter. Blasting will be of no use, as the slates are thereby shattered in pieces, and they do not separate in layers till after the frost has acted upon them. The proprietor of this locality is one of those enlightened and enterprising farmers, whose leisure moments have been devoted to reading, study, and meditation upon scientific subjects. He takes great pleasure in assisting strangers who may visit the place, and is ready at all times to communicate any desired information.

I have obtained as many as five species from Middlefield. Whether they have as yet been named, with the exception of the two varieties mentioned above, is somewhat uncertain, owing to the rarity of works which treat of fossil ichthyology. If they have not, I wait for other and more experienced collectors to describe and classify them. D. L. H.

Central Village, Ct., March 15, 1838.

4. *Fossil Fishes in Virginia; from* William C. Redfield.—William Kemble, Esq., of this city, has kindly placed in my hands a fragment of shale containing beautiful impressions of fishes, of which portions of twenty individuals can be made out on one side of the fragment, the size of which does not exceed twelve by eight inches. It was brought to this city by Mr. George B. Cook, from the Virginia coal region, thirteen miles west of Richmond, and was obtained a few days since, about two hundred feet below the surface, and beneath one hundred and eighty feet of rock, in a new shaft which is excavating in quest of coal. All the impressions appear to belong to a single species, are four or five inches in length, and nearly resemble the *Catopterus gracilis* described in the fourth volume of the Annals of the New York Lyceum of Natural History.

New York, April 6, 1838.

5. *Analysis of the scales of the fossil Gavial of Caen, in Normandy;* by A. Connell, Esq., F. R. S. E., &c., in the Ed. New Phil. Jour. No. 46.

Mr. Connell found the constituents of the Caen scales to be as follows:

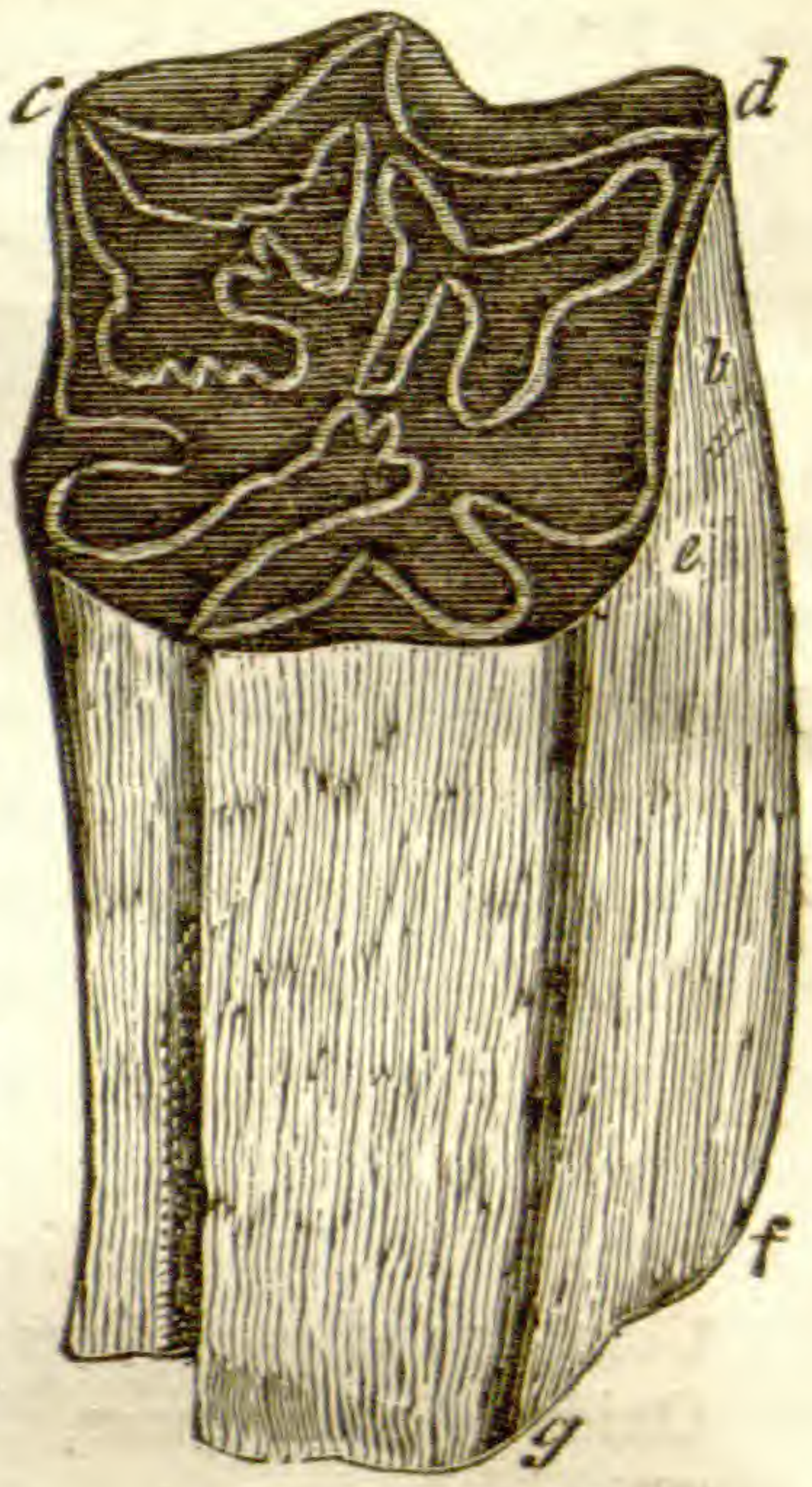
Phosphate of lime, with a little fluoride of calcium,	78.59
Carbonate of lime, - - - -	12.53
Sulphate of lime, - - - -	1.96
Phosphate of magnesia, - - -	.11
Chlorides of potassium and sodium, - -	.74
Oxide of manganese, - - - -	.45
Siliceous matter, - - - -	.37
Water, - - - - -	5.07
	99.82

The author, from the above analysis, concludes that these scales were originally of the nature of bone, and in all probability analogous to the osseous scales of fishes; and hence the presence or absence of bone-earth in such fossil relics can be of no service in determining whether they had belonged to saurian animals or to fishes, as he at one time, from the usua views of chemists respecting the nature of recent saurian scales, had thought might have been the case.

6. *Interesting Fossils found in Louisiana.*—The following is an extract of a letter to the Editor, from W. M. Carpenter, A. M., M. D., dated Jackson, La., Feb. 6, 1838. The fossils herein described were found in the parish of West Feliciana, about 25 miles from this place, on a small stream which is called Little Bayou Sara, in a part of the country whose geology is different from the greater part of Louisiana, in not belonging to the delta formation. This formation runs from the lower part of Alabama across the lower part of Mississippi westward, until it strikes Lake Ponchartrain, continues around the eastern shores of this lake, and

then N. E., until it strikes the Mississippi river at Baton Rouge. It then continues on the eastern side of this river up to Vicksburg, forming the steep bluffs on the eastern side; it then crosses the river, and extending across the country, strikes the Red river at Alexandria; from thence it passes down southward, its eastern boundary being almost exactly parallel with the Bayou Bœuf, lying altogether W. of this river, and continuing on to the sea, but inclining more to the westward after it reaches the parish of Attakapas. This is the formation over which the prairies are found. It consists first of clay, composed of aluminous clay and sand in various proportions, sometimes almost without grit; next of a layer of rolled pebbles; then a layer of sand; then a layer of aluminous clay, varied red and white, sometimes in nodules of irregular form; then quicksand; and then a similar layer of variegated aluminous clay. The fossils generally found are not *in situ*, but are confined to the rolled pebbles, which contain impressions of shells, encrinites, and asterias; they are (no doubt) quartz replacements of lime.

Fig. 1.



The fossils above alluded to were found in the first layer, beneath the vegetable mould, that is, in the sandy clay. They were—First: a mastodon's molar tooth, corresponding exactly with that figured in Cuvier's Ossemens Fossiles, third edition, Vol. I, Plate 1st for Mastodon, Fig. 1. This tooth weighs 6½ pounds. Second: a part of the right lower jaw, containing two teeth of the mastodon, but evidently a very young animal, as they were not at all worn; the whole weighs eight pounds. These teeth have only three ridges transverse. These were found about a mile apart. Thirdly: a molar, somewhat similar to the first, but much larger, and the transverse ridges of the crown, which were four, are worn down almost smooth; weighs 12 pounds. Fourthly: a tooth which was found with this last, (about two miles from the two first.) It is the third molar of the upper right jaw of a horse. A drawing of the crown, and oblique view of two sides, is given at Fig. 1; the outer side of the tooth is shown at Fig. 2; the front side at Fig. 3.

There are some slight deviations from the common forms of the festoons of the enamel upon the crown; but differences frequently are found in the forms of these in living horses. From *c* to *d*, (Fig. 1.) measures an inch and a quarter; from *d* to *f*, (Figs. 1 and 3.) it measures 3½ inches, though all of the hollow or shelly parts of the roots are gone, which in common horses measure ¾ of an inch. This would make the original length of the tooth more than four inches. The size of the tooth in other directions was about proportional. Now as these measurements go far over those for our largest horses, they would seem to indicate a fossil horse larger than those of the present epoch; whereas Cuvier says that all the bones of horses seen by him, indicated the former existence of small horses. (*Ossemens Fossiles*, 3d edition, Vol. II. pp. 112, 113.) This fossil is rendered interesting, as the remains of the horse are but seldom found fossil in America.

Fig. 2.

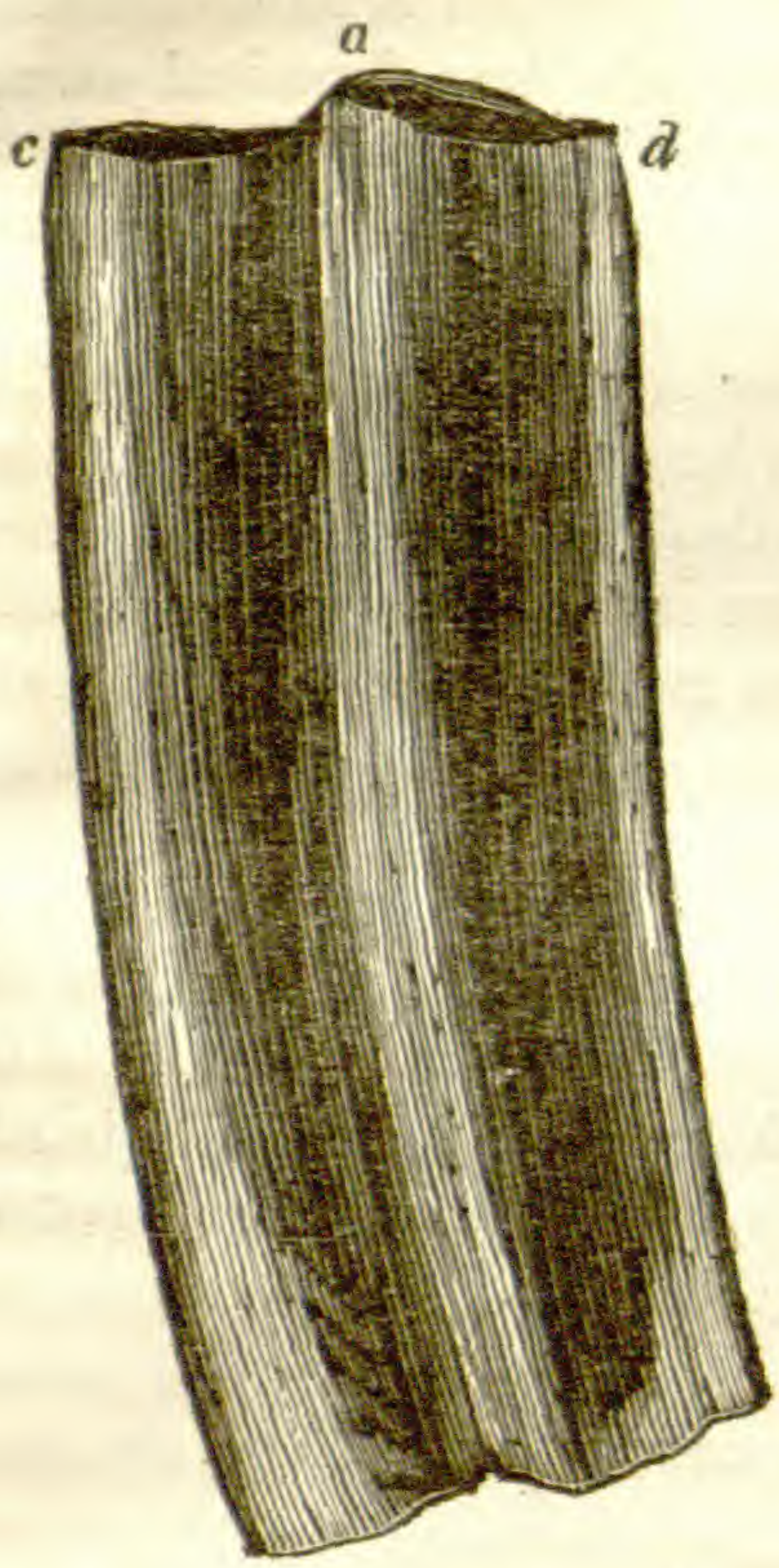
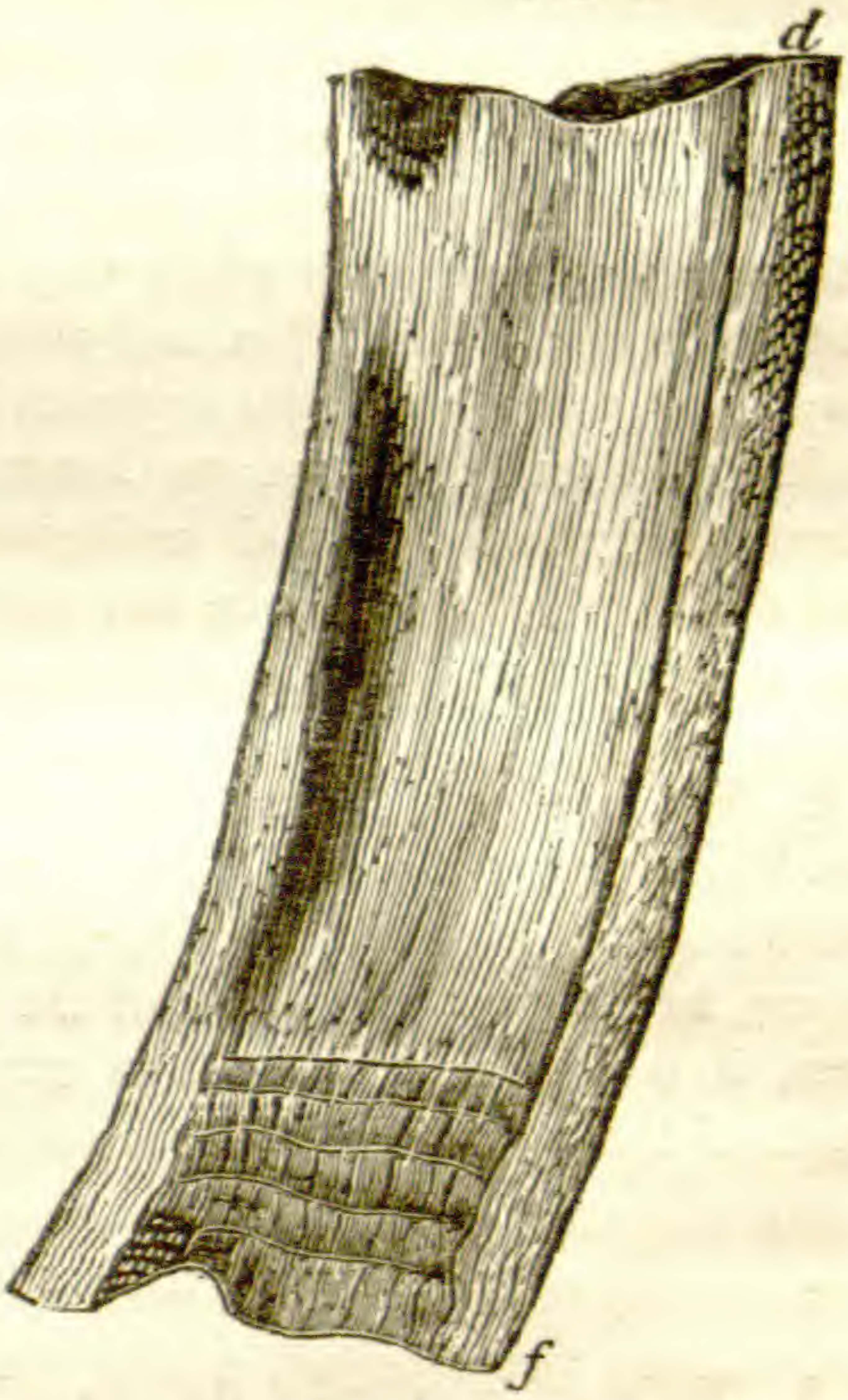


Fig. 3.



The enamel of all these teeth is in a good state of preservation; the internal or bony parts have a peculiar ferruginous color, a little deeper than that of the sandy clay in which they were found; they are very fragile. The large mastodon's tooth and that of the horse were found immediately together, at a considerable depth (several feet) beneath the original surface.

These fossils came from a neighborhood which seems to abound in those of the mastodon. A molar was found about six or seven miles from the same place, several years since, weighing 13 pounds. It was sent to England by the person who obtained it.

Those lately found are in my charge, deposited in the cabinet of the College of Louisiana.

7. *Sienitic Granite, near Christiana, Norway.*—An eminent English geologist, who has recently visited this famous granite, states, that "it occupies a mountainous country, and has (geologically considered) the true granite character, and that Von Buch was quite right in affirming that all of it is decidedly newer than the shales and limestones containing trilobites and orthoceræ, &c.; that it sends off veins into this transition formation, and hardens and alters it for a considerable distance, without deranging its strike or dip; yet this same granite, so decidedly newer than the Siberian strata of Norway, passes sometimes into gneiss, and in other places sends veins into gneiss; yet this gneiss is much older than the fossiliferous transition strata, having been disturbed in its stratification and greatly denuded before the fossiliferous beds were deposited unconformably upon it. I never had an opportunity before," remarks the observer, "of seeing a perfect gradation into each other of these two crystalline rocks, in a country where they can be proved to be so extremely distinct in age. How often may other masses of granite be newer than we suspect, where no similar evidence is at hand to establish their chronological relations?" It can no longer be doubted that granite has been occasionally thrown up in all geological ages not more recent than chalk, and therefore granite may be not only the most ancient rock, but also one of the newest.

8. *New locality of Tourmaline.*—Brown tourmaline was found by us last September at the steatite quarry near Orford, N. H., of great size and perfection. It is firmly imbedded in the steatite of certain portions of the quarry, to the great annoyance of the workmen; and owing to its brittleness, it is somewhat difficult to extricate it unbroken from its matrix. Some of the crystalline faces are curiously modified.

GENERAL PHYSICS AND CHEMISTRY.

1. *Notice of a splendid Aurora of* 1789—communicated by the Rev. Prof. Henry Ware, D. D., &c. of the University of Cambridge, Mass.—On the evening of Saturday, Nov. 14, 1789, at Hingham, Mass., was exhibited the most remarkable Aurora Borealis that I ever witnessed. It first attracted my notice at about seven o'clock; and from that time till eleven,—and I know not how much longer,—was exhibited a constant succession of rapid and surprising changes in shape, color, extent and motion.

At about ten o'clock a large portion of the northwestern quarter of the hemisphere was covered for a considerable length of time, with a dark uniform blood color,—continually, but by a slow and graceful motion, varying in its shape and extent; at the same time that the exhibition of various hues was continued in the north and east. At about half past ten, there burst out in the southeast, at the elevation I should think of about 45°, a light of dazzling splendor, which rapidly spread itself around in all directions, becoming less distinct, as it was further diffused. At first the brightness was too intense for the eye; and after it had lost much of its brilliancy by its diffusion, it was still such as to enable me to read the finest print by its light with great ease. It continued to spread around in every direction, until the whole hemisphere was covered, and a beautiful crown was formed in the zenith, exhibiting all the colors of the rain-bow. The bursting forth of the brightness in the southeast was instantaneous, and of about the apparent size of the moon. It was as if the blue concave had been pierced through by a cannon ball, and torrents of liquid silver at a white heat had rushed through the aperture, rolling along in waves on the inside of the shell,—gradually cooling as it spread, changing its color, and becoming fixed.

2. *Transmission of Galvanic light through metals of different conducting powers;* by James Thomas.—On the occasion of trying some experiments with the galvanic battery, previous to an exhibition of them before the Mechanics' Institute, I wished to repeat Mr. Children's experiments, relative to the transmission of the electric current through wires of different conducting powers ; for this purpose I formed a chain of silver and platinum wire in alternate links, and also one composed of copper and platinum, following the directions given by Mr. Brande.*

"Select some fine silver and platinum wire and cut it into lengths of about two inches; then form a continuous wire by joining these lengths endways in alternate order, and suspend it in the form of a festoon, between two thick copper wires, forming the poles of the battery, having previously temporarily united these poles by a thick copper wire; on removing the latter, the electricity traverses the compound wire, and occasions the ignition of the platinum portions of it, the silver being unaffected. The object of uniting the poles by a thick copper wire, whilst the compound wire is being attached, is to prevent the sudden fusion of the latter at the point of contact, which often happens when this precaution is not taken."

"Platinum and gold being thus connected and introduced into the electric circut, the platinum was instantly made red hot, whilst the gold remained unaffected. With a similar arrangement of gold and silver wires the gold was ignited ; the silver not. With alternations of platinum and silver all the platinum wires were ignited, but none of the silver."

On trying the experiment with a chain of this description, the battery when in action was incapable of producing ignition, to any extent, in the

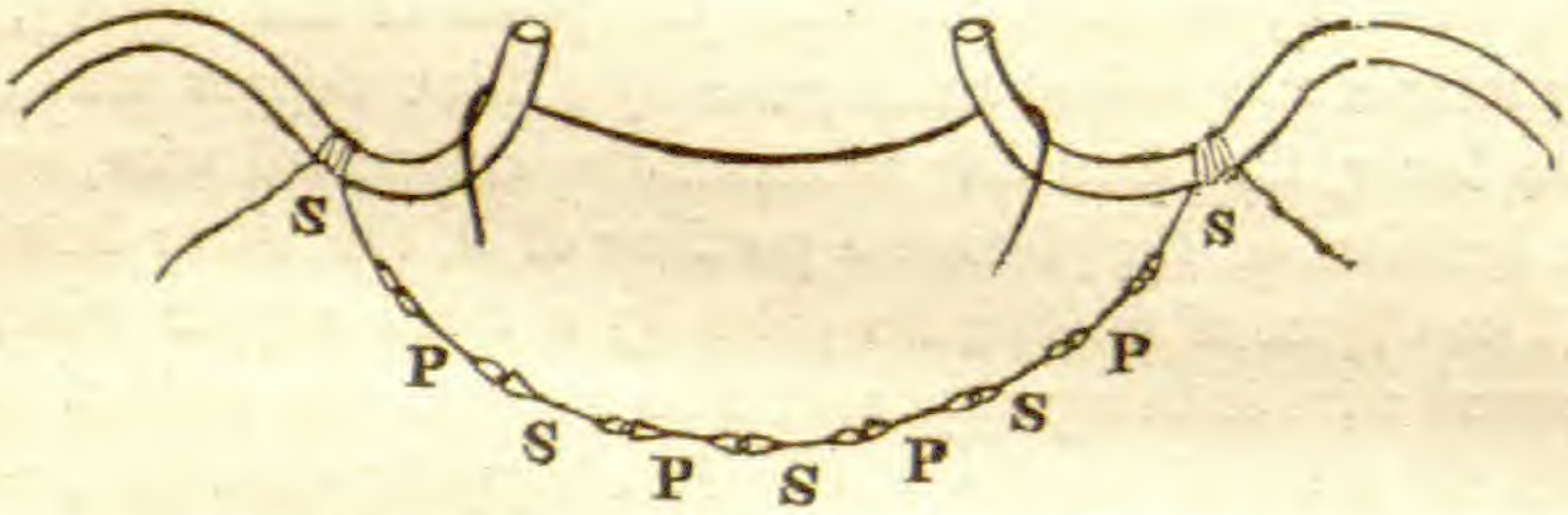
* Manual, fourth edition, page 271.

platinum portions of the wire, and I had greatly to reduce its length before the experiment would succeed. Indeed so little satisfactory did the experiment appear to be, that I was going to substitute in its place, that of shewing the ignition of a plain piece of platinum wire; when recollecting that whenever the poles of a battery in action come in contact, or the contact is broken, a spark is given out; I thought that if the contacts of the alternate links could be broken, or even a little disturbed, they would shew the electric spark at the points of contact.

To try if this was correct, I rejoined the links of the chain of platinum and silver wire, making it about one and a half or two feet long. Each end was silver wire, to attach it to the poles of the battery. The battery being in action, and its poles connected by a copper wire; the chain was suspended from the poles in a festoon. The copper wire being removed, on giving the festoon a short irregular motion, by striking it on the under or convex side, with a splint of wood, a succession of sparks was produced, of a brilliant and imposing appearance. This will continue, the battery being in action, as long as the proper motion is given to the chain. This motion can be so managed, as to give out sparks in a slow or a rapid manner.

This experiment was repeated in the evening before the members of the Institute; and the lights being nearly extinguished, it shewed the experiment to better advantage than by day light. The battery that was used is the one belonging to the Institute, of about 200 double plates; I believe you have used it, on one occasion or more, when in this city.

Will you be kind enough to repeat this experiment, if not interfering with your arrangements.



Note.—It is found better to use the copper wire bent as in the above, than to twist it around the poles, as it could be detached without trouble, or danger of receiving shocks.

3. *On a new pyrogenic acid*, by M. S. Baup.—M. Baup has discovered that, independently of a spirituous liquid and a bituminous oil, pyrocitric acid is not the only product of the distillation of citric acid, but in addition a second acid is formed which hitherto has not been remarked. It is obtained by evaporating the liquid resulting from the distillation of citric acid, until small acicular crystals are observed; when these crystals are to be separated preparatory to obtaining the new

acid, which is easily isolated from the first by successive solutions and crystallizations, on account of their very different solubility. M. Baup names this acid *citricic,* reserving *citribic* for the pyrocitric acid of Lassaigne.

It is inodorous, and possesses a strongly acid taste. Its crystals are rhomboidal octahedrons, and its primitive form the right rhomboidal prism. At 10° C. it is soluble in 17 parts of water; at 20° in 12 parts. Its solubility augments with the temperature. At 15° it dissolves in four parts of alcohol at 0.88; it is also soluble in ether. A heat of 100° or even 120° C. separates no water of crystallization. At 161° C. it is a colorless liquid which crystallizes on cooling. In the crystalline state it may be represented by formula $C^{10} H^{6} O^{4}$. When it combines with bases it loses one atom of water and becomes $C^{10} H^{4} O^{3}$. This acid is therefore isomeric with that of the citribic acid of Dumas.

Citricic acid precipitates the acetates and subacetates of lead, and communicates a reddish tint to the ferric salts. The citricates of potash and soda are very deliquescent. In the neutral citricates as well as citribates the oxygen of the base equals one third that of the acid.—*L'Institut, No.* 167.

4. *On the non-existence of a compound of Platinum and Hydrogen,* by M. Döbereiner.—According to Berzelius, the black non-metallic substance obtained by precipitating a compound of chlorid of platinum and iron, and afterwards reducing by means of hydrogen gas, is a compound of hydrogen and platinum. Davy also supposed that a compound of these two elements was formed by throwing an alloy of platinum and potassium into water, by which the potassium was separated into black scales.

Döbereiner has studied both these compounds with care, and finds that they present the same action with hydrogen, (that is, they become red,) as the compounds obtained in the moist way by means of alcohol, sugar, or formic acid. Moreover, they oxidize formic and oxalic acids, producing at the time carbonic acid, and acetify alcohol. His experiments therefore demonstrate that all these properties proceed from oxygen gas, which is mechanically condensed in this preparation of platinum, on account of the strong affinity of powdered platinum for oxygen.—*Ann. der Phys. und Ch.* 1835, *No.* 10.—*L'Institut, No.* 161.

5. *Sixth satellite of Saturn.*—By a letter from Sir J. Herschel, from the Cape of Good Hope, dated June 12, 1837, to a gentleman in London, it appears that he has rediscovered the sixth satellite of Saturn, (the second in order of the seven from the planet.) Since his father's observation no one had been able to procure any decisive evidence of its existence, farther than by his report. Sir J. H. had several good observations of it, and has traced it round and round many revolutions.—*Editor's correspondence.*

6. *Meteorological Register for* 1836, *kept at Montreal, Lower Canada, in Lat.* 45° 30′ *N., Long.* 73° 22′ *W., by J. S. M'Cord, Corresponding Secretary, Natural History Society.*

Months.	Barometer.	Thermometer.	WIND. Number of days blowing.								WEATHER. Number of days of each.						Rain Gage.	Snow Gage unmelted.‖	Temperature of the bottom of the Well at Guilbault's Botanic Garden, thirty one feet deep.
			N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Cr.	Cy.	Rn.	Shrs.	Fog.	Sn.			
January, ...	29.946	17.05	7.00	4.50	0.50	. .	3.00	3.50	7.50	5.00	10.00	13.25	0.50	. .	. .	7.25	. .	18.20	43
February, ...	29.965	11.32	5.50	1.00	. .	. .	1.50	6.50	9.50	5.00	12.25	10.75	1.75	*1.75	0.25	2.25	. .	19.35	43
March, ...	29.907	20.90	5.00	1.34	. .	1.16	6.50	7.84	7.66	1.50	14.25	12.50	1.00	. .	. .	3.25	. .	14.40	41
April, ...	29.959	35.24	8.33	3.34	0.84	0.33	5.83	4.50	2.50	4.33	17.25	7.50	1.75	0.25	†0.25	3.00	0.50	8.45	41
May, ...	29.870	53.32	9.34	1.50	1.58	0.50	0.83	4.50	4.75	1.00	9.50	8.75	5.00	0.75	‡. .	. .	3.70	0.50	41.5
June, ...	29.934	65.25	4.00	4.00	4.00	3.50	8.00	3.00	2.50	1.00	14.75	9.50	2.50	2.75	0.50	. .	1.25	. .	45
July, ...	29.859	71.90	7.84	1.50	1.00	. .	4.50	9.33	4.50	2.33	19.50	7.00	2.25	2.25	. .	. .	2.70	. .	50
August, ...	29.872	63.05	4.00	0.50	2.00	0.50	6.00	7.00	5.50	3.50	14.75	8.25	4.50	1.50	§. .	. .	2.95	. .	53
September, . . .	29.917	57.46	5.84	1.33	1.50	1.83	4.50	6.50	6.00	2.50	15.75	9.00	4.25	.75	. .	0.25	2.05	. .	52.5
October, ...	29.989	39.37	1.00	3.00	. .	.50	4.50	8.00	10.50	3.50	10.50	14.25	4.25	. .	. .	2.00	3.55	. .	51.5
November, . . .	29.869	32.24	5.50	. .	1.00	.50	4.50	5.00	8.50	5.00	6.75	18.25	3.00	. .	. .	2.00	2.50	5.15	46
December, . . .	29.956	18.09	2.50	3.00	. .	. .	6.00	7.00	9.50	3.00	6.25	15.75	3.25	. .	. .	5.75	. .	11.60	43
	29.920	40.43															19.20	77.65	45.87

* Drifting. † Hail. ‡ Only 24 days of this month were recorded. § Only 29 days of this month were recorded.

‖ The Snow Gage is kept at Long Point, five miles from Montreal, by W. Belin, Esq., M. D.

Mean pressure of the year, corrected and reduced to 32° Fahrenheit, - - - - - -		29.920
Mean temperature of the year, being the mean of the maxima and minima taken by register thermometers, - - - - - - -		40.43
Maximum height of the barometer during the year, -	30.550, (24th December, 9 P. M.)	
Minimum, - -	29.000, (14th December, 9 A. M.)	
Range of barometer, -	1.550	
Warmest day, (9th July,)	90° (mean of the 24 hours, 79.75.)	
Coldest day, (2d February,)	– 19	
Range of thermometer,	109	

Number of days of westerly winds, - - -	189.24
" " easterly " - - -	46.25
" " north " - - -	65.85
" " south " - - -	55.66
Number of days observed, - -	357.00

N. B. The instruments used are all of the first description. The barometer, a standard mountain, by Newman. The register thermometers by the same, and compared with a standard by Adie & Son, Edinburgh. The rain gage by Newman, after the one used by the Royal Society, London. Every precaution is used in the placing of the instruments, which a residence in a city will admit of.

7. *Oil of the Tutui or Candle Nut Tree.*—From Mr. French of Honolulu, through the Rev. John Diell, Seaman's Chaplain, we received in August 1835, a bottle of the oil named above. Mr. French at that time had a mill and press, employed several native hands, and manufactured from one hundred to one hundred and fifty barrels annually. Mr. Diell remarks that "it is found when dried to answer an excellent purpose for paint oil, and that it might be manufactured to any extent, as the trees are found in abundance upon all the islands. The greatest difficulty appears to be in drying it properly—for if it is not boiled very carefully, and to just such a point, it never dries."

We are not informed whether varnish has been mixed with it, and whether boiled upon litharge, as is common with flax seed oil.

8. *Aerolites.*—An account has been received from Brazil, of the appearance of a meteor of extraordinary brightness, and as large as the balloons used by aëronauts. It was seen for more than sixty leagues in the

province of Ceara, and over the village of Macao, at the entrance of the Rio Assu; it burst with a noise like thunder, and an immense quantity of stones fell from it, in a line extending more than ten leagues. The largest portion fell at the entrance of the river, and in various places they pierced through several dwellings, and buried themselves several feet deep in the sand. No human life was lost, but many oxen were killed, and others severely hurt. The weight of those taken out of the sand varied from one to eighty pounds.—*The Athenæum*, (London,) Dec. 16, 1837, p. 915.

9. *New Magnetical discoveries.*—We have been favored with an opportunity of inspecting some proof sheets of a work by Dr. Henry Hall Sherwood, of New York, which will shortly be published, containing discoveries in magnetism of a very extraordinary kind, and probably of great importance. They include apparently unexceptionable demonstrations of the latitude, longitude, rate of motion, and periodical revolution of the magnetic poles, or "vortices" of magnetism, round the terrestrial poles; of the angles of the magnetic with the terrestrial meridians in every part of the earth, at any given time; together with a universal method of determining latitude, longitude, and variation, under all possible circumstances, by the dipping needle alone. The perfect regularity of the lines of no variation, and the value of their angles with the terrestrial axis in every parallel of latitude, also seem to be demonstrated; and this, in connection with the relative position of the nodes of the magnetic with the terrestrial equator, which is found with the utmost facility and precision, forms the basis of calculations for determining the past, present, and future variation of the compass needle, at any given place on the globe. These calculations are tested by numerous observations made in various countries, and the agreement is most strikingly exact in all the examples adduced.

One of the most interesting facts seemingly established in this work, is that the magnetic poles revolve in the latitude of the arctic and ant-arctic circles, or 23° 28′ from the terrestrial poles; and this coincidence is ascribed to the solar origin of these magnetic vortices, and to the correlative fact that the inclination of the earth's axis to the plane of the ecliptic is 23° 28′. In short, these discoveries, (here only partially and cursorily mentioned,) sustained as they are by extremely simple calculations, which evidently harmonize with all the recorded and original observations to which they have been applied, seem to warrant the expectation that terrestrial magnetism, at least, will soon be rescued from its present state of uncertainty and confusion, and elevated to a distinguished station among the exact sciences. We await the publication of Dr. Sherwood's work with an unusual degree of interest.—*Communicated.*

BIBLIOGRAPHY.

1. *This Journal.—Notice forwarded to the Editor from a distant city in the South.*—REMARK: Were not this Journal principally the production of others, it might appear improper for the editor to publish the following communication, which was wholly unlooked for. The writer, who is not a New England man, is a gentleman well and advantageously known in the literary world, and of a profession in no way connected with the direct cultivation of the sciences which the Journal sustains.

It is his particular request that the notice may appear, and we know not that we are precluded by considerations of delicacy. The writer of the notice possesses a complete copy of the Journal in all its volumes.—EDITOR.—*April* 3, 1838.

To the Editor,—Dear Sir,—Having some leisure, in the evenings, during the past year, I took up the American Journal of Science for reading, and I soon found it such an interesting and valuable companion that I read it through *in course*, omitting the articles on mathematics, and occasionally on some other branches. Praise would be out of place here, as I am addressing this note through the Editor himself; but I can, at least, say to you that we owe you a debt of gratitude for having persevered as you have done for twenty years, with this valuable publication. But gratitude alone, though I believe it is widely felt, is a poor recompense for such labors as these. The Journal of Science ought to be extensively taken throughout our country. This publication is as large as most of our own "quarterly reviews," and has a great number of expensive plates, and not a little difficult composition, and yet the price per annum is only a dollar more than other quarterly journals of popular literature. When bound, it makes a handsome and creditable addition to any library: and a more valuable mass of matter than its 33 or 34 volumes contains, I have never met with in the same number of pages. A great portion of it is readable, or may easily be made so, in a family circle, and certainly it would be a more profitable kind of reading than is often selected for such occasions. To scientific men, or to one who like myself is only a lagging inquirer in the ways of science, it is truly useful not only as condensing a valuable portion of the successful scientific labors of other countries, but also as affording a clear exhibition of much that is doing in our own; and to our adventurers in the scrutiny into nature, it is a happy and valuable stimulus as well as guide and assistant.

What a change has occurred in our country, since a few individuals, who were then the solitary collectors of minerals, could find no one even to give their specimens names. Now almost every principal town (not to mention smaller ones,) has its Lyceum with a good cabinet: private cabinets are to be met with every where; and many of the states have sent forth their public geologists to explore their territories and to search out the concealed wealth, that richly repays them for the expense. We have to thank you and your Journal for a large part of this rapid improvement: and it is a poor compliment for the intrinsic merit of your publication, for the public spirit which you have shown in persevering amid many discouragements, and for the aid and stimulus which you have afforded to scientific research in our land, and what I have to suggest is this. Nearly all the colleges in our country, I presume already take the Journal: every one ought to have a complete set, for it affords us a good exhibition of many of the most important facts attending the advancement of science in our country, and independent of its present utility, its value in years to come will be very great from this consideration alone. City and town lyceums ought also to possess the Journal of Science. They can well afford the expense and they will hardly find such a condensed mass of valuable matter any where else. We should encourage it as a book for reading in our families: the mind will be informed and the taste improved. Much of it would be intelligible, at the outset; and by conversation and a little study we could easily make more of it so, even to families. If it is too expensive for individual subscription, two or three gentlemen might easily unite, and in this way a number of *good* subscribers might be procured in every town. Lastly and especially, let those who take it, be punctual in paying for it.

A more valuable publication, I am satisfied, cannot be found in the whole range of periodicals in our land. With sincere respect,

Your friend and servant, H. L. P.

2. *Prof. Agassiz' Great Work on Fossil Fishes.**—We are happy to learn, by a letter dated Nov. 12, 1837, from this distinguished and indefatigable naturalist, that he had then very recently published the 8th and 9th livraisons of his magnificent work. We are thus assured that it is going forward towards, we trust, a happy completion, and that the rumor of its discontinuance was unfounded. Prof. Agassiz speaks in terms of warm commendation of the labors of Mr. Redfield, Jr., on the fossil fishes of Durham, Ct., &c., as they appear in a memoir presented last winter to the Lyceum of Natural History of New York, with drawings. M. Agassiz remarks, that these fossil fishes are described and determined by Mr. Redfield "with rare talent, and that it is much to be desired for the interest of science, that this expert (habile) naturalist should continue his researches, which appear to be destined to throw, at a future day, great light upon the geological relations of America and Europe."

3. *Prof. Agassiz on the Echinodermata.*—We are informed by Prof. Agassiz, that he is now occupied upon a detailed description of the Echinodermata, the prodrome of this work having appeared some years ago.

* See this No., page 46, under the doings of the British Association.

In the prosecution of this work, he is exceedingly desirous to obtain specimens of any remarkable species not hitherto described, of these animals, either dead or living; that is, either existing or fossil.

We beg leave, therefore, in behalf of this eminent and very meritorious naturalist, and of the common cause, to call the attention of men of science and of collectors to this subject, and with it to that of fossil fishes, that M. Agassiz may be enabled to include within his works as many American species as possible. Our fossil fishes, (or good drawings of them,) our corals, echini, alcyonia, crinoidea, &c., will be acceptable, and reference may be had to a friend of Prof. Agassiz now resident in New York, M. August Mayor, care of Meyrat Nagath, in the same city, who will transmit specimens to Neufchatel, Switzerland, the residence of the author.

It is exceedingly to be desired that the small list of American subscribers to Prof. Agassiz' great work on fossil fishes should be augmented. While we have had the pleasure of forwarding a few names of individuals or institutions, we should be much gratified to be instrumental in augmenting the number, and now again call upon opulent individuals, and upon all institutions for the promotion of science and good learning, to aid in sustaining this undertaking. A notice of the work and of the terms may be found in Vol. xxviii, p. 193, and a full analysis of the first four livraisons, by Prof. Jameson, in Vol. xxx, p. 33.

4. *Statistical Tables*, exhibiting the condition and products of certain branches of industry in Massachusetts, for the year ending April 1, 1837; prepared from the returns of the Assessors, by John P. Bigelow, Secretary of the Commonwealth: Boston, 1838, pp. 209.

Statistics have as yet occupied but a small part of the attention of the legislatures of our several states, and it is certain that nothing but legislative enactment can ever give us a full view of the varied statistics of so vast a country as this. Mr. Worcester, in the preface to the American Almanac for 1838, remarks justly: "The statistics of the whole country can never be collected by one individual, nor by a society formed for the purpose. If the work is ever accomplished in a suitable manner, it must be done under the direction of the government of the United States. And if the national government should connect this object with the taking of the next census, the design would certainly commend itself to every man of enlightened views, and it would redound to the lasting honor of the administration that should first introduce the system."

The beautifully printed and correct tables under consideration, sent to us by the kindness of the Secretary of the State, present accurate returns from about seventy distinct branches of industry practiced in the Commonwealth of Massachusetts, from which it appears, that the value of her various manufactures for the year ending April 1, 1837, was $91,765,315;

the number of hands employed, 117,352; and the capital invested, $54,851,643. The population of the State is 701,331. Thus it seems that more than a seventh of the whole population are engaged in some branch of manufactures; that the annual value of the industry of each laborer is more than seven hundred dollars; and that their united labor produces a yearly sum nearly double the capital invested.

5. *Crania Americana:* Or a comparative view of the skulls of various Aboriginal nations of North and South America; to which is prefixed an Essay on the varieties of the human species, and on the American race in particular: illustrated by sixty plates, and a colored map. By Samuel George Morton, M. D. Phila., for the author, by J. Fuller. 1838. Folio.

An announcement of the proposed publication of this great work, was contained in the 32d volume of this Journal, (page 207,) although we did not then expect that any part of it would be laid before the public so soon. The part now on our table comprises the prospectus and eighteen beautiful plates. The American press has rarely issued a book in so liberal a style. The figures of the skulls are drawn on stone, with much fidelity and elegance, and of the natural size, one head only being placed on each plate, instead of two, as at first proposed. We are told in the prospectus, that the introductory essay will embrace a brief illustrative view of the human species; the strictly American portion of the work will contain lithographic illustrations of more than forty Indian nations, with a particularly extended series from North America. The extraordinary distortions of the crania of some of the tribes will be illustrated, and those from the mounds and caves of our western territory will form a separate division of the work. The author's materials for the successful completion of his great undertaking, are more ample, probably, than those of any other individual; and as he has no favorite hypothesis to support, we may expect a candid exposition of facts, and a strict adherence to them. Many interesting developments respecting the natural history of man, will doubtless arise from these investigations. The work is in such a state of forwardness, that it is proposed to deliver it to subscribers by the first of October, 1838. We trust that the author may receive sufficient encouragement, especially as he has, single-handed, shouldered the expense of this great undertaking. The work is to be obtained from the publisher by subscription,—the price, $20.

6. *Annals of the Lyceum of Natural History of New York.*—The first four numbers of the fourth volume, under the same covers, of the Annals of this Society, have recently appeared. The article by Mr. J. H. Redfield, on the fossil fishes of Connecticut, has already excited much attention among those interested in that subject, as may be seen by a reference to the remarks of Professor Agassiz, contained in this number. The

other articles are a new mineralogical nomenclature by J. D. Dana. On the structure and Affinities of Ceratophyllaceæ, by Asa Gray. Notice of the appearance of the Pine Grosbeak in the vicinity of New York, by J. F. Ward. Descriptions of five species of Vespertilio, by Wm. Cooper. On two species of Molossus inhabiting the United States, by the same. On two species of American Plecotus, idem. Discovery of Vauquelinite in the United States, by John Torrey. Account of several new Genera and species of North American plants, by the same. Observations on the Genus Sarracenia, including a new species, by H. B. Croom. Melanthacearum Am. Septentrionalis Revisio, Auct. Asa Gray.

It is due to the Lyceum to give circulation to the following notice.

"The object of the Lyceum, in publishing its Annals, is to record new and valuable facts in Natural History; and to advance the public good by the diffusion of useful knowledge. The importance of this science is, at present, every where acknowledged; and the attention bestowed on it, in our own country, has already been amply repaid. A great variety of new, useful, and elegant productions have been discovered; and important facts connected with the agricultural, commercial, and manufacturing interests, have been elucidated. In our attempts to bring to light the hidden riches of our country, we solicit the assistance of the public. We ask no emolument, we expect no gain. We cherish the hope that our exertions will be encouraged; that we shall be enabled to proceed in the course which we have now commenced.

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Persons at a distance wishing to subscribe for the future Nos. will please make arrangements with some person in the city to receive, forward, and pay for them. Odd numbers to complete sets may also be obtained in the same way."

7. *Description of new species of Mollusca and Shells, with remarks on several Polypi, &c., found in Massachusetts Bay;* by JOSEPH P. COUTHOUY. From the Journal of the Boston Soc. Nat. Hist. Vol. II.

We are pleased to see so much critical knowledge and laborious research brought to bear on the shells and polyps of our coast, as is evinced in the article before us. Its zealous author has discovered nearly all the shells herein described, in the entrails of the sea fish, brought to the Boston market.

The following are the short specific descriptions of the new species; we have not space to copy the remarks or figures which accompany them. Massachusetts Bay is the locality of the species, when not otherwise stated.

TUBULIFERA STELLIFERA. T. tubulis brevibus, simplicibus, aggregatis, carnosis, stellis parvulis purpureis coronatis. Hab. *Boston harbor;* grows about the bottom of the piles at Craigie's bridge.

HOLOTHURIA CHRYSACANTHOPHORA. H. tentaculis—? corpore molli, cylindrico, cinereo-lutescente, spinis aureis, exilibus, frequentibus instructo.

TELLINA SORDIDA. Testâ ovali, compressâ, albidâ, epidermide corneâ tectâ; dentibus cardinalibus valvâ dextrâ duobus, altero simplici, altero bifido, sinistrâ plerumque obsoletis; lateralibus posticis remotis; intus albâ. Hab. *Boston Bay.*

CARDIUM PUBESCENS. Testa mediocri, obliquè rotundatâ, subæquilaterali, cinerescente; costellis 36, ciliatis; umbonibus tumidis; natibus approximatis; margine crenato; intus albo-lutescente.

NUCULA MYALIS. Testâ ovata, sub-equilaterali, lævi, concentricè zonatâ; latere postico longiore et latiore, rotundato, antico sub-rostrato; natibus approximatis; dentibus rectis; epidermide olivaceo-nigricante.

N. TENUISCULATA. T. elongatâ, inæquilaterali; latere antico longiore attenuato, rostrato, postico rotundato; umbonibus prominulis, concentricè confertimque striatis, tenuissimèque sulcatis; colore virescente.

TEREBRATULA SEPTENTRIONALIS. T. obovata, tenui, albidâ, valvâ majore apud apicem coarctatâ, radiatim creberrimè striatâ, nate emarginatâ foramine magno semi-elliptico, margine non inflexo, denticulato.

EOLIS BOSTONIENSIS. Corpore oblongo, capite brevi, tentaculis quatuor, branchiis cirriformibus, purpureis, apicibus albis, utrinque fasciculis quinis; pede amplo, posticè per-acuto; tentacularum caudæque extremitatibus cyaneo tinctis. Hab. *Tide water of Charles River, Mass.*

Eolis (Cavolina, *Brug.*) salmonacea. Corpore oblongo, capite lato, tentaculis quatuor, branchiis numerosis, salmonaceis, lineis longitudinalibus dorso dispositis, pede amplo, supra lacinulato, posticè acuto. Hab. *Tide water of Charles River, Mass.*

Eolis (Tergipes, *Cuv.*) gymnota. Corpore elongato, albido, capite brevi, orbiculato-depresso, tentaculis quatuor, branchiis fulvo-rufescentibus; utrinque fasciculis septem, medio dorsi nudo. Hab. *Tide water of Charles River, Mass.*

Tritonia Reynoldsii. Corpore elongato, postice attenuato, papilloso seu verrucoso rubro-fuscescente, maculis albidis notato; tentaculis duabus serratis, vaginulis lacinulatis retractilibus; branchiis arboreis, utrinque quinis, posticè gradatim minuentibus; ore corrugato, branchiis vel ramulis branchiiformibus senis instructo, papillisque numerosis circumdato. Hab. *Tide waters of Charles River, Mass.*

Chiton fulminatus. Testâ oblongo-ovali, anticè sub-attenuatâ, plerumque rufo-flavescente aut virescente, lineis albis angulatis et flammulatis pictâ; valvis sub-carinatis, minutissimè granulatis, marginibus posterioribus albo punctatis, areis lateralibus indistinctis; margine pubescente, rufescente, albo maculato.

C. sagrinatus. Testâ parvulâ; elongato-ovali, nigricante; valvis sub-carinatis, tenuissimè et concentricè striatis, minutissimè sagrinatis; areis lateralibus indistinctis; valvis terminalibus semilunatis; margine granulato.

C. Emersonii. Testâ ovali, anticè paulum compressâ, albidâ, membranâ squalidâ pubescente tectâ, valvis posticê arcuatis, lateribus rotundatis, areis centralibus cordiformibus et granulatis, valvâ anticâ divaricatim lineatâ, posticâ emarginatâ et valdè arcuatâ; valvis intermediis, lineâ bicarinatâ ab apice ad latus posticum obliquè decurrente; margine fasciculis crinitis ordinibus binis dispositis.

Patella candida. Testâ parvulâ, ovali, sub-diaphanâ, candidâ concentricè striatâ, costis scabris, exiguis, radiantibus; intus nitidâ.

Bulla Triticea. Testâ parvulâ, cylindricâ, albidâ, nitida, epidermide ferruginea tectâ; spirâ depressiusculâ imperforatâ; columellâ basi sinuosâ, leviter reflexâ, albâ.

Natica consolidata. Testâ subglobosa, lævi, rufescente, interdum albidâ; spirâ brevissimâ; umbilico parvo, consolidato; aperturâ ovatâ, operculo calcareo lævi; epidermide fusco-virescente.

Oxinoe? glabra. Testâ ovali, parvâ, ventricosâ, sub-umbilicatâ albâ, fragili, spirâ brevi, laterali, labro integro, columellâ arcuatâ, aperturâ valde effusâ.

Jaminia exigua. Testâ parvulâ, conicâ, albido-pellucidâ; anfractibus convexis; suturis impressis; aperturâ ovali; basi effusâ; columellâ reflexâ, uniplicatâ; epidermide fuscescente.

SCALARIA SUBULATA. *An.* Corpore spirali, griseo, albo-maculato; pede brevi, crasso, oblongo; tentaculis duabus; oculis parvulis, nigris; ore orbiculato, corrugato; proboscide nullâ; operculo corneo.

Sc. testâ acuto-turritâ, obscuro-albidâ, interdùm fuscescente, imperforatâ; anfractibus sub-convexis, contiguis; costis sub-æqualibus, depressis, supernè angulatis; aperturâ ovali; labro basi emarginato, intus albo.

SCALARIA NOVANGLIÆ. Testâ elongato-turrita, sub-perforatâ, albâ, maculis fuscescentibus notatâ; costis parvulis inæqualibus, interstitiis tenuissimè striatis, anfractibus convexis, vix contiguis; aperturâ ovatâ; labro integro.

TURBO INCARNATUS. Testâ sub-conicâ, rubra, anfractibus convexis, transversim creberrimè striatis; basi convexâ, latè profundèque perforata; labro tenui, lævi, intus fulgido; operculo corneo.

TURBO CINEREUS. Testâ pyramidali, tenui, cinereâ; anfractibus convexiusculis costellis numerosis cinctis, longitudinaliter tenuissimè striatis; basi subconvexâ perforatâ; labro tenui, crenulato; intus margaritaceâ; operculo corneo.

T. OBSCURUS. Testâ subconicâ, perforatâ, fusco-rubente; anfractibus convexis, supernè leviter angulatis; basi convexâ, aperturâ rotundâ, labro tenui, lævi, intùs iridescente; operculo corneo.

PYRAMIS STRIATULUS. Testâ parvâ, subulatâ, albidâ, transversim tenuissimè striatâ suturis impressis, apertura ovatâ, basi leviter effusâ.

TURRITELLA EROSA. Testâ turritâ, fusco-rufescente, apice acuto; anfractibus sub-convexis, transversè sulcatis; aperturâ orbiculatâ, labro tenui, sub-crenulato; columella leviter callosâ, epidermide viridi-corneâ.

PLEUROTOMA BICARINATA. Testâ perparvâ, fusiformi, turritâ, fusco-nigricante, transversè striatâ et sulcatâ; suturis impressis; anfractibus convexis, medio bicarinatis; aperturâ ellipticâ; labro crenulato, cauda brevi, sinu minimo.

CANCELLARIA BUCCINOIDES. Testâ ovato-conicâ, lacteâ apice acuto; anfractibus convexis, transversè sulcatis, longitudinaliter striatis; labro intus candido, denticulato; columellâ leviter callosâ, arcuatâ, triplicata; epidermide olivaceâ.

FUSUS HARPULARIUS. Testâ fusiformi, turritâ, fulvo-lutescente; anfractibus supernè planulatis, costis obliquis numerosis instructis, transversè tenuissimè striatis; apertura obovatâ, labro lævi, caudâ perbrevi.

FUSUS PLEUROTOMARIUS. Testâ acutissimè elongatâ, fuscâ; anfractibus convexis, plicis longitudinalibus instructis; aperturâ ovatâ, labro intùs lævi; columellâ arcuatâ, caudâ brevi.

Trichotropis costellatus. Testâ ovatâ, turrito-acutâ, fuscescente, epidermide foliaceâ luteo-albida tectâ ; spirâ canaliculata ; anfractibus costis 5-rotundatis instructis ; apertura ovali, lutescente ; labro costis indentato ; columellâ arcuatâ, albescente.

The Polyps *Tubularia indivisa*, Ellis, *T. coronata*, Muller, *Ophiura lacertosa*, Lam., *Actinia plumosa*, Mul. *Actinia, senilis*, Linn., *have also been observed by the author in the Massachusetts Bay.*

8. *Third American Edition of Bakewell's Geology, from the fifth and last of the author in London.*—Professor Silliman is particularly charged by Mr. Bakewell, with the care of a third American edition of his Geology, to be printed from the fifth of the author. Mr. Bakewell writes to Professor Silliman, under date of February, 1838, that the new edition of his work would be out, in England early in March, and consequently it may be daily expected in this country. It is enlarged by about 80 pages of new matter, has from 15 to 20 new cuts, and contains a chapter on a new topic, relating to coal, hitherto overlooked by all geologists. This work will be printed with all convenient speed by B. & W. Noyes, booksellers and publishers in New Haven, and successors of Herrick & Noyes, and of Hezekiah Howe. The edition will be superintended by Professor Silliman, and by Mr. Robert Bakewell, Junior, son of the author.*

9. *Olmsted's Natural Philosophy*, 2 vols. 8vo.—A new and improved edition of this work, is in press, and will shortly be ready for delivery.

10. *Second report of the Geology of Maine.*—Since the notices of the geological reports were written, this has come to hand, but too late for mention in our present number.

INTELLIGENCE.

1. *Return of the Bonite, from a voyage around the world.*—We are happy to see it announced from the French papers, that the Bonite sloop of war, which left Toulon on the 8th of Feb., 1836, has arrived at Brest, after an absence of twenty-one months. The crew consisted of 151 men, under the command of M. Auguste Vaillant, Capitaine de Corvette.

The return of this vessel was anxiously looked for by the scientific world, in the belief, as well from the character of the scientific corps, as from the specific instructions of M. Arago, and others of the Academy of Sciences, that many important discoveries would be made, going far toward the elucidation of interesting questions in magnetism, meteorology, and other branches of science. For a knowledge of what has been accomplished we must await the published account of the voyage, which the French government, with their former liberality, will no doubt soon place in our hands. The scientific corps were, *in botany*, M. Gaudichaud,

* For a notice of this gentleman see Vol. XXXI, No. 1, of this Journal.

who has before circumnavigated the world in L'Uranie; in zoology, M. Eydoux, naval surgeon of the first class, who sailed round the world in L'Favourite; in geology, M. Chevalier Enseigne de Vaisseau; in astronomy, M. Chevalier Fouchard; in hydrography and observations on terrestrial magnetism, in connection with the other officers of the ship, M. Darondeau. M. Lauvergne, the same artist who has twice before been around the world in the Astrolabe and the Favourite, was draftsman to the expedition. What is most singular, is the fact, that not one person died out of the whole crew and numerous passengers; nor did any serious illness appear, except a few cases of scurvy, towards the close of the voyage. This extraordinary exemption is to be attributed to the watchful care of the captain, in airing the vessel, and enforcing exact cleanliness among his men, and making them suit their dress to the climate they were in, and to the diurnal variations of the temperature. No accident occurred to the vessel herself.

OBITUARY.—THE HON. NATHANIEL BOWDITCH.

The death of this excellent and illustrious man has left a void in the American scientific world, which it will be very difficult to fill.

His reputation was not merely American—it was European—it belonged to his fellow-men of every enlightened and christian land.

We heard of his extreme and hopeless illness, and almost immediately after, of his death, with acute pain, and with a sense of hopeless bereavement—hopeless, as regards the prospect of looking upon his like again.

The following able obituary from the pen of an eminent scholar, and one intimately acquainted with Dr. Bowditch and his history, appeared in the Boston Daily Advertiser and Patriot of March 17, 1838, and we, without hesitation, adopt it, as better and fuller than any thing which our more limited acquaintance with Dr. Bowditch would enable us to prepare. We are happy, however, to learn that a more ample biography will be written by the same able hand, and will appear in the Memoirs of the American Academy of Boston. While waiting for this full portrait of one of the most distinguished men of his age, we will venture only to add, that from opportunities which we were so fortunate as to enjoy, of familiar interviews with Dr. Bowditch, in the bosom of his amiable and happy family, we were not less delighted with the warm and generous expression of his private affections, and the frank assuring impress of his manly manners, than we had been, before knowing him, with the splendor of his public reputation. Of the latter, he appeared to be almost the only person who was unconscious; and if he was great to the world of mathematicians and astronomers, he was delightful in the hours and scenes of the domestic and evening circle.*—Ed.

It gives us pain to announce the decease of our distinguished townsman, Dr. Bowditch, which took place yesterday, at 1 o'clock, after an illness of several weeks.

The death of this eminent man will be felt in America as a national loss. His name was identified with the science of his native country; and our national char-

* The President and faculty of Yale College, where Dr. Bowditch's character was much honored, on hearing of his death, transmitted to his children, resolutions expressive of their high veneration for the deceased—of their deep sense of the loss to the nation and the world, and of their sympathy with his bereaved family.

acter, with men of science abroad, is indebted to no one individual—with the exception, perhaps, of Dr. Franklin—so much as to him.

Dr. Bowditch was born on the 26th of March, 1773, at Salem, in the State of Massachusetts. In his education, he had no other advantages than those afforded by the common town schools, which at that period were comparatively meagre, and inadequate to the great purposes of disciplining and storing the mind with knowledge.

At the usual age, he was placed as a clerk, or apprentice, in the store of a merchant in Salem; and while in that situation, it is said, he used to employ his leisure time in his favorite science of Mathematics, and various practical subjects connected with it.

His attention was directed, at an early age, to the *Principia* of his great master, Newton. But, as this work was published in the Latin language, which he had not then learned, he was obliged to begin his reading of it, by asking some of the Cambridge students, during their vacations at Salem, to explain it to him in English. He soon discovered, however, that his own knowledge of the subject, with the aid of the mathematical processes and diagrams on the pages of the Principia, enabled him to comprehend the reasoning contained in the modern and technical Latin of the work, more readily than he could do with the help of the superior knowledge which the University students possessed of the Latin of Cicero and Virgil; and he was soon convinced that his shortest course would be to acquire a knowledge of the language for himself; which by great perseverance he accomplished, and was enabled to read any work of science in it. And thus he was another instance, like that of the ancient Greek writer, who relates of himself that during his residence at Rome, he obtained a knowledge of the *language* of the Romans, by his knowledge of the *subjects* which they discussed in it. He afterwards learned French, for the purpose of having access to the treasures of French mathematical science; and, at a late period of his life, he acquired some knowledge of the German language.

A little circumstance connected with his study of Newton's Principia, will not be uninteresting to the learned and the unlearned. The Latin copy of it, which Dr. Bowditch used, was presented to him by a mercantile friend in Salem, who made no pretension to science, and would never have thought of opening the work; but he had preserved it, in his little library of popular works, as a book, that possibly might one day be of use to some person. By a remarkable coincidence of circumstances, the volume came to the knowledge of Dr. Bowditch; and his friend, upon being requested to lend it, with great liberality presented it to him—the man who, above all others in the country, was the best able to make the most advantageous use of it. So far as great effects may be justly said to flow from small causes, what important consequences may have followed from the preservation of this single and apparently worthless volume, by an individual who could make no use of it! Dr. Bowditch sometimes alluded to this occurrence; and, on the occasion of presenting a copy of his La Place to a friend, who declined taking it because he was no better able to read it than his mercantile friend could the Principia, delicately insisted upon its acceptance; and, in the last resort, reminded his friend, that if not useful to him personally, it might, perhaps, be placed in the hands of some one, to whom it might be valuable, as the copy of the Principia had been to himself.

Dr. Bowditch did not remain long in the situation of a merchant's clerk. His mathematical talent, in a town eminently distinguished for nautical enterprise, could not fail of being called into exercise, in connection with the art of navigation; and a large portion of the well known skill of the navigators of Salem may justly be considered as the fruits of the instruction which may be traced, directly or indirectly, to his scientific acquirements. He was, besides, a practical navigator himself for a few years, principally, if not exclusively, in East India voyages, which gave him the most favorable opportunities of rendering his mathematical studies practically useful to the nautical interests of his country.

At that period, the common treatise on navigation was the well known work of Hamilton Moore, which has occasioned many a shipwreck, but which Dr. Bowditch, like other navigators, was obliged to use. Upon examining it, however, in his daily operations, he found it abounding with blunders and overrun with typographical errors, particularly in the Nautical Tables, in which, above all parts of the work, great accuracy was indispensable; of these last errors, many thousands, of more or less importance, were corrected in his early revisions of the work. He published several editions of Moore's work under that author's name; but the whole fabric at length underwent so many changes and radical improvements by the addition of new, and the rejection of old and worthless matter, as to warrant his publishing it under his own name; and the work of Moore is now only remembered from its having been superseded by "Bowditch's Navigator."

It may be added, that he was enabled to give the greater accuracy to his work by means of a collection of manuscript *Journals* of his seafaring townsmen, preserved in the valuable East India Society's Museum, in Salem. By a rule of that association—which is believed to have been proposed by Dr. Bowditch—each member was required to carry with him on every voyage, a blank book, methodically arranged, for the porpose of keeping a journal of observations and remarkable occurrences; these journals (now amounting to many volumes) at the end of the voyage were returned to the Museum; and they form a repository of innumerable observations in nautical and geographical science not to be found in any other sources.

In connection with this part of the subject, it should be further observed, that Dr. Bowditch also employed himself during several seasons (1805, '6, '7,) in making an elaborate hydrographical survey of the harbor of Salem, with the adjacent harbors of Marblehead, Beverly, and Manchester; of which he published an admirable chart of surpassing beauty and accuracy. With such extraordinary exactness was this laborious work performed, that the pilots of the port discovered, and were the first to observe to the author, that many of their landmarks—which, however, Dr. B. did not know to be such—were in fact laid down with such perfect accuracy in the survey, that the various ranges on the chart corresponded with the utmost possible precision to those of the natural objects.

The ardor and perseverance which distinguished Dr. B. through life, were very early conspicuous in the prosecution of his mathematical and philosophical studies. While his pecuniary means were very limited, he used to make copious abstracts of the scientific papers in that immense repository, the Philosophical Transactions of the Royal Society of London: this labor was continued through many years; and the numerous large volumes of these manuscript abstracts in his library, embracing a great portion of that whole work, still remain the testimonials of his untiring industry and zeal in the cause of science.

During a large part of his life he was a principal contributor to the Memoirs of the American Academy; and it is unnecessary to add, that his communications are among the most important in that work. He is also the author of a few reviews in the leading journals of the time.*

In the year 1806, at the particular instance, as it was said, of the late Chief Justice Parsons—whose extraordinary attainments included a knowledge of the higher branches of mathematics—Dr. Bowditch was elected Professor of Mathematics and Natural Philosophy in the University of Cambridge. He could not, however, be persuaded to accept the office; principally, it is believed, if not wholly, from an apprehension that the circumstance of his not having been educated at that univer-

* In the Monthly Anthology and North American Review.

sity might render the discharge of his duties less satisfactory to himself than he could wish. Those who knew him best, however, often remarked upon his extraordinary power of communicating instruction in the clearest manner; and Chief Justice Parsons, as competent a judge in the case as could be found in any country, has said to the writer of this notice, that of all the men he had known, he had never found one who could make any mathematical proposition so transparently clear and intelligible by mere oral statement, without a diagram or figures, as Dr. Bowditch. It may also here be added, that Dr. B. had the highest respect for the great mathematical attainments of Chief Justice Parsons; and it may be interesting to many persons to know, that under the Rules for Lunar Observations in the "Practical Navigator," Dr. B. has introduced an improved method of correcting the apparent distance of the moon from the sun or a star, which was suggested by that great man, whom he justly characterizes as "eminently distinguished for his mathematical acquirements."*

It should have been before stated, that after quitting the life of a navigator, Dr. B. held the office of president of a marine insurance company in his native town for several years; until, upon the establishment of that well known and invaluable institution, the Massachusetts Hospital Life Insurance Company, in Boston, his talents were deemed indispensable in its organization and management; and he was invited to take charge of it, under the title of its Actuary. The great exactness of calculation and the order and precision introduced by him into that institution, will long attest the comprehensiveness of his views and his facility in the practical management of its affairs.

On the occasion of leaving his native town to enter upon his new office, his townsmen spontaneously united in a public dinner, as a testimonial of their respect and grateful recollection of his eminent services to his country and of his great private worth.

While he resided in Salem he undertook his well known translation of La Place's *Mécanique Céleste*, accompanied with his invaluable Commentary upon it. This truly gigantic task was begun in the year 1815, and has been the steady occupation of his leisure hours to the time of his death. His elucidations and commentaries, while they show him to have been as thoroughly master of that mighty subject as La Place himself, will make that great work—the most profound of modern times—accessible to innumerable students, who without such aid would be compelled to forego the use of it.

The labor of translating and commenting on the whole of that work had defied the zeal and industry of the scientific men of Great Britain; and one of their leading journals gives due credit to America for this extraordinary and honorable achievement in the cause of Science, which had not been accomplished by any individual among the numerous scientific associations of Great Britain.

"The idea," says the journal alluded to, "of undertaking a translation of the whole *Mécanique Céleste*, accompanied throughout with a copious running commentary, is one which savors, at first sight, of the *gigantesque;* and is certainly one which, from what we have hitherto had reason to conceive of the popularity and diffusion of mathematical knowledge on the opposite shores of the Atlantic, we should never have expected to have found originated—or, at least, carried into execution in that quarter. The part actually completed [the first volume,] is, with few and slight exceptions, just what we could have wished to see—an exact and careful translation into very good English—exceedingly well printed, and accompanied with Notes appended to each page; which leave no step in the text, of mo-

* Bowditch's Navigator, p. 161, edit. 1811.

ment, unsupplied, and hardly any material difficulty either of conception or reasoning unelucidated."*

The progress of Dr. Bowditch's last illness was so unremitting, that he was not able to complete the final revision of the whole of this great work. He had, however, corrected the last sheets of the fourth volume a few days before his death, and while his physical powers were scarcely capable of executing what his clear and unclouded intellect dictated. The fifth, and only remaining volume is, comparatively, of little importance, and it would probably have had but slight revisions, even if he had survived.

On this great work Dr. Bowditch's fame, throughout the scientific world will ultimately rest. And, surely, the most lofty ambition could not desire a more solid and lasting monument—a monument, which will endure until that day of desolation shall arrive, when no one of the human family shall remain to contemplate the mighty fabric of those heavenly systems, whose structure and laws are inscribed upon it.

The long study of the French mathematicians, in connection with Dr. B.'s labors on La Place's work, had given him a well founded partiality for the French, or Continental mathematical school, so far as that may be said to differ from the English. And on one great question, which in the age of Newton raised such a furious tempest of altercation between the English and Continental mathematicians—the quarrel between Newton and Leibnitz for the immortal invention of the differential calculus—Dr. Bowditch did not consider Newton as the exclusive discoverer, but, as the more candid of all parties now generally agree, that he and Leibnitz were both original discoverers of that wonderful method of analysis, and that neither of them was a plagiarist from the other, as each had been illiberally called while the controversy was raging.

The reputation of Dr. Bowditch was such, that he had for many years been a member of various learned societies in Europe and America; and he was one of the few Americans who have been Fellows of the Royal Society of London. In his native State he has been for some years the President of the American Academy of Arts and Sciences, which is indebted to him for a large share of the reputation it has enjoyed.

Such is a brief outline of the intellectual character and scientific labors of this eminent man. It need only be added, that in social life he was distinguished for rigid integrity, extraordinary energy of character, and unremitting zeal and perseverance in whatever he undertook to accomplish; his manner was ardent, and indicative of that warm heart which has now ceased to throb for those friends who enjoyed the happiness of his society; his deportment was, in an extraordinary degree, unaffected and simple; and he had a frankness in expressing his opinions, which an age of artificial civility would feel to be a standing reproof of its own heartlessness, and would hardly consent to rank among the virtues.

How saddening is the reflection, that these high intellectual and moral endowments, from which we had fondly, perhaps unreasonably, hoped for still further benefits to the world, should now lie powerless, prostrate, and in ruins before us! Never has there been an individual in our country, solely devoted to the pursuits of science and the tranquil walks of private life, and shunning the allurements of that political notoriety which is the distempered and all-absorbing passion of the day, whose death has been more generally and deeply lamented—

"Multis ille bonis flebilis occidit"—

"We read his history in a nation's eyes;"

and the demonstrations of sorrow in every face are at once a spontaneous homage to science, and a heart-felt tribute to eminent private worth.

* London Quarterly Review, vol. 47, July, 1832.

Plate 1.


Fig. 1.
Ground Plan
of a Groupe of Indian Mounds,
of various forms, on the Elevated Prairie,
Seven Miles East of the Blue Mounds.
Wisconsin Territory.
From admeasurement by R. C. Taylor Esq.
Magnetic
True Meridian
N. N. E.
550 Feet
Great Indian Trail or War Path from the Mississipi to Lake Michigan
Tumulus
Oblong Mounds
120 ft
Circle
Open Prairie
Scale of Feet
100
200
300
400
Fig. 2.
The figures represent the number of Feet
In the dimensions of the Mounds.

Plate II

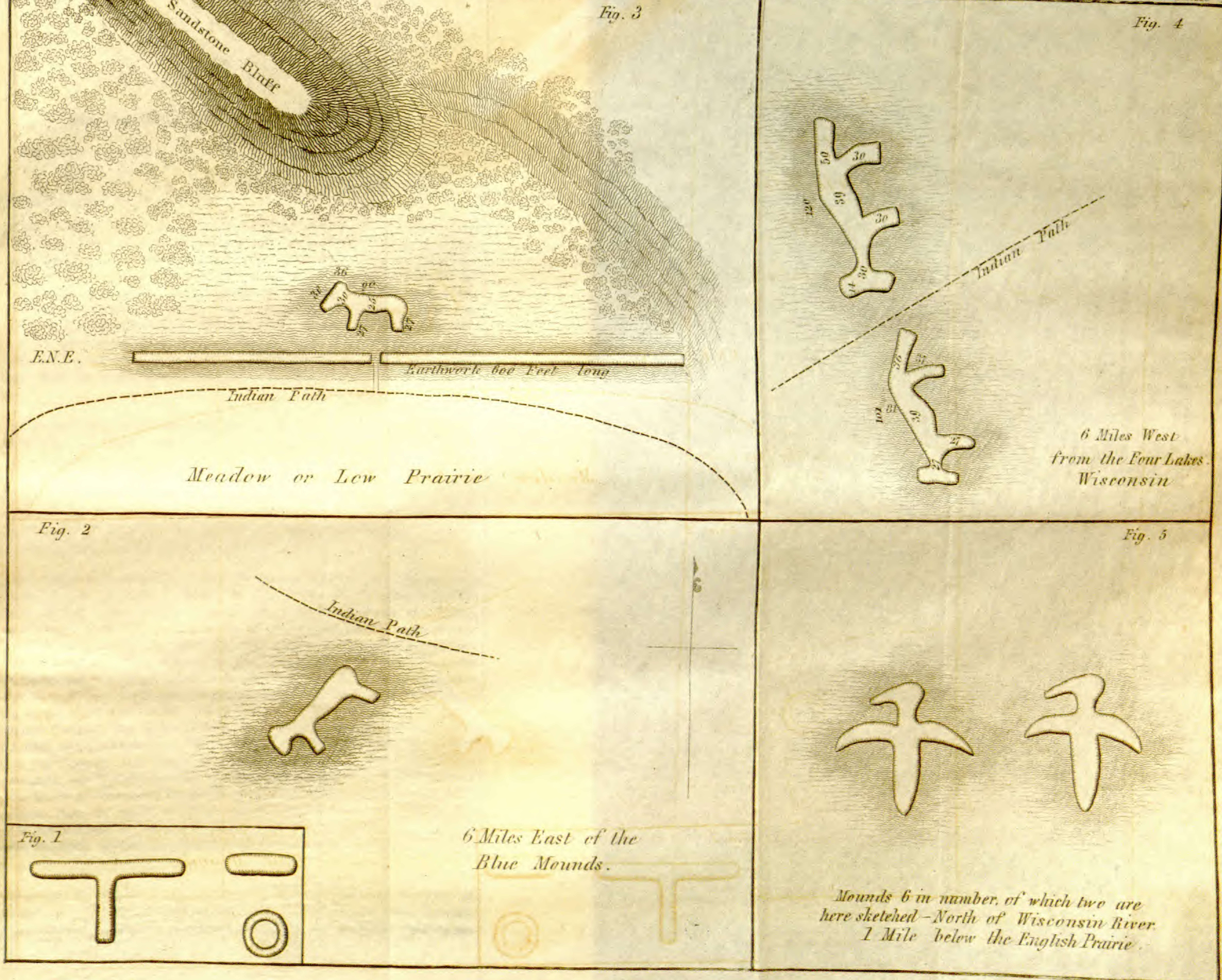
Fig. 3
Sandstone Bluff
E.N.E.
Earthwork 600 Feet long
Indian Path
Meadow or Low Prairie
Fig. 4
Indian Path
6 Miles West
from the Four Lakes.
Wisconsin
Fig. 2
Indian Path
6 Miles East of the
Blue Mounds.
Fig. 1
Fig. 5
Mounds 6 in number, of which two are
here sketched – North of Wisconsin River.
1 Mile below the English Prairie.

MR. BUCKINGHAM'S ADDRESS

TO THE PEOPLE OF THE UNITED STATES.

New-York, October 25, 1837.

MEN, BRETHREN, AND FELLOW-CHRISTIANS:

THE numbers of human beings that every day approach your shores from all parts of the old world, must so familiarize you with the arrival of strangers from every quarter of the globe, as to justify your indifference toward all who do not ask your attention on some special account, since it would be impossible for you to show it to every individual of so countless a multitude, and without some grounds on which to establish exceptions, none could be fairly expected to be made. This consideration, while it will fortify me in the propriety of the step I am taking, will also, I trust, dispose you to lend a favorable attention to a short statement of the circumstances which have driven me to your shores, of the motives which impel me to the course I am pursuing, and of the objects which I hope, under the blessing of Providence, and with your aid and protection, to accomplish.

A train of events, much too numerous to be narrated in detail, occasioned me very early in life to leave my native country, England, and to visit most of the nations of Europe — still more of the interior of Asia — many parts of the continent of Africa — and some portions also of the two Americas. It was after an active life of some twenty years thus devoted, in which it fell to my lot to traverse, I believe, a larger portion of the earth's surface, and to visit a greater number and variety of countries, than almost any man living of my age, that I settled as a resident in the capital of the British possessions in India, where I remained for several years.

During the voyages and travels that I was permitted to make along the shores of the Mediterranean, amidst the Isles of Greece, in Asia Minor, Egypt, Nubia, Palestine, Syria, Arabia, Mesopotamia, Chaldea, Assyria, Babylonia, Media, Persia, and India, I had an opportunity of personally inspecting almost all the remarkable cities and monuments of ancient greatness in the several countries named; including the gigantic pyramids, colossal temples, stately obelisks, majestic statues, and gloomy catacombs and sepulchres, which stud the classic banks of the Nile, from Alexandria and Grand Cairo to the cataracts of Syene; the hoary mountains of Horeb and Sinai, and the Desert of Wandering, across which the children of Israel were led from out of the land of Egypt, to the promised Canaan; the plains of Moab and Ammon, with Mount Pisgah, the valley of Jordan, and the Dead Sea; the ruined cities of Tyre and Sidon; the ports of Joppa, Acre, and Cesarea; the villages of Nazareth and Cana of Galilee; the cities of Sechem, Samaria, and Bethlehem; the mountains of Lebanon, Hermon, Tabor, and Carmel; the Mount of Olives and Mount Zion; the holy city of Jerusalem, with all its sacred localities, from the pools of Siloam and Bethesda, near the brook Kedron, in the valley of Jehoshaphat, to the more touching and endearing spots of the Garden of Gethsemane, the Rock of Calvary, and the sepulchre in which the body of our Lord was laid.

While these were the objects of my inspection in Egypt, Arabia, and Palestine, the Scriptural countries of Syria and Mesopotamia were scarcely less prolific in the abundance of the materials which they presented to my view. In the former were the sea-ports of Berytus, Byblus, Tripolis, and Laodicea, with the great interior cities of Antioch on the verdant banks of the Orontes, Aleppo on the plains, and the enchanting city of Damascus, whose loveliness has been the theme of universal admiration, from the days of Abraham and Eliezer to those of Naaman the Syrian, and the great Apostle of the Gentiles, and from thence to the present hour: while the great Temple of the Sun at Baalbeck, the splendid ruins of Palmyra, the gorge us monuments of ancient splendor in the Roman settlements of Decapolis, and the still earlier dominions of those who reigned before either Greek or Roman in Bashan and Gilead, and the regions beyond Jordan, added splendor to beauty, and combined all that the traveller or antiquary could desire.

Mesopotamia, including the ancient empires of Chaldea, Assyria, and Babylonia, into which I passed from Palestine, largely rewarded my researches. In the former, the celebrated city of Ur of the Chaldees received me within its gates, and I passed many days in this ancient birth-place and abode of the patriarch Abraham. The extensive ruins of Nineveh, spread in silent desolation along the banks of the Tigris, and the fallen Babylon, stretching its solitary heaps on either side of the great river Euphrates, were also objects of patient and careful examination; as well as the Oriental capital of the Caliphs, Bagdad the renowned; and the remains of the great Tower of Babel, on the plain of Shinar, of which a considerable portion still exists to attest the arrogance and folly of its builders.

Media and Persia came next in the order of my wanderings; and there, also, the ruins of the ancient Ecbatana, the tomb of Cyrus at Pasagarda, and the splendid remains of the great temple at Persepolis, gratified in a high degree the monumental and antiquarian taste; while the populous cities of Kermanshah, Ispahan, and Shiraz, with the lovely valleys of Persian landscape, amply fed my love of the beautiful and the picturesque.

In India, as the field was more extended, and the time devoted longer by several years, far more was seen, experienced, and felt. It may suffice, however, to say, that all the outlines of that magnificent 'Empire of the Sun,' from the Red Sea and the Persian Gulf on the west, to the Bay of Bengal on the east, were traced by my voyages along its shores; for after navigating, and accurately surveying both the seas named, from Suez to Bab-el-mandeb in the one, and from the mouth of the Euphrates to the port of Muscat in the other, I visited Bombay, and all the ports upon the coast of Malabar; from thence to Colombo and Point de Galle in the Island of Ceylon; afterwards anchored at Madras, and entered the ports of Bimlipatam and Vizagapatam, on the coast of Coromandel and Orissa, in the region of the Idol temple of Juggernaut; and ultimately reached the British capital of India, Calcutta, on the banks of the Ganges.

It may readily be conceived that in so extensive and varied a track as this, the personal adventures I experienced were as varied as they were numerous; and I may assert, with confidence, that while privation and suffering had been endured by me in almost every form — in hunger, thirst, nakedness, imprisonment, shipwreck, battle, and disease — so also, every pomp and pleasure that man could enjoy, from honors bestowed, and hospitalities received, agreeably relieved the tedium of my way; so that although my course was not invariably on a bed of roses, neither was it always across a path of thorns.

Amid all these changes, however, there was one thing which, in me at least, remained happily the same. No length of travel, no amount of suffering, no blandishments of pleasure, no intimidations of tyranny, no debilitation of climate, no variety of institutions, had been sufficient to abate in me, in the slightest degree, that ardor of attachment to Liberty, civil, political, and religious, which God and Nature implanted in my breast from the cradle—which experience fanned into maturity with manhood—and which Providence, I trust, will keep alive in my heart to the latest period of my advancing age. Animated by this love of Liberty, which you, the people of America, as you know how to cherish among yourselves, will not be disposed to condemn in others, I continued, even under the burning clime and despotic rule of an Eastern tyranny, to think, to feel, and to speak, as every Englishman, proud of his country, his ancestors, and his laws, ought to do, so long as he bears that honored name. For thus presuming to carry with me from the land of my fathers that spirit, which made England for so many years the Hope of the world, and which, infused into the early settlers of your own still freer country, and continued in their proud posterity, makes it now the Asylum and the Home of the Oppressed; for this, and for this alone, I was banished by a summary and arbitrary decree, without trial, hearing, or defence; my property destroyed, to the extent of not less than two hundred thousand dollars, and the prospective certainty of another two hundred thousand dollars at least cut off, and annihilated at a single blow.

With the details of this atrocity it is not my purpose or intention to trouble you; but while I record the fact, as one which forms an important link in the chain of circumstances that impel me hither, I may add, that the almost universal indignation of the people of England has been expressed against this gross injustice—that a Parliamentary Committee, composed of men of all parties in politics, unanimously pronounced its condemnation—and that the highest authorities among our public men have expressed their abhorrence of the deed; but from the impunity enjoyed by the East India Company in their oppressions abroad, and the impossibility of making them subject to our legal jurisdiction at home, no redress has, to this hour, been obtained, nor, according to all human probability, is any ever likely to be procured.

From the period of my arbitrary and unjust banishment from India, up to the reform of our Parliament in England, I was incessantly and successfully engaged in directing the attention of my countrymen to the evils of the East India Monopoly, and enlisting their interests and their sympathies in demanding its extinction. With this view I was occupied about six years in addressing the British public through the pages of the 'Oriental Herald,' and four years in a patriotic pilgrimage through England, Scotland, and Ireland, on a crusade against the abominations of the East; in the course of which I traversed all parts of the three divisions of our kingdom, visited almost every town of the least importance in each, and addressed, in public speeches, lectures, and discourses, on this important subject, not less than a million of my assembled countrymen, in audiences varying from five hundred to two thousand each, including persons of all ranks, from the peasant to the peer, of both sexes, of every age, and of every political and religious persuasion.

The result of all this was the kindling a flame throughout the entire nation, which burnt brighter and brighter as the hour of consummation approached, and at length became perfectly irresistible. More than an hundred provincial associations were formed, among which Liverpool, Manchester, Leeds, Glasgow and Birmingham took the lead, to demand the abolition of the East India Company's commercial monopoly, and the amelioration of its civil government; and not less than 100,000*l.* was raised and expended in the legitimate promotion of this object, through public meetings, deputations, and the powerful agency of the press.

The reform of Parliament being accomplished, I was invited, under circumstances of the most flattering nature to myself, but on which I will not dwell, to become the representative of the town of Sheffield, in which, and to which, I was then personally an entire stranger, but its invitation was founded on a knowledge of my public life and labors alone. I was successfully returned to the first reformed Parliament as its member, and had the happiness to advocate, in my place, in the British House of Commons, the views I had maintained in India—for maintaining which, indeed, I was banished from that country — and which I had since, by the exercise of my pen and tongue, for ten years, spread so extensively in England. The triumph of these principles was at length completed by the accomplishment of all my views. The India monopoly was abolished, and free trade to India and China secured. The liberty of the press in India was established, and trial by jury guaranteed. The political as well as the commercial powers of the East India Company were curtailed. The horrid and murderous practice of burning the widows of India alive on the funeral piles of their husbands was put down by law. The blood-stained revenue derived from the idolatrous worship of Juggernaut was suppressed. The foundation of schools — the promotion of missions— the administration of justice — were all more amply provided for than before— and to me, the sufferings and anxieties of many years of peril and labor combined, were amply rewarded by the legal and constitutional accomplishment of almost every object for which I had contended, and the gratification of almost every wish that I had so long indulged.

In addition to my ordinary share in the duties of the Senate, I had the happiness to be the favored instrument of first bringing before it the great question of Temperance; and through the investigations of a Committee, I had the satisfaction of presenting to the world such a body of evidence and so demonstrative a Report, as to convince a large portion of the British nation, that it was their solemn duty to God and man, to follow their American brethren in the noble example which they were the first to set in this most important branch of Moral and Social Reform.

Of the remainder of my labors as a member of the British Legislature, it is not necessary that I should speak: but I may perhaps, without presumption, be permitted to add — and there are happily now in the city of New-York some of the most intimate and influential of my constituents among the merchants and manufacturers of Sheffield, who can confirm the statement — that I had the happiness to sit as the representative of that large and opulent town for a period of six years, in the enjoyment of as much of the confidence and approbation of its inhabitants as it was possible for any representative to be honored with; and that in every annual visit made to my constituents, for the purpose of giving them an account of my stewardship in Parliament, and surrendering up my trust to the hands of those who first bestowed it on me, I was uniformly crowned with the testimony of their unanimous approbation, and sent back to the House of Commons as their Representative, with, if possible, still more unlimited confidence than before.

The period came, however, in which it was necessary, for the interests of those who are dear to me by blood and family ties, and for whom it is my duty as it is my happiness to provide, that I should quit my senatorial duties, and after nearly thirty years devoted to the service of the public, at a sacrifice of ease, fortune, leisure, domestic enjoyment, and indeed every thing but honor and character, that I should resign my trust to some more fortunate successor, and devote the few remaining years of health and activity, that might be spared me, before old age should render exertion impracticable, to providing a retreat for the winter of life, and acquiring the means of making that retreat independent as well as honorable. I accordingly announced this intention, and the reasons on which it was grounded, and at the close of the last session of Parliament in July, 1837, I paid a farewell visit to my constituents at Sheffield, where, though all our previous meetings had been cordial, hearty, and affectionate in the extreme, this was more cordial, more affectionate — though tinged with a new element of sorrow and regret — than any that had gone before.

These, then, are the circumstances, and I have narrated them with as much brevity as possible, which have led me to quit the land of my nativity, and go, with my family, to other shores. The motives which have induced me to prefer those of the United States, as the first, at least, to be visited in my course, and the objects which I hope to accomplish among you, still require to be explained.

It is an opinion, not now professed by me for the first time, but long entertained, and frequently avowed, that America is destined, in the course of time, to be the great centre of Freedom, Civilization, and Religion, and thus to be the Regenerator of the World. In the ages that are passed, we have seen the rays of science and the beams of truth first illumining the countries of the East, and then passing onward, like the light of Heaven itself, progressively toward the West: — Chaldea giving knowledge to Egypt — Egypt to Greece — Greece to Rome — Rome to Iberia, Gaul, and Britain — and these three in succession to their respective settlements in America; — till these last, shaking off their dependance, and rising in the full dignity of their united strength, asserted and secured their freedom, and took their place among the most enlightened and most honored nations of the earth.

From that moment you have gone on, rejoicing like the sun in his course, increasing in population, in commerce, in liberty, in wealth, in intelligence, in happiness, till your people have penetrated the primeval forests, and spread themselves as cultivators of the soil from the Atlantic almost to the Pacific, till your ships cover every sea, and till the Message of your President, unfolding the measures of the past, and developing the prospects of the future, is looked for with interest at every court in Europe, and read with eager and intense attention by the humblest lover of freedom in every country in which it is made public.

Commanding, therefore, as you now do, a position the most favorable to national greatness, to useful influence, and to honorable renown; the vast interior of your extensive surface embracing every variety of climate, soil, and production, and your extended sea-coasts furnishing ports of attraction to all the world; with the Atlantic Ocean for your highway to Europe, and the Pacific for your approach to Asia; your mighty rivers, rising cities, populous villages, increasing colleges, temples of public worship, and adult and infant schools; what is wanting, but time, to place you at the head of those nations of the old world, who, less than a century ago, derided your intelligence and your strength, to both of which you have long since compelled them to pay the homage that was justly due?

While others, therefore, visit your shores, charged either with merchandise to sell, or gold and silver to buy, I venture to come among you, freighted with no cargo of goods for your consumption, or with the precious metals for purchase or exchange. In the midst, however, of all the bustle and animation that fills your crowded marts, there will be room, I hope, for one who brings only the knowledge and experience acquired by years of travel in the Scriptural and Classical countries of the East, to communicate to those who may have leisure and disposition to hear, and taste and education to enjoy, whatever can illustrate the history and poetry of early days; and above all, whatever can tend to unfold the beauties, confirm the prophecies, and give strength and force to the sublime and important truths contained in the Sacred Volume of our common faith.

This is the first object which I hope to accomplish by my sojourn among you, and this alone would well justify my visit to your shores. If, at the same time, there be others not incompatible with this prominent one, but auxiliary and subordinate to it, that I may be permitted to pursue — such as a careful and impartial examination of your own resources, institutions, literature, and manners — so that while diffusing information for the gratification of others, I may be adding to my stores of knowledge for my own delight, I doubt not that I shall find among you all the kindness of aid for which you have so long been renowned.

The mode that I have chosen for the communication of the interesting details with which the past history and actual condition of the Scriptural and Classical countries of the East abound, namely, that of oral discourses, or extemporaneous lectures, may appear to some to be less dignified, as it is undoubtedly less usual, than the diffusion of this class of information through printed books. But it may be defended, first, on the ground of its greater practical utility, being at once more attractive and more efficient; and secondly, on the ground of its high antiquity, and of the sacred and classical, as well as noble and historical precedents in its favor.

As to the ground of its attractiveness, it has been found, in Britain at least, that thousands would be induced to assemble to *hear* a traveller personally narrate his adventures, and describe the objects he has seen, where it would have been difficult to get even hundreds to bestow the time and labor of *reading* the same things in printed books; and when I add that in London, Edinburgh, Dublin, Glasgow, Belfast, Liverpool, Manchester, Leeds, Birmingham, Sheffield, Hull, Bristol, Bath, and others of our largest and most intellectual cities, audiences increasing from five hundred to two thousand persons have been attracted for six successive nights, without apparent inconvenience or fatigue — the proof of the superior attractiveness of spoken discourses, over printed books, may be considered as complete. Of their superior efficiency there is even still less doubt; for the very fact of so many persons being assembled together at the same time, and hearing the same observations at the same moment, excites an animation, sympathy and enthusiasm, which is contagious in its effects on both speaker and hearers, till their feelings flow in one common current; the facts sink deeper into the memory at the time, and the subsequent conversation, criticism, comparison, and reflection, to which this gives rise among those who attend, implant them with a firmness that no amount of mere reading could accomplish.

For precedents or authorities, it is not necessary to go far in search, so profusely do they abound in ancient and in modern annals. In Scriptural ages, the oral mode of communication was almost the only one in use, from the days of Abraham, who, according to the testimony of Josephus, thus taught the Chaldean science of Astronomy to the Egyptians — down to the time of Solomon — who discoursed so eloquently of the productions of Nature in the animal and vegetable kingdoms, and from whose lips the profoundest maxims of wisdom were poured into charmed ears — and from thence again to the days of Paul, who stood before Festus, Felix, and Agrippa, at Cesarea; and who, clothed in all the majesty of Truth, addressed assembled thousands at Antioch, at Ephesus, at Athens, at Corinth, and in Rome.

In classical countries the custom was universal, and there are many who conceive, with the great Lord Bacon, that one of the causes of the superior intellect of the Greeks, was the method in use among them of communicating knowledge by oral discourses, rather than by written books, when the pupils or disciples of Socrates, of Plato, and of Epicurus, received their information from these great masters, in the gardens and the porticos of Athens, or when the hearers of Demosthenes, of Eschylus, of Sophocles, or Euripides, hung with rapture on their glowing sentences, as pronounced in the Areopagus — the theatre — the gymnasium — or the grove.

Of classical authorities, the memorable instance of Herodotus will occur to every mind. This venerable Father of History, as he is often called, having been first banished from his native country Halicarnassus, under the tyranny of Lygdamis, travelled, during his exile, through Egypt, Palestine, Syria, Mesopotamia, and to the borders of Media and Persia, in which he was engaged for several years. On his return from his travels he was instrumental in uprooting and destroying the very tyranny under which his banishment took place; but this patriotic deed, instead of gaining for him the esteem and admiration of the populace, who had so largely benefitted by his labors, excited their envy and ill-will; so that he a second time left his native land, and then visited Greece. It was there, at the great festival of the Olympic Games, about five hundred years before the Christian era, being then in the fortieth year of his age, that he stood up among assembled myriads of the most intellectual auditors of the ancient world, to narrate, in oral discourses, drawn from the recollection of his personal travels, the subject matter of his interesting history and description of the Countries of the East; and such was its effect upon the generous hearts and brilliant intellects of his accomplished hearers, that while the celebrated Thucydides, then among them as a boy, shed tears at the recital of the events of the Persian war, and his young bosom was perhaps then first fired with the ambition which made him afterwards one of the most accomplished historians of Greece, the people received Herodotus with such universal applause, that as an honor of the highest kind, the names of the nine Muses were bestowed upon the nine Books or subdivisions of his interesting narrative, which they continue to bear to the present hour in every language into which they have been translated.

Pythagoras, of Samos, is another striking instance of a similar career. Disgusted with the tyranny of Polycrates, he retired from his native island; and having previously travelled extensively in Chaldea and Egypt, and probably in India, he also appeared at the Olympic games of Greece, and travelled through Italy and Magna-Grecia, delivering, in the several towns that he visited, oral discourses on the history, religion, manners, and philosophy of the Countries of the East; and their general effect was not less happy than that produced by the narrations of Herodotus; for it is said that 'these animated harangues were attended with rapid success, and a reformation soon took place in the life and morals of the people.'

I might go on to enlarge the catalogue of precedents, for both ancient and modern history is full of them — Marco Polo, Columbus, Camoens, Raleigh, and Bruce (all, too, treated with the deepest injustice by their countrymen) will occur to every one — but it is unnecessary. May I only venture to hope, that as some similarity exists between my own history and sufferings from tyranny and the ingratitude of contemporaries and that which marked the career of those great men whose names I have cited — Herodotus and Pythagoras — as well as in the countries we each traversed, and the mode of diffusing the information thus acquired by oral discourses among the people of other lands — the similarity may be happily continued — if not in the honors to be acquired, at least in the amount of the good to be done; and that in this last respect, the Olympia and Magna Grecia of the East may fairly yield the palm to the more free and more generally intelligent Columbia of the West, is my most earnest hope and desire, my most sincere and fervent prayer.

I will say no more, except to add, that should my humble labors among you be crowned with the success which I venture to anticipate, and should Providence spare me life and health to follow out the plan I have long meditated and designed, it is my intention, after visiting every part of the United States of America, to extend my tour through the British Possessions of Canada, New-Brunswick, Nova Scotia, and the West Indies; to visit from thence the Isthmus of Darien, for the purpose of investigating this barrier between the Atlantic and Pacific Ocean; to make an excursion through Mexico, and from thence pass onward by the South Sea Islands to China, visit the Phillippines and the Moluccas, go onward to Australia and Van Dieman's Land; continue from thence through the Indian Archipelago, by Borneo, Java, Sumatra, and Malacca, to India; traverse the Peninsula of Hindoostan, from the Ganges to the Indus, and return to Europe by the Red Sea and the Mediterranean.

Throughout the whole of this long and varied route, there are a few prominent and important objects, which, as they have been long favorite subjects of study, and have engaged a large share of my attention in the past, I shall hope to keep steadily in view, and do all within my power to advance in the future. It has long been my conviction, that among the most prolific causes of vice and misery in the world, those of Intemperance, Ignorance, Cruelty, and War, are productive of the greatest evils; and that the best service which man can render to his fellow-beings is therefore to promote, by every means within his reach, the principles and practice of Temperance, Education, Benevolence, and Peace. My belief is, that more of sympathy and cordiality in favor of these great objects will be found in the United States of America, than in any other country on the globe. Already, indeed, has she done more than any other country that can be named for the advancement of Temperance, the spread of Education, the amelioration of the Criminal code, the improvement of prisons and penitentiaries, and the practical illustrations of the blessings of Peace. And placed as she now is, between the two great Seas that divide the old from the new world, and separate the ancient empires of the East from the modern nations of the West,—so that with her face toward the regions of the sun, she can stretch out her right hand to Asia and her left hand to Europe, and cause her moral influence to be felt from Constantinople to Canton—she has the means within her reach, as well as the disposition to use those means, for the still further propagation and promotion of her benevolent designs. It is this which encourages me to believe that my ulterior projects and intentions, which I thus freely avow, will not lessen the cordiality with which the first and more immediate object of my mission to your shores will be received. The land now covered with the descendants of the Pilgrim Fathers, and the offspring of those noble and unyielding spirits, who, fleeing to the uncleared wilderness as a refuge from tyranny and persecution, found in its primeval forests the liberty they in vain sought for in their native homes, and whose posterity, while filling these forests with cities, and covering the wilds with civilization and religion, have never forgotten those lessons of Freedom which their ancestors first taught by their practical privations and sufferings, and then sealed and cemented by their blood — such a land is not likely to refuse its shelter to one whose past history may give him some claim to the sympathy of its possessors, whose present labors may be productive of intellectual gratification to themselves, and whose future undertakings, if blessed by Divine Providence, may sow the seeds, at least, of benefit to other widely-scattered regions of the earth.

To you, then, the People of America, I frankly submit this appeal: and at your hands I doubt not I shall experience that cordial and friendly reception which may smooth the ruggedness of a Pilgrim's path, and sooth the pillow of an Exile's repose.

J. S. BUCKINGHAM.

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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 and pamphlets 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, as now, in part, retrospective.—*Eds.*

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Discourse before the Massachusetts Horticultural Society, by J. L. Russel. Boston. 1835.

The Napolead, in 12 books, by Th. H. Gerine, Esq., to the public library in New Haven.

First Annual Report of the board of education, &c. No. 26. Senate of Massachusetts. Boston. 1838. From Horace Mann.

The same. From E. Davis.

Report of the secretary of the board of education on the subject of School Houses, &c. Boston. 1838. E. Davies.

The same. From H. Mann.

A Discourse on the life and character of Nathl. Bowditch, LL. D. F. R. S. Boston. 1838. From the author, Rev. Alex. Young. A second copy from Isaac P. Davis, Esq.

Eulogium on the life and character of the Hon. Nathaniel Bowditch, by Hon. Judge White, of Salem. From the author.

Nineteenth Annual Report of the Directors of the New York Institution for the Deaf and Dumb. New York. 1838. From H. P. Peat, principal.

American Journal of Pharmacy. January, 1838.

Annual Report of the Colonization Society of the city of New York. 1838.

Speech of Gov. W. W. Ellsworth, May, 1838, to the Legislature of Connecticut.

Document No. 121, U. S. Government, containing observations on the tides near the northern extremity of Cape Cod, Mass., by and from James D. Graham,—two copies, one for Yale College library.

Engraved Portrait of Rev. Jonathan Edwards, usually called the first. From I. P. Davis, Esq. Boston.

Do. of John Winthrop, Governor of Massachusetts colony.

Do. Do. Do. of Connecticut. The two latter for Yale College. From I. P. Davis, Esq. Boston.

Colored lithograph portrait of the Indian chief Osceola. From Geo. Catlin, Esq., the artist, through D. Macumber.

An Essay on the relation between the respiratory and circulating functions, by Charles Hooker, M. D. of New Haven. Boston. 1838. From the author.

Charter and by-laws of the Maryland Academy of the Fine Arts. Baltimore. 1838.

Atlantic Steam Ships, &c. From Ithiel Town, Esq.

Cheever's Latin Accidence; recommendations of the work, and a biographical notice of the author. Boston. 1835.

Report of Mr. Talmadge in the Senate of the United States, on the memorial of Henry Hall Sherwood, claiming to have made important discoveries in magnetism, &c. From Mr. C. Cushing, M. C.

FOREIGN.

Practical observations on the Asphaltic Mastic, or cement of Seyssel, &c. London. 1837.

The country of the Iguanodon restored, by John Martin, Esq., from geological discoveries of Gideon Mantell, Esq., LL. D. F.R.S. &c.; two beautiful prints. From Dr. Mantell.

Two engraved portraits of Dr. Mantell.

Handbuch der Oryktognosie von Carl Cæsar von Leonhard; professor, &c. Heidelberg, Germany.

Hawaiian Spectator. Vol. I. No. 1. January, 1838. Honolulu, Oahu, Sandwich Islands.

India Review and Journal of Foreign Science and Arts. Edited by Frederick Corbyne, Esq. Calcutta. 15 Nos. from the Editor, through J. V. C. Smith, Esq., Boston, by Capt. Wiley, S. Frank.

The Sixth Report of the British Association for the Advancement of Science. Vol. V. From the Association.

Laws and Regulations of the Meteorological Society, instituted in 1833. London. 1838. From the Society.

Observations made during 37 successive hours, commencing at 6 A. M. of the 21st of March, 1838, and ending 6 P. M. of the 22d.

S. Maynard's Catalogue of English and Foreign Mathematical books. London. J. S. Hodson.

Bulletin de la Société Française de Statistique Universelle, Livraison 1, 2, 3, 6, and documens No. 8. 1830–31.

Annals of Electricity, Magnetism, and Chemistry, &c., by Wm. Sturgeon. January, 1838. No. 2.

Select Views in Greece, with classical illustrations, by H. W. Williams, Esq., F. R. S. E. Lond. 1829. In two volumes largest royal 8vo., superbly bound, and containing sixty-four splendid engravings of scenes in Greece—the classical illustrations and their translations from John Patterson. Edinb. Presented to the Trumbull Picture Gallery of Yale College, by John Dunlop,* Esq. of the city of Edinburgh.

Wonders of Geology, 2 vols. 12mo., with numerous plates and wood cuts, by Gideon Mantell, LL. D. F. R. S., &c. Lond. 1838.

Oratio in Academia Fridericiana Halensi cum Vitebergensi consociata, &c. October, 1831. Habita ab Prof. J. S. C. Schweigger. Phil. Soc. &c. &c. &c. From the author.

The following is the peroration: " Vir per-illustris,—qui legatum summi rerum nostrarum administri agens nobis ædes academicas tradidisti: Magnificè Academiæ protector; Per-illustris Director; viri summe reverendi, per-illustres, illustres, amplissimi, doctissimi; auditores omnium ordinum honoratissimi."

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* Mr. Dunlop has travelled extensively in this country, and is well known for his acts of munificence and benevolence.

Ueber die Natur der Sonne mit Beziehung, auf V. Sæmmeorrings Sonnbeobachtungen. Vom Dr. J. S. C. Schweigger, Prof. der Physik und Chemie, &c. &c. Halle. 1829.

Statuten der Naturhistorischen Gesellschaft, zu Athen.

Ueber die alteste Physik und den Ursprung des Heidenthums aus einer missverstandener naturweisheit, &c. Von Dr. Schweigger.

Einleitung in die Mythologie auf dem Standpunkte der Naturwissenschaft. Von Dr. J. S. C. Schweigger.

Diploma from the Natural History Society in Athens, Greece.

A Popular Treatise on Voltaic Electricity and Electro-Magnetism, &c., by and from B. H. Bachhoffner, lecturer on chemistry, &c. &c. pp. 35. 1838.

Stenographic round-hand, by Isaac Pitman. London. 6 copies.

Rules of the London Electrical Society, with an address, delivered by Wm. Sturgeon, Esq. Aug. 7th, 1837, at the theatre, Adelaide street.

Memoirs published by the Society. Both the above from the Society, or Mr. Clarke, the Electro-Magnetician.

Agenda Geognostica. Von C. C. von Leonhard. Heidelberg, Germany. 1829. From W. C. Woodbridge.

Memoir on the bones of birds discovered in the strata of Tilgate Forest in Sussex, by Gideon Mantell, LL. D. F. R. S., &c., with a plate : 4 copies. From the author.

On the advantages of exercise in some spinal deviations, addressed to Sir B. C. Brodie, by Dr. Riofrey. London.

List of prices of magnetical, philosophical, optical, and chemical instruments and apparatus, manufactured by Edward M. Clarke, No. 11, Lowther Arcade. London.

List of chemical and philosophical apparatus, and chemical tests, manufactured and sold by E. Palmer, 103 Newgate street. Lond. 6 copies, with 6 cards.

Proceedings of the Geological Society of London. Nos. 41, 52, 53, 54 and 55. From the Society and from Dr. G. Mantell.

Prospectus of the Zoology of the ship Beagle. 1832 to 36.

Prospectus of Bryologia Europea seu Genera Muscorum Europærum monographice illustrata ; auctoribus Bruch & W. P. Schrimper. 13 copies.

Prospectus de Le Muséum Zoologique de Heidelberg. 8 copies. The museum offers exchanges with foreign museums, via Hâvre en France, par Messrs. Warner, Langert & Co., or via Rotterdam en Hollande, surtout pour les objets fragiles. The director of the museum is Prof. H. G. Bronn.

The prospectus makes known the conditions, and we will forward them if desired.—*Ed. Am. Jour.*

Prospectus of an Institution for the advancement of the Arts and Practical Science. London.

Brighton (Eng.) Herald. No. 1683. Containing a notice of Dr. Mantell's Wonders of Geology.

Mining Review, an entire bound copy, for the Yale College Library. Henry English, Esq. London.

American Newspapers.

Elizabethton Republican, Tenn., various Nos.

Daily Nat. Intelligencer. Washington, March, 1838. Mr. Buckingham on duelling.

Boston Courier, May 20th, 1838. Mr. Buckingham's vindication.

Mohawk Courier, Little Falls, Feb. 15th, 1838. Notice of the American Journal.

Providence (R. I.) and Pawtucket Advertiser, May 31st, 1838. Notice of Geological Reports.

Cincinnati Journal, June 7th, 1838.

Albany Journal, Feb. 18th, 1838. Speeches in the New York legislature on the small bill law.

Newburgh Journal. J. D. Spalding, June 16th, 1838. Agency for periodical works.

Cleveland Gazette, May 23, 24, 26, and 28, 1838. Meteor and N. W. passage. Rise of water in the lakes. Question of vegetable origin of coal. It is not difficult to answer the writer's objections to the vegetable origin of coal, and to demonstrate that it certainly had that origin.

Mobile Examiner, April 20th, 1838.

Journal of the American Temperance Union. May, 1838.

Feliciana Republicana. Nos. 4 and 8. W. M. Carpenter, M. D.

Missouri Saturday News. Nos. 5 and 6. Anon.

Cincinnati Daily Gazette. No. 3319. From Dr. John Locke.

New York Journal of Commerce. No. 4188.

Buffalo Daily Commercial Advertiser. No. 1036, From Mr. R. W. Haskins.

Baltimore American, &c. No. 13965. From Mr. N. Hickman.

Cincinnati Daily Gazette, March 29th, 1838. Dr. Beecher's address to Mechanics.

Lancaster Herald, June 21st 1838. M. Ellmaker.

Circular of Josiah Holbrook on the Lyceum System of education.

Columbus Register, April 5th, 1838. Geological and Magnetical survey of Ohio.

Buffalo Advertiser, May 10th, 1838. Notice of the American Journal, No. 1 Vol. xxxiv. E. Haskins.

Gennessee Farmer, June 16th, 1838.

Library of Yale College.

From Rev. President J. Adams, Charleston, S. C.

Sermon before the Protestant Episcopal Convention, Charleston, S. C., Feb. 13th, 1833.

Eulogium on Elias Horry, Esq., Charleston, Jan. 23d, 1838.

Sermon, Advent Sunday, on the day of the total eclipse of the sun, Nov. 30th, 1834.

Baccalaureate Address at the annual commencement, Charleston College, Nov. 3d, 1835.

Sermon, Advent Sunday, Charleston, Nov. 29th. 1835.

Address before the Euphradian Society, Charleston College, Oct. 30th, 1833.

Oration on the moral causes of the welfare of nations, Charleston College. Before the graduates, Nov. 1st, 1834.

Inaugural Discourse. Geneva, N. Y. Aug 1st, 1827.

New Electro-Magnetic Instrument, from Dr. C. G. Page, Boston, and now of Washington, D. C.

Do. E. M. Clarke. London.

Large and splendid specimen of the Florida shell rock, from St. Eustatia Island, for Yale College Cabinet. From Mrs. Mary Wilkinson, late Miss Peters.

Do. of the sandstone of the Cattskill mountains, replete with terebratulæ, &c.

Beautiful polished marbles from Proctorsville, Vt., from Mr. Ilock Hills, proprietor.

Rich lead ore galena, St. Thomas, W. I. P. I. Minvielle.

Box of terebratulæ, trilobites, &c., from the vicinity of Buffalo. E. G. Hayes.

Henry English, Esq. of London, Editor of the Mining Review and Mining Journal, has placed at the disposal of the Editors of this Journal the sum of twenty dollars, "to be given as a premium for the best paper on a subject intimately connected with mining pursuits, with drawings," to be inserted in this Journal.

To Proprietors of Land and others in Illinois and other Western States.

A professional gentleman, travelling to the West, during the ensuing autumn and winter, and well acquainted with Geology, will be willing to undertake a geological investigation, and make a responsible report of any interest connected with the mineral kingdom, in any of the States contiguous to the Ohio river or the great lakes. His address and full information may be obtained from the editors of this Journal.

New Haven, July 12, 1838.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*Description of a Crustaceous Animal, belonging to the genus Caligus—C. Americanus;* by CHARLES PICKERING, M. D. and JAMES D. DANA, Members of the Yale Natural History Society.

Read before the Yale Nat. Hist. Soc., Feb. 20, 1838.

THE species of the genus Caligus, and of other allied genera, are commonly called *fish-lice*, in allusion to their parasitic mode of life. The individuals which are the subject of the following remarks, infest the Common Cod* of this part of the American coast.

During the fall of the year, when the shoal fish are brought to the New York market,† the Caligi are exceedingly abundant. Occasionally, forty or more individuals may be taken from a single fish. As the season advances, the fish are taken in fewer numbers off Sandy Hook and Long Island, and afford a much smaller proportion of parasites. The Caligi are most numerous on the half-grown fish; they are found indiscriminately on the head or different parts of the body, but never within the gill-covers. A European species has been said to live under the scales: we have never observed this peculiarity in the species on this coast; indeed, the closeness of the small scales of the cod, renders it impossible.

* It has not been satisfactorily ascertained whether the cod of this coast is identical with the European species, Morrhua vulgaris; this, however, is the common opinion.

† These investigations were made at the city of New York, and occupied the latter part of November last, together with the following months, December and January.

When disturbed, they move with rapidity over the fish, and either backward or forward with nearly equal facility. In swimming, their motion is equally rapid. They thus travel over the body of the fish at will, and, we doubt not, occasionally leave one fish for another.

Both sexes frequently occur on the same fish, though the females (during the months of November, December, and January) have been far the most abundant. The latter are, in general, readily distinguished by the two filiform appendages to the body, which are the external ovarian tubes; or, if these are wanting—as often happens—by the larger abdomen, whose greater size is owing to the eggs it contains. If destitute of eggs, it does not present this peculiarity. The sexes differ, moreover, in the form of the first and third pair of feet, as will be particularly noticed when speaking of these members.

The sizes of the individuals which have come under our notice, have been very various. The adult males frequently attain a length of five ninths or nearly two thirds of an inch, (fig. 2, Pl. III.) The females are always smaller than the males, and seldom exceed a half inch, exclusive of the ovarian tubes, (fig. 3.) The smallest individual seen, was one tenth of an inch long. Its legs had less slender proportions than usual; otherwise, it did not differ from the adults.

The Caligi live several hours on the body of the cod taken from the water; but generally die soon after the death of the fish. When taken from the fish and confined, they exhibit a strong inclination to leave the water. We have often observed, after the introduction of fifteen or twenty into a glass of salt water, that the greater portion of them seek the surface, where they attach themselves to the glass; and quite a number leave the water entirely, crawling up the glass an inch or two above the surface. The water they confine under their broad shell, which is closely attached at its margin, supports them for a while; but, unless assisted again to their element, they remain, without any apparent attempt to return, and in a few hours die.

These animals, like the cod, on which they live, require a low temperature, and have been observed to swim, with scarcely diminished activity, in water that was freezing. In some instances, when the water had evidently reached a temperature below 32° F., without congelation, they have been rendered torpid, and apparently dead; but on bringing them into a room not above 45° F., they have soon resumed their usual activity. When the temperature has been as high as 60° F., they have generally died in the course of a short time. This may be owing in part to the deterioration of the air in the water, arising from the decompositon of the animal matter contained in it. They die almost immediately when thrown into fresh water.

Although the imperfect descriptions of the European Caligi, by early authors, have been improved by subsequent investigators, still, in consequence of the obscure structure of these animals, their characters are yet very inaccurately described. We have therefore been unable to satisfy ourselves fully, that the species of this coast is distinct from the European. Yet, as many of the characters stated respecting the foreign species, do not apply to ours, we have ventured to propose it as new, under the name given at the head of this article.* The following description, together with the accompanying plates, it is hoped, will enable the future investigator of the European individuals to decide in regard to their identity.

The results of our investigations have shown, that many of the errors of authors are of the most fundamental character. Among the principal of them, we find that a front pair of cups, serving for the attachment of the animal, have been mistaken for its eyes;—the exserted ovarian tubes have of late been considered the respiratory apparatus;—and what is still more essential, as it affects the late classification of the Crustacea, the mouth is supposed to be a sucker, whereas it contains large dentated mandibles, and other manducatory organs, appertaining to the maxillated species. This last character has been proved to belong also to the Argulus, another of the *Siphonostoma*, or *Crustacés Suceurs*, in an article on that animal, in this Journal, Vol. XXXI, 1837.

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* We find in a folio volume by M. Duhamel du Monceau, entitled *Traité Générale des Pesches*, MDCCLXXIII, *Paris*, at page 294, a description of the Caligus found on the Salmon, accompanied by drawings, which, if at all accurate, show that the species are not identical. The same conclusion may be drawn from Desmarest's figures in his Gén. Consid. des Crustacés, if they can be relied on. Other figures that we have seen are so evidently inaccurate, or so destitute of details, that we would not venture to form an opinion from them.

I. Tegumentary System.

a. *Segments of the Body.*

The body of the Caligus is provided with a flexible, subcorneous, and perfectly transparent covering. By dissection, we were able to distinguish only two coats. The internal is a thin, moist membrane, easily separable from the exterior, and often presenting, especially in old individuals, numerous dendritic delineations of an ochre-yellow color. Occasionally, they are so abundant as to give the animal an ochreous tinge. The exterior coat or shell is pellucid, very flexible, and somewhat elastic, and does not exhibit a fibrous structure. In some portions of the shell, and particularly about the eyes, it is divided into areas, as represented in fig. 8, Pl. IV. The shaded subtransparent area in this figure passes longitudinally over the space between the eyes.

When the animal dies, it assumes, after some time, a rose-red tint. Under the microscope, this color is found to be disposed in dendritic delineations, like the yellow color above noticed, and apparently in the same membrane with it; and in a few instances, we are confident that the dendrites which before were yellow, have this reddish hue. We cannot say that this is true of all these delineations.

The body is composed of four distinct segments, (fig. 7,) of which the first two include the head and thorax, and the third and fourth, the abdomen. The anterior of these segments, which we may designate the *cephalo-thoracic*, is divided into four portions, by imperfect articulations. Two of these articulations are longitudinal, and separate the lateral portions of this segment from the central. The other articulation connects the centre of the two longitudinal articulations, like the cross-line in the letter H, and thus divides the central part of this segment into an anterior and posterior portion. The two lateral portions correspond to the united epimeræ of the higher crustacea, and may be called the *epimeral* segments; the anterior of the two central, may be called the *cephalic* portion, and the posterior forms the anterior portion of the *thorax*. The anterior or cephalic segment presents an imperfect articulation near its front margin, which separates a narrow segment; this segment we shall hereafter designate the *anterior* or *first cephalic* segment, and the remaining portion the *posterior*, or *second cephalic* segment.

Viewed as a whole, the *cephalo-thoracic* segment is slightly convex, and has an obtuse ovate form, a little broader posteriorly, with an emargination in front, (A, fig. 7,) and a deep sinus on each side in the posterior margin, (B.) It is bounded, both anteriorly and laterally, by a thin transparent margin, which appears transversely striated, when highly magnified. The lateral margin is about four times as wide as the anterior. A row of extremely minute curved spines project above the junction of the membranous margin, as is exhibited in figs. 1 and 19. Similar spines are scattered over the back; but a very high magnifying power and the most favorable light are required to discover them.

The articulation of the first with the second cephalic segment, though mostly imperfect, approaches a perfect joint towards each side, (C, fig. 7,) where there is an osseous process in the two segments, with opposite articulating surfaces. The process on the first segment is narrow, and transversely oblong. That on the second is long and slender, and extends to a point laterally in advance of the eyes; it is much enlarged at the articulation, and at that place resembles the process on the anterior segment.

The articulation of the cephalic with the thoracic portion of the cephalo-thoracic segment of the body is curved parallel with the anterior margin of the animal, and terminates on each side, near the centre of each lateral half of the cephalo-thoracic segment, (D, fig. 7.) From this point the articulation of the epimeral with the central segments commences. A thin semi-corneous margin extends from the cephalic segment, and covers its articulation with the adjacent parts. The junction of the epimeral and cephalic segments is directed towards the anterior portion of the lateral margin, but becomes obliterated before reaching it; the junction with the thoracic segment is continuous in a curve, concave inward, to the posterior margin just outside of the sinuses in the latter segment. An osseous articulation, similar to that between the two cephalic segments, unites the epimeral and cephalic segments, (E, fig. 7;) the process on the former is long and slender, and curves backward, giving firmness to that portion of the shell.

The *thoracic* portion of the cephalo-thoracic segment approximates to a circular form. The sinuses before referred to, (B, fig. 7,) are situated in its outer posterior margin. Between each sinus and the articulation of the epimeral segment, there is a narrow lobe, which is provided, on its interior margin, with a folded membrane. The lobe is slightly movable upon a joint at its base, and the membrane has a very free motion, and serves to close the sinus.

The *posterior thoracic* segment (F, fig. 7,) is quite short; its breadth nearly equals one third of the greatest breadth of the anterior portion of the body. Laterally it terminates in an angle, from the posterior side of which, the legs arise which belong to this segment.

The *first abdominal* segment (G,) differs in form in the two sexes. In both, the length and breadth are nearly equal, though in general the former is somewhat greater in the female, and the latter in the male. The sides are much curved in the male, (fig. 7,) and the whole is narrower anteriorly. In the female, (fig. 18,) the form approaches a square with rounded angles. The posterior angles in the male are projecting, and furnished with three short hairy setæ; the same in the female are provided with the same setæ, but they scarcely project beyond the adjoining parts. These peculiarities only exist in the gravid female. When the abdomen is destitute of eggs, it resembles that of the male.

The *remaining abdominal* joint, (H, fig. 7,) has a flattened subovate form, and is about two thirds the breadth of the preceding. Two short leaf-like appendages are obliquely articulated with its posterior extremity. These leaflets are furnished with three terminal plumose setæ or pinnulæ, the ciliæ of which have a length equal to three times the breadth of the seta. There are two short setæ exterior to the pinnulæ, and one interior. These leaflets are ciliated on their internal margin.

b. *Organs appertaining to the several segments.*

1. *Anterior Cephalic Segment.*—This segment presents, in its front emargination, (A, fig. 1,) two minute rounded papillæ, covered on their inner surface with very short hairs, which appear to correspond to the inner antennæ of other crustacea. Below and just behind their insertion we observe a small semicircular process convex outward, which projects a short distance beyond the surrounding surface.

Toward the lateral extremity of this segment, on its lower surface, there is a remarkable organ, which the animal employs in attaching itself, (I, fig. 1 and fig. 19,) but which has heretofore been considered its eyes. It consists of a thin nearly circular membrane, attached by its central portions. Its surface is finely marked with lines running towards the outer margin; on the inner margin, these lines, though possessing the same general direction, freely anastomose. We have often tested the use of these organs by applying the blade of a knife to the front margin below, while the animal was on its back, when in numerous instances it has adhered with sufficient force to be lifted from the fish and carried some distance. The membrane of the segment extends beyond the cup and curves around over the base of the antenna adjoining, (fig. 7, Pl. IV.) These antennæ have no connection with the cup.

About two fifths of the distance from the cup to the centre of the front margin, we find, on the back, a single slender naked seta. (K, fig. 1.)

The *antennæ* which terminate laterally this first cephalic segment, (L, fig. 1, and fig. 19, Pl. V,) are articulated with it by a joint passing obliquely upwards and inwards, towards the cup. They are two-jointed. The first joint is broad and large at base, and somewhat triangular in form. Its anterior and apical portions are covered with soft ciliated oblong papillæ, (fig. 19,) each of which receives a distinct branch of the large nerve that passes to this organ. They shrink up and become obliterated on drying, and in this respect differ from similar appendages to other parts of the body, and even from the naked setæ that terminate the apical joint of the antennæ. This apical joint is nearly cylindrical in form and is about two thirds the length of the basal. The terminal setæ are of two kinds; those at the inferior part of the apex are slender and acute, and those at the superior part, short and somewhat obtuse. A single naked slender seta, usually curved or bent, may be observed near the middle of the posterior margin of this joint.

2. *Posterior Cephalic Segment.*—The *mouth*, (figs. 1 and 12,) is situated in an oblong mass, which lies entirely external, along the under surface of the body, near the centre of the posterior cephalic segment. This buccal mass is in part a hollow organ, (fig. 12, Pl. IV,) bounded above and below by distinct membranes, a portion of which represent the upper and under lip. It has a lunate opening between the approximating lips, (a a and b, fig. 12,) and contains a pair of strong mandibles and other organs, which we shall soon describe. It is articulated with the cephalic segment by its broad posterior portion.

The lateral and anterior margin of the buccal mass is formed by a slender bone, (c b, fig. 12,) which forms a projection posteriorly where it suddenly curves around inward, and runs backward a short distance nearly parallel with the margin. These bones form the sides to the *lower* membrane of the cavity of the mouth. At the anterior extremity of the buccal mass within, they are connected with several small bones which run to the medial line of the mouth, and constitute part of its manducatory apparatus, (m, l, and n, fig. 13, r, s, t, fig. 17, an under view ;) these bones lie either on or in the lower membrane of the mouth. No portion of the *upper* membrane of the buccal mass is connected with the bones of the lateral margin except a small subtriangular piece near the anterior angle, (d a e, fig. 12.) These pieces leave between them and the anterior margin of the buccal mass a semicircular opening ; the edges of this opening are furnished with ciliæ, and constitute the lower margin of the lunar opening, or the *lower lip.* This lower lip is divided at its centre, (b, fig. 12,) and the edges thus formed are curved inward, so that in a vertical view several ciliæ are projected together, and have the appearance of one branching cilia.

The whole membrane forming the upper portion of the buccal mass may be called the *upper lip.* It is represented separate in fig. 15. It is united with the lower portions, at its posterior extremity, (p p, figs. 12 and 15.) It may be viewed as consisting of two parts, an anterior movable, and a posterior, apparently immovable. The *movable* portion, which is very much the smallest, is an elliptical, nearly circular, membrane, inserted in a semicircular concavity (a a) in the anterior margin of the *immovable* portion. Its front edge is coarsely subcrenated and furnished with ciliæ. The large immovable portion of the upper lip is bounded by a bony edge, on all sides except posteriorly. At f, (figs. 12, 15,) there is a curved process elongated outward, serving for the attachment of a muscle.

Through the opening between the lips, (fig. 12,) we may observe the two slender bones l, (fig. 13,) and just within these, there are visible, through the membranes, two dentated organs, which, when the membranes above are removed, appear as represented in fig. 14. These organs are the *mandibles.* They are long slender organs with a falciform termination, curved inward and dentated on the interior edge ; the number of teeth is about twelve. The outer margin of the dentated portion is provided with a narrow corneous transparent edge. These mandibles extend backward and pass out of the buccal mass just anterior to the lateral projection, c, (figs. 12 and 13,) and behind the process, f. Here they are connected with a bony tendon, to which the large muscles are attached which move the mandible. The mandibles have no appendages, and are very slightly connected at their base with the membranes of the buccal mass. When the buccal mass is separated from the body by force applied below, the mandibles invariably remain attached to their muscles.

The remaining corneous organs at the extremity of the mouth have been already described as connected with the lower membrane; the two pairs m, l, on the surface of this membrane, and the remaining, in its texture. The pair l, have just been referred to as seen through the opening between the lips. These bones approximate at their apices; at the other extremity they curve backward and terminate under the junction of the two lips, (fig. 13, and a a, fig. 12;) the bones, m, which are situated under the mandibles, are very finely pectinated on their outer margin; they terminate at the same place with the preceding pair.

The remaining bones form a kind of frame work for the lower membrane. Three slender bones r, s, t, (fig. 17,) occupy the extremity of this membrane, and the bones, o, its inner portion. The bones, o, extend backward and enlarge at the posterior part of the buccal mass, (g, fig. 17,) where they serve for the attachment of the muscles elevating the buccal mass. They appear to form by their union at their anterior extremity, (figs. 17 and 13,) a short, oblong process (k,) which is situated between the apices of the pectinated bones, m. The piece, n (figs. 13 and 17,) passes directly outward from this process, and is gradually lost in the membrane.

This complicated apparatus, the buccal mass, appears to be composed of the upper and lower lips, united with the different parts of a pair of maxillæ.

We have often observed through the upper membranes of the buccal mass, and just in advance of the bony arch a, a, fig. 12, an obscure curved line nearly concentric with the anterior margin of the buccal mass, (fig. 12,) which is frequently in motion. From the peculiarities of its action we suppose that there is here an internal opening to the esophagus. Within this inner mouth, if we may so call it, there are several folds seen below, (fig. 17,) which may be the seat of the sense of taste. Above we observe, (fig. 12,) four fleshy oblong organs extending from a point deeply situated near the base of the esophagus, obliquely upwards to the upper part of the buccal mass. At their lower extremity, they are connected by a slender ligament with the bone, g. These organs appear to close the esophagus. They often open and close in consequence of the similar action of the processes, g, with which they are connected.

The articulation of the buccal mass with the surrounding parts is formed by means of a bony process situated in it below f, and another slender process (h, figs. 12 and 17,) extending backward and outward in the adjacent teguments. A curved bony process, (i, fig. 13,) connects the projection c (figs. 17, 13,) with the process below f, uniting the two portions of the buccal mass.

The remaining organs of the *cephalic* segment consist of four pair of feet, corresponding to the second pair of maxillæ and the three pairs of maxillipeds in the decapodous crustacea.

The *first pair* are three-jointed. The basal joint is broad and oblong, and is connected with the body by its long posterior side. At its inner extremity, which is directed outward nearly parallel with the basal, it curves upward and receives the following joint. The two terminal joints are very different in the two sexes. In the *male*, (fig. 1,) the second joint is large and subconical, with an obliquely truncated apex. It appears to be composed of two joints, but there is no articulation. The terminal joint is obliquely articulated with the preceding; it is small and short, and terminates in two strong curved spines, occupying like horns the lateral portions of the apex. A slender seta is situated on the outer margin, and another on the inner surface near the articulation. The exterior of the apical spines is often brought in contact with a prominence on the apex of the preceding joint. In the *female*, (fig. 18 and 18 a,) the second joint is large, but scarcely longer than its breadth. The terminal joint gradually tapers with an irregular curve to a pointed corneous extremity, which is bent downward at right angles with the preceding part. The basal joint is peculiar in having a stout spine directed backwards, on its posterior margin.

Exterior to the outer portion of the basal joint of this leg, there is a large hooked spine, arising from a broad base, and having an oblique position. This may be considered an appendage to the maxilliped just described. It is similar in the two sexes.

The *second pair* of maxillipeds are rudimentary. They are situated along side of the buccal mass. The basal joint is a large fleshy mass, having a strong spine directed backward on its posterior side, (fig. 4, a.) Upon this mass near its anterior part, there is a very short cylindrical leg, of a single joint, which bears at its apex a long slender spine, and three or four small seta. It moves in every direction, and the spine is as frequently pointed inward or backward, as in the manner given in the figure.

The legs of the *third pair* are situated each on a fleshy base, just exterior to the spine of the preceding pair. They are long and slender, and composed of three joints. The basal joint is rather longer than the two terminal joints of the first pair, and diminishes very gradually to its apex. The second joint is one third longer than the basal, and about one fourth as large, and is of uniform size throughout. At its apex, below, it has a slender ensiform extension, which is doubly edged with a finely pectinated membrane, (fig. 4, b.) The terminal joint, is very similar to the process just described, but is much longer. A single short spine is situated on the second joint, a short distance from the articulation of the terminal joint.

The fourth pair, the last of those on the cephalic segment, is very dissimilar in the two sexes. In the *male* (fig. 1,) it consists of a very large basal joint, articulated at its extremity with a stout terminal claw, which curves inward and is usually brought in contact with a strong spine near the apex of the basal joint. The breadth of the basal joint is nearly one half its length, except at its insertion, where it is quite small. Between the strong spine just noticed, and the apex of this joint, there is a small fleshy prominence, and a stout spine. The terminal claw has a small seta near its apex.

In the *female*, (figs. 18 and 18 b,) the greatest breadth of the basal joint is scarcely one fourth its length, and it is destitute of the strong spine, near the apex; in some young females we see traces of it, and the leg has more bulky proportions than here stated. The terminal joint is much longer and larger, and more fleshy than in the male; it has a short spine at its apex, and three or four short setæ.

The remaining pairs of legs are four in number; three pertain to the anterior thoracic segment and one to the posterior.

3. *Anterior Thoracic Segment.*—The first two pairs of legs on this segment are natatory, the third is expanded into a broad apron. Preceding the first pair of these legs, there is, on the medial line, a broad furcate corneous process, directed backward, and capable of being elevated or depressed.

The articulations of the two pairs of natatories with the body are very remarkable. These organs not only move on their respective sternums, with which they are articulated, but the sternums have a hinge motion on their posterior margin, in which the legs participate. For this purpose the basal joints are attached to the adjoining parts of the venter by the greater part of their anterior side. The whole distance between the apices of the basal joints in the first pair of natatories, forms thus a single hinge on which the legs revolve; and in the second pair of natatories, the greater portion of the second joint is similarly attached, and for the same purpose.

Several of these joints are provided with long, finely ciliated setæ, or pinnulæ, similar to those terminating the abdomen, which renders them well adapted for swimming. The ciliæ, though very long, are exceedingly slender. The pinnulæ appear to be mostly hollow. They contain a central longitudinal line, which appears on the first view to divide them into two portions; further examination has led us to believe that this is not the case.

The *first pair*, are composed of three nearly cylindrical joints, the first two of which are very similar in size, and the third about one half the length of the preceding. The basal joint has a short movable hairy seta at its apex, and another on its posterior margin; also a very short jointed appendage on the same margin near its extremity. The second joint has a similar seta near its apex and is ciliated on its posterior margin. The terminal joint is furnished on its posterior margin with three long finely ciliated setæ, or pinnulæ, whose length about equals the preceding joint of the leg. The ciliæ are very short on the outer side of these pinnulæ; but of the usual length on the inner. At the apex there are four short obtuse naked setæ. The *sternum* to which this pair of legs is articulated, is very narrow and terminates on each side in a process lengthened posteriorly for articulation with the legs.

The *second pair* of natatories are composed of five stout compressed joints, with a large tri-articulate appendage to the second joint. The basal is very short, and has on its posterior margin a curved pinnula, which extends over the median line. The second joint is very large and increases in size from its base to its apex. There is a short seta near its posterior margin, and another near its apex. On its posterior edge there is a broad membrane, exceedingly thin and transparent, and finely striated like the margin of the shell.

The *appendage* to this joint arises from the inner part of its extremity, and curves backward and inward. It is provided with seven long pinnulæ, which in general, extend with a curve to the median line of the body; the first joint has one of these pinnulæ, the second two, and the third four. These joints are mostly very flat. The first joint is short and very similar in form to the basal joint of the leg. It is furnished exteriorly with a broad plate, which is ciliated at its apex. The second joint of this appendage, is smallest at its base, and increases with a curve to its apex, which is rounded. Its outer margin is ciliated. A shallow concavity receives the apical joint, which is small and nearly semicircular.

The remaining joints of this leg, are also furnished with seven long natatory pinnulæ, of which one appertains to the third joint of the leg, one to the fourth, and five to the fifth. The third joint is broad and oblong, and is ciliated on its inner margin. A large stout spine, with a thin corneous expansion on two opposite sides, is articulated with the apex of this joint. The fourth joint is shorter than broad, and has a small spine at its apex. The terminal has nearly equal length and breadth, and is obliquely truncated at its extremity. There are two short spines at its apex. The pinnula terminating this joint, is provided with ciliæ only on its inner margin. The other margin is furnished with a thin membrane, which extends from the apex, to an enlargement in the seta near its base.

The sternum uniting the legs of this pair, is quite large; its breadth is one third its length. The posterior margin is somewhat fleshy and thin, and provided with a delicate membrane, whose breadth is nearly as great as that of the sternum. The anterior articulating margin of this sternum is firm and osseous. The adjacent teguments with which it is articulated are similarly ossified, and supported both before and behind by two strong osseous processes, situated in the teguments. The anterior processes are short, and terminate in a curve between the two sternums. The posterior are nearly three times the length of the sternum;

they diverge from their insertion and extend to the base of the apron, (fig. 18.) Here they are united by a slender osseous process, which forms the upper limits of the sternum of the apron. They continue on, making at first one or two irregular curves, and form also the lateral boundaries of this sternum. By this remarkable arrangement, the articulation of the sternum of the large natatory legs is rendered sufficiently firm for their powerful action in the motions of the animal.

The *third pair* of legs has been already stated to be expanded into the form of an apron, forming a broad lamellar appendage to the cephalo-thoracic portion of the body. This apron is composed of the same parts as the natatory last described, and there is an almost perfect coincidence in the number and nature of the appendages.

The sternal piece is very wide and lamellar. On its posterior margin there is a broad membranous expansion, identical in structure and position with that appended to the preceding sternum. The portion of the apron corresponding to the small first joint of the natatory leg, is very narrow, and has very imperfectly defined limits; we see an indication of its presence in the single pinnula, behind, adjacent to the sternum.* The second joint is expanded into a broad, irregular trapezoidal figure, with concave sides excepting its posterior margin. Like the same joint in the natatory, it is furnished with a broad thin membrane posteriorly, and a jointed appendage provided with pinnulæ. The first joint of this appendage is quite small, and bears a single pinnula as in the perfect leg; the remaining portion is circular and is furnished with six pinnulæ. We find the analogue of the third joint of the natatory in a broad nearly circular plate, which is the lateral termination of the apron; it is connected with the basal portion by an indistinct suture. The posterior margin of this joint, like the same joint above, bears a ciliated leaf-like expansion. The analogy of the parts is still farther apparent in the strong articulated spine and pinnula attached to this joint, and in the two small terminal joints, furnished with pinnulæ; the first with a single pinnula and a spine at its apex, and the second with four pinnulæ, and two short apical spines.

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* The corresponding parts of the apron, and the second pair of natatories, are indicated in the figure by the similar numbers in them.

4. *Posterior Thoracic Segment.*—The legs attached to this segment arise from the posterior part of the lateral surface. They are composed of four joints, which gradually diminish from the base to the apex. The basal joint is large, nearly cylindrical, and irregularly rounded at each extremity; there is a short hairy seta at its apex. The second joint is scarcely half the diameter of the preceding. It gradually diminishes to a pointed apex, furnished with a curved spine. The third joint is flat, and is articulated, by its obliquely truncated base, with the inner side of the preceding joint. There are two long setæ on its inner apex, which are edged on two opposite sides with a pectinated membrane. There is a short pectinated appendage, projecting like an epaulette over the base of each of these setæ, and also over the articulation of the following joint. This terminal joint is long, slender, and setiform. It has a row of short spines along its inner edge.

5. *Abdominal Segments.*—The anterior abdominal segment is entirely destitute of any articulated appendages. Posteriorly, on each side, there is a broad lamellar sub-triangular organ, which, in the male, is much elongated, while in the female, excepting young individuals, it is very short.

The appendages to the terminal joint have already been described.

Change of Skin.—But few facts have come under our observation respecting the change of skin; these few, however, appear quite peculiar and worthy of remark.

When the time for shedding the old skin approaches, the internal membrane, which is to form its new envelop, is very variously folded into ridges throughout the whole body. In some parts, the ridges or folds are situated around the bases of the muscles, and enclose regular areas. These folds continue increasing in size, till the time of moulting. This process produces a singular arrangement of the *anterior* portions of the inner shell, or, we may say, inner animal, as it affects the form of the included parts. The centre of the front margin of the internal shell is drawn inward and backward, as represented in fig. 23, Pl. V, in which c d represents the outer margin, and c′ n d′ the corresponding edge of the inner shell, e f the articulation in the old shell, and e′ m f′ the corresponding articulation in the inner.

These folds undoubtedly result from an increase of the animal within a shell too small to admit of its expansion. The internal members, like those of animals having a soft skin, appear to increase in actual quantity of matter, as rapidly when enveloped in their unyielding corneous covering, as in their new membranous envelop.

There is a remarkable fleshy appendage to the anterior portion of the soft internal animal, the importance or functions of which we are unable to explain. It is represented at m n, fig. 23, in its natural position. It lies wholly external to the inner shell, and is attached only at o, its anterior extremity. Figure 24 is a profile view of this appendage; similar letters mark the corresponding parts in the two figures. After separating the outer skin, it may be drawn forward into the position in fig. 25. In one instance, we found an animal with this singular appendage, in front, presenting very much the appearance in fig. 25. It was, however, composed of three of these appendages, m n, placed end to end, and appeared to have undergone three successive moultings.

In external appearance, this organ very much resembles a muscle, as it is striated, like them, though very coarsely. It is probably attached, by its large extremity, to the outer shell.

II. Muscular System.

The muscles moving the several members, may, in general, be distinctly seen and traced to their insertions through the pellucid covering of the body. Yet, under a magnifying power of five hundred diameters, we have not succeeded in detecting the ultimate fibres as given by Straus. With a much lower power, however, we have observed that all the muscles appear transversely striated, and by means of this important character, have been enabled to distinguish the nerves from the muscles, which, without this aid, would in many instances have been difficult or even impossible. These striations are most distinctly seen in the flat, simple muscles; those composed of several bundles of fibres, which is the case with many of the large muscles on the back, exhibit it, but less perfectly. We have examined the muscles of the common lobster, (Astacus marinus,) and have found these striæ in some instances, though with less distinctness. These striations vary much in their fineness. In general, they are from $\frac{1}{7000}$ to $\frac{1}{8000}$ of an inch apart. In some muscles, among which we may mention those elevating the buccal mass, we found them as coarse as $\frac{1}{5000}$ of an inch. We have conjectured that they are the result of minute folds in the muscular fibres; but we have been unable to detect an approximation of these striæ, or any alteration in their appearance, during the contraction of the muscle: this, however, may be owing to their extreme minuteness.*

On account of the very peculiar forms and motions of some of the organs in this animal, it contains several muscles of very unusual character. We reserve the description of them till these organs come under consideration.

a. *Muscles of the Segments of the Body.*

The first cephalic segment is flexed by two short slender muscles on each side, (R, R′,) situated just exterior to the process which forms the articulation of this segment, (figs. 1 and 7,) and directed backward and outward. They unite in a common short tendon. They act in depressing this segment, and assist in attaching its cup and anterior margin. This margin is provided with a narrow ridge, which is striated or wrinkled transversely, like the cup, and is apparently intended to produce a closer attachment of this margin.

For the mutual motions of the cephalic and thoracic segments, there are three pairs of muscles situated in the former, two attached near the median line, and one pair laterally. A pair of short muscles (I, I, fig. 7) run nearly parallel with the median line; they produce the slight flexion admitted at this articulation. Another pair of muscles, long and large, (S, fig. 7,) are situated on each side of the preceding; they pass obliquely outward. In addition to aiding in flexion, they produce a lateral sliding motion, often observed between these segments. A third pair (K, fig. 7,) also assist in flexion. The large muscles, (K′,) situated in the posterior segment, appear also to pertain to this joint; but we are not fully assured that this is really their insertion.

The extensor muscles of the posterior thoracic segment, and of the abdomen, arise adjacent to the median line, near the centre of the anterior thoracic segment. Three pairs of muscles are attached at this point. The outer (L) pass obliquely outward and

* Since writing the above, we have found that these striations have been observed by Dr. Hodgkin in the muscles of man. He says: "Innumerable very minute but clear and fine parallel lines, or striæ, may be distinctly perceived, transversely marking the fibrillæ." These observations have led Dr. Hodgkin to doubt the globular constitution of the contractile fibre. We have also observed them distinctly in some of the Arachnides.

are inserted near the apex of the thoracic joint. The two pairs (M, N,) appear to continue through the thorax, to the last joint of the abdomen. Another pair of muscles (O) commence in the thoracic joint, near the median line; they pass obliquely outward to a point in the first abdominal segment, just below its centre, where they are inserted into the teguments. Another pair of slender muscles (P) arise near the insertion of the last, and pass to the following segment.

The flexor muscles of these segments, situated along the venter, are remarkable for having but two anterior attachments, although, counting the several insertions in the posterior segments, there appear to be six distinct muscles. Two broad muscles arise on each side of the medial line opposite the prehensile legs. As they pass between the sternums of the natatory legs, they divide into three portions as represented in fig 5 a, Pl. I. The large muscle here suddenly contracts in size, and afterwards continues on, much diminished in volume; exterior to this continuation two muscles are attached, each by a tendon, to the diminishing portion of the main muscle. Though apparently distinct, these three muscles continue connected, and pass on beyond the sternum of the second pair of natatories, where there is a second subdivison of the muscle. We observe an oblique constriction of the whole, (fig. 5, b,) below which, the three muscles are continued of nearly their former size, and a fourth is added, exterior to the three. Thus divided, the muscle continues into the abdomen, where the four parts are separately inserted: the exterior pair diverge and are attached near the base of the abdomen; the interior, are inserted below the centre of the abdomen, directly under the insertions of the extensor muscles of the back; the two remaining pairs are continued into the terminal abdominal segment, the outer passing beyond the centre of this joint. Another pair of small muscles are inserted in the base of this joint, which arise near the attachment of the interior pair of abdominal muscles.

The other set of muscles, consisting of two pair, arise a short distance below the sternum of the posterior natatory, exterior to the muscles just described. One pair, the outer, is inserted in the base of the thoracic joint, and the inner, laterally below the centre of the abdomen.

The lateral motion of these joints is produced by the simultaneous action of the flexor and extensor of the same side. The insertion of the more powerful of the abdominal muscles below the centre of this segment, in preference to an attachment near its base, enables the animal to give this segment great flexion. When the animal has been attached to the glass out of the water, we have often separated the anterior portion of the body from the glass, till it formed an angle of 75° or 80° with the abdominal portion, and generally the animal has succeeded through the action of these muscles in restoring its head again to the glass.

The muscle (O) on the back may possibly be attached to the muscle (N) and not to the thoracic segment. We have not succeeded, in our dissections, in exposing these muscles in order to determine this point.

b. *Muscles of the organs appertaining to the several segments.*

1. *Anterior Cephalic Segment.*—In the following account, we shall in general describe only the muscles moving the basal joints of each of the legs. More minute particulars may be obtained by reference to the plates.

The muscles moving the cup, have not been satisfactorily determined. A slightly elevated line passes from each side with a curve into the membrane of this organ, which may be muscular; if so, they act in flattening the cup preparatory to its attachment.

The antennæ have two extensors and one flexor. The two extensors are inserted in a tendon, occupying the anterior margin of the base. They extend half way to the eyes; one (a, fig. 7 and fig. 1) above the flexor of the anterior cephalic segment, is attached to the upper shell; the other, (a′, fig. 1,) much the smallest, passing under the same muscle, is attached below. The flexor (b, figs. 7 and 1,) is inserted near the outer part of the base, by means of a short tendon, and is attached near the base of the preceding muscles. These organs have but little motion, and are seldom observed in action.

2. *Posterior Cephalic Segment.*—The elevators of the *buccal mass* are four short narrow muscles, inserted in the bony processes, g, (figs. 12 or 17,) and attached to the teguments below, under the anterior extremity of the mouth; the insertion of one is exactly posterior, and of the other, a little lateral, as is represented in fig. 17. By means of these muscles the buccal mass may be elevated to a right angle with the surrounding parts. On dying, the mouth is often left in this elevated position. A muscular band passes across the back part of the buccal mass and after

attaching itself to the curved process, f (fig. 12,) on each side, continues on, and is inserted in the shell. At c, (fig. 7,) near the eyes, we observe the attachment of a pair of muscles which are in action when the buccal mass moves; we have not detected their insertion, but suppose from their position that they act in depressing it.

The internal parts of the mouth which receive distinct muscles are as follow: the upper lip, the mandibles, and the parts of the inner mouth. The upper lip is provided with two pairs of retractors which are attached near the centre of the exterior membrane of the mouth. The interior pair are very slender; they are inserted in a minute process near the extremity of the lip, (fig. 15,) and move merely the extremity, giving it the position in fig. 16. The exterior pair are four times the width of the interior; they are inserted near the middle of the lip and retract this organ nearly to the bony arch.

The mandibles are provided with muscles of extraordinary length and power. There are two pairs connected with the same slender bony tendon, the one with its extremity, and the other with its posterior side. The former, (d, figs. 1 and 7,) pass outward and a little downward, and on approaching the apex of the basal joint of the third pair of maxillipeds, curve suddenly backward; they are finally inserted in the margin of the shell opposite the articulation of the head and thorax, after having run over a space equal to one half the whole length of the cephalo-thoracic segment. The other pair extend obliquely backward and outward under the base of the rudimentary feet. Although these organs are provided with such remarkable muscles, they are very confined in their motions. They occasionally have a vibratory motion when the animal is nearly exhausted, and this is the only action we have observed. Their position and the form of the adjacent parts satisfies us that their extremities cannot be projected out of the mouth; and probably they can scarcely reach the opening between the lips.

On account of the thickness of the enveloping membranes, and the difficulty of dissecting the internal parts of the buccal mass, we have not discovered the muscles moving these parts. We can only specify one pair of slender muscles, which are inserted in the lateral portions of the process g, (fig. 17.) It is the retractor of these processes, and through them opens the folds which close the esophagus, by means of a tendon inserted in the lower extremity of these folds.

The basal joint of the *first pair* of *maxillipeds* has but little motion. There are two short muscles, elevating or depressing the extremities of this joint, which we may consider a flexor and an extensor. The flexor, which is inserted near the interior extremity, is directed backward and a little outward to its attachment to the lower shell, exterior to the base of the following pair of feet. The extensor is inserted at the posterior margin of the joint, and extends obliquely inward, approaching the attachment of the flexor. In the female these muscles have nearly the same position as in the male (fig. 18 a;) the flexor is inserted near the spine on this joint. The united action of these muscles draws the anterior margin of this joint from the shell. To oppose this motion there is a large muscle inserted near this margin and extending one side below the eyes, (e, fig. 7,) where it is attached to the back shell.

The extensor of the second joint of this pair of legs is a long broad muscle attached to the shell above the large curved spine, (f, fig. 7.) There is a small flexor of this joint, attached to the posterior apex of the basal joint.

The rudimentary feet, or *second pair*, are provided with but few small muscles, requiring no remarks.

The *third pair* are remarkable for having as various motions as could be afforded by a ball and socket joint. This arises from their insertion on a fleshy prominence, composed probably of the rudiments of the small basal joints in the corresponding organs of the higher crustacea. To produce these various motions, each leg is provided with five muscles radiating from the base, some of which are of very peculiar form. Four of these muscles are inserted into the base of the first joint and one along its posterior margin. The latter appears to be attached to the back near the median line, a short distance behind the eyes, (g, fig. 7.) Of the remaining muscles, two pass forward and outward, (h, i fig. 1 and fig. 7,) one directly outward, and the fourth, (k, fig. 7,) backward and outward. The most anterior (h) is a slender muscle, attached just exterior to the base of the first pair of maxillipeds. The second (i, fig. 1 and fig. 7) is composed of two parts inserted into the same tendon. These parts continue together through half their length, then separate, and soon after each divides into two nearly equal portions, which diverge under the large curved spine and pass to their attachment at the margin of the shell.

The base of the *fourth pair* of maxillipeds has a narrow prolongation, which affords attachment to two muscles; one passes posteriorly, and is attached near the articulation of the head and thorax, (m, fig. 7,) another extends outward in front, beneath the extremity of the adjacent spine. Two other short muscles are inserted at the base of the prolongation, and are also attached near the spine; one on the back, and the other below. The last of the muscles moving this pair of legs, extends outward and is attached to the epimeral articulation, (l, fig. 7.)

The terminal claw is provided with flexor muscles of great strength. A large conical muscle attached along the whole posterior margin, is inserted in a bony tendon extending from the inner portion of the base of the claw. Another large muscle arises from the basal portion of the joint and is inserted into the preceding muscle a short distance from its insertion. There is the same arrangement in the female, (fig. 18 b.) A small extensor is inserted in the outer part of the base of the claw and attached to the outer posterior margin of the first joint.

3. *Anterior Thoracic Segment.*—The two legs of each pair of natatories, have been described as simultaneous in their action, which consists in their rotation with the included sternum, on their anterior margin.

The principal elevator of the *first pair* of natatories is a large digastric muscle. This muscle occupies the space between the basal joint of these legs and the preceding pair. It is composed of four muscles which unite in a common tendon; this tendon passes under a curved osseous process, by which it is confined in its place, and is then united to another bundle of mûscular fibres inserted in the lower surface of the leg. The depression of these legs is produced by a long muscle which is inserted in the joint near its base; it is directed forward and outward, passing under the digastric muscle beyond the articulation between the head and thorax, and is attached to the epimeral articulation (n, fig. 7.) This pair of legs, though thus provided with muscles of considerable strength, is seldom used by the animal in effecting its motions.

We have already seen that the *second pair* of natatory legs are well adapted to form powerful propelling organs; that the flabelliform arrangement of their pinnulæ, the attachment of these pinnulæ to two distinct articulated branches, added to the flattened form of the joints, give the oars a broad expanded surface for action on the water in swimming. They are farther fitted for this object by the provision of a large number of powerful muscles, which occupy nearly the whole of the thoracic segment.

Inserted in the anterior part of these legs, there are three large muscles attached to the back shell, two of which (o, p, fig. 7) arise on the median line—a third (q) at the articulation between the head and thorax. Four powerful muscles are inserted in its posterior margin; the three outer (u, t, s,) pass backward, and are inserted in the posterior and medial part of the segment above. The fourth (r) is attached to the back shell over the anterior part of the base of the leg, near the medial line of the body; it first passes inward and backward, then curves outward around the base of the muscle adjoining, (s,) and finally extends upward to the posterior margin of the leg. The circular form of this muscle is so very extraordinary, that we at first doubted its muscular nature. We have however assured ourselves of this fact by frequent dissections. Two other short muscles with converging fibres, (w, v,) arise laterally from a broad base in the epimeral articulation, and serve to retract the leg to the shell. These muscles probably cooperate with the posterior, in the depression of the leg.

If these oar-like legs struck the water with the same broad expanded surface, in their backward motion, as in their forward propelling action, the animal would advance but slowly, if at all; for the latter would be counteracted by the former. There is a provision against such a defect, in the muscles moving the several joints of these legs, by the action of which, the terminal portions receive a partial revolution, and cut the water, when drawn backward, by their thin anterior edge. Their special adaptation for this purpose is apparent, even in the pinnula terminating the leg, which instead of being ciliated on both edges, is furnished anteriorly with a thin membranous expansion.

These legs appear to be the only organs for walking as well as swimming.

The principal extensors of the *third pair* of legs, or the *apron*, are four in number; two (y, z) arise on the back near the medial line, and pass laterally to the outer insertion of the apron. One of the remaining two, (x,) arises just above the posterior sinus, and the other from the inner margin of this sinus; both are attached on the back, and inserted near the articulation of the sternum. The flexor muscles arise below, just outside the apron, and occupy the greater part of its interior. A single muscle is attached near the articulation of the sternum, and passes into the basal portion.

This apron, appended to the cephalo-thoracic segment, forms the anterior portion of the body into a large, broad cup, which is perfectly closed, with the exception of a small opening at each of the posterior sinuses. These we have already described as provided with a folded membrane, furnished with muscles capable of drawing it over and completely shutting the opening. The membranous margin of the animal near the antennæ, has also a fold by which a small leak, if it be such, is closed. Considering these several provisions, it is probable, that the whole of this anterior portion of the animal is especially adapted to enable the animal to attach itself firmly during the rapid motions of the fish, and that the small marginal cups in front are relied on, only while the fish is stationary, or but slowly moving.

The remaining pair of legs are moved by short slender muscles, and seem to possess little power. They usually hang loose and motionless while the animal is swimming, and when attached to the body of the fish, are commonly extended by the side of the abdomen.

III. Nervous System.

a. *The organs of the senses.*

The only organs in the Caligus, which we have been able to distinguish as the undoubted residence of special senses, are the eyes and the antennæ. The latter organs have already been described; it remains to explain the structure of the eyes.

The *eyes* are wholly *internal*, and are situated near the centre of the posterior cephalic segment, directly over the lower part of the buccal mass. They are two in number, simple in their structure, and placed near one another, on a single reddish-black ground. They project from each side of this colored ground, with a spherical surface, somewhat exceeding a hemisphere. On dissection we readily distinguish the following parts.

1. A *cornea*, which is thin and transparent and forms the spherical surface of the eye:

2. A *lens*, simple, spherical, and distant from the cornea; its diameter is about half that of the cornea:*

3. A colorless, transparent fluid, which we presume to be the *aqueous humor*, occupying the space just within the cornea:

4. A deep red, nearly black *pigment*, which forms the colored spot supporting the eyes.

We have not observed the vitreous humor. In the spherical form of the lens, the eyes resemble the same organs in fishes. They are not movable, and have no connections except by the optic nerve. The adjacent parts are transparent, enabling the animal to see in both directions. We have already described the shell above, and referred to its representation in fig. 8, Pl. IV. It is perfectly flat, without any spherical projection, corresponding to that of the cornea within. The translucent elongated space in fig. 8, lies in the shell, and passes over the space between the eyes.

b. *The nerves.*

The nervous system contains but two ganglions, and these by their close approximation appear at first, to compose but one. They are situated directly behind the eyes, the one above the esophagus, and the other below it, and are so intimately connected on each side of this portion of the alimentary canal, that it has been found impossible to separate them, (fig. 20.) Indeed, it would scarcely convey an incorrect idea of the *form*, to describe it as a single mass, with a longitudinal cavity through the centre, for the passage of the esophagus. The size of the united ganglions is rather greater than that of the buccal mass. The nerves arising from these ganglions are flat, fibrous cords, enclosed within a membranous envelope or neurolemma. This neurolemma is often one fourth wider than the bundle of nervous fibres contained within, and these fibres appear to pass through without any attachment. The neurolemma is sometimes slightly folded, which gives a crenated appearance to the margin of the nerve.

The *brain* or cephalic ganglion has a broad ovate or sub-cordate form. It gives off three pairs of nerves.

The first pair, (a fig. 20, Pl. IV,) leaves the central part of the anterior margin and passes directly to the eyes. As the eyes are adjacent to the ganglion, these nerves are very short.

* The lens in the simple eyes of crustacea is usually described as being in immediate contact with the cornea: it was very evidently distant from this membrane, in the Caligus.

The second pair, (b fig. 20,) arises from the same margin laterally, and extends upward towards the cup, (fig. 18,) passing just within the articulating process of the cephalic segments. It gives out large branches which are distributed to the surrounding muscles and teguments. The anterior extremity which goes to the cup is scarcely one third the size of the base.

A small hollow vessel, (fig. 18,) extends from the organs which we have considered analogous to the inner antennæ in other crustacea, along the median line, and appears to terminate in a bulb, about half way to the brain. This vessel has been the subject of much investigation, without removing all the doubts respecting its nature. When separated from the body, it appears to be a large neurolemma, containing two small bundles of nervous fibres, and this is our final conclusion, though adopted with some hesitation. It appears probable, from the result of some of our dissections, that this bulb receives a nerve from each side, which either arises directly from the brain, or, is a branch of the nerve last described. If this is a distinct pair, it corresponds to the *third*, or inner antennary pair in the lobster, as given by Edwards, and the pair described as passing to the cup, and surrounding teguments and muscles, is the analogue of the *fourth* pair, which has a similar distribution in the lobster.

The remaining pair of nerves, (c,) arise from the anterior angles of the brain, and pass to the antennæ; they are one half larger than any other in the body. Near the origin, they give off exteriorly a slender branch, which continues nearly parallel with the main nerve, and passes to the muscles of the antennæ. Without farther branching they extend in nearly a straight line to the base of the antennæ, where they subdivide into four large branches, which are distributed to the fleshy papillæ, (fig. 19, Pl. V.) Two nerves from the posterior branch run along the muscles, and are continued into the terminal joints, one to each of the two terminating sets of setæ. The antennæ are so abundantly furnished with nerves, that they must be the seat of an important sense. The sense of touch is the only one for which their peculiar form, and their delicate papillæ, appear adapted.

The thoracic ganglion, which is composed of all the thoracic and abdominal ganglions united, has a cordate form, and is somewhat larger than the brain. Its inferior extremity extends rather farther beyond the brain, than the brain beyond it in front. This ganglion gives off seven pairs of nerves in front and laterally, and two pairs behind, besides a central nerve or the spinal cord.

The first two pairs originate at the centre of the anterior margin, (d, e, fig. 20.) The inner is quite slender and appears to enter the mouth each side of the esophagus. The second has twice the diameter of the first; it curves more outward, and is supposed to go to the mandibles and their muscles. These nerves pass under the buccal mass, and cannot be traced while it is in its natural position. They invariably appear broken off when the buccal mass is removed; and sometimes after detaching it, a nerve equal in size to the first, has been seen entering the mouth near the esophagus, as above stated. These facts have been deemed sufficient to authorize the above opinion respecting the destination of these nerves.

The *third* pair (f, fig. 20) arise from the anterior angle of the ganglion. They give out a branch exteriorly to the muscles of the first pair of legs, and afterwards continue to these organs, and pass into the terminal joints after giving a branch to the basal.

The *fourth* pair (g) arise just posterior to the last, and are distributed to the outer teguments. They afford a branch near their origin, which probably passes to the rudimentary legs: soon after they divide into two parts; one branch passes outward and a little forward towards the curved spine, and subdivides into four branches before reaching it, which are distributed to the neighboring teguments; the other branch, extends backward to the epimeral articulation, just below the articulating processes, where it passes to the epimeral segment; it then branches, and is distributed to the various parts of the inferior portion of this segment.

The *fifth* pair (h) arise from the lateral margin of the ganglion, some distance behind the preceding. They give off a slender branch near their origin, and pass along with the branch to the third pair of maxillipeds.

The *sixth* pair (i) arise near the preceding, and are large nerves. They divide immediately, and then subdivide into several branches, which are distributed to the fourth pair of maxillipeds, and their muscles.

The *seventh* pair (k) originate near the last, soon divide into two branches, which pass to the muscles of the same legs. They are slender nerves.

These seven pairs appear to correspond to those of the first thoracic ganglions in the macrural crustacea. The remaining nerves pertain to the thoracic legs, and the abdominal portions of the body.*

The outer pair (l) belong to the anterior natatories. They continue parallel with the spinal cord till they reach the furcate process on the venter; they then curve outward, exterior to the ventral muscles, give off three branches in succession from the outer side, to the muscles of the first natatory. Before entering the basal joints of these legs, they divide into three portions, which enter together; the inner branch is quite slender, and passes to the posterior movable seta, and the jointed appendage; the middle is distributed to the muscles of the basal joint; the outer branch gives a slender nerve to the apex of the basal joint, and then passes to the two following joints, dividing as it enters them. We refer for minuter details to figure 18, Plate V.

This pair of nerves give off a slender branch near their origin, (r, fig. 20,) which passes to the attachments of the stomach.

The next pair of nerves (m) are distributed to the second pair of natatories. They diverge from the spinal cord—to which they are adjacent—below the furcate process, and soon give off a branch

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* The apparent correspondence of these nerves, with those of the first thoracic ganglion in the higher crustacea, together with the great similarity in the last two pairs, to those which are distributed to the posterior pair of maxillipeds in the decapodous species, (see Edwards's Hist. Nat. des Crustacés, T. I. p. 137) have induced us to adopt the designations heretofore employed in speaking of the organs of this segment of the body, in which we consider the three posterior pairs of cephalic legs as the anologues of the three pairs of maxillipeds in the typical species. The only objection which can be urged to this view, arises from there then being but *four* pairs of thoracic legs. This objection will however be removed if we may consider the furcate bone on the venter, just anterior to the first pair of natatories, as the rudiment of the sternum of a fifth pair, which view is favored by its position, and its resemblance to the sternums of the following pairs.

If this conclusion is correct, the twenty-one rings, the *normal* number constituting the body, may be considered as distributed in the following manner:

The *anterior cephalic* segment, includes the second and third, as the first—the ophthalmic—is wanting. The *posterior cephalic* segment, contains the following six, corresponding to the mandibles, (fourth,) and a pair of maxilla, (fifth,) in the buccal mass; and the four pair of feet attached to this segment. The *anterior thoracic* segment will include the tenth, eleventh, twelfth and thirteenth rings, to which the furcate process, the two pairs of natatory legs, and the apron, pertain. The *posterior thoracic* segment, is the fourteenth ring. The remaining seven rings, the abdominal, constitute the terminal portions of the body; some of these last may however be wanting.

interiorly, which passes down the venter, and appears to be distributed to the ventral muscles. As they approach this pair of natatories, they give off another branch from the same side, which also passes backward, and is supposed to furnish nerves to the posterior muscles of these legs. On entering these natatories, the nerve divides into two branches, the upper of which soon gives off a third; the inner nerve, as in the preceding legs, goes to the posterior seta, and the articulated appendage; the middle furnishes the basal joint, and sends a branch into the terminal; the outer affords a small nerve to the seta at the apex of the basal joint, and then passes into the extremity of the leg.

This pair of nerves give off a branch exteriorly near their origin, (s, fig. 20,) which curves outward under the furcate process, (s, fig. 18,) *beneath* the ventral muscles, gives a nerve to these muscles, and is then distributed to the anterior muscles of the second pair of natatories, and to the adjoining teguments. Its branches may be seen at s′, s″, fig. 18.

The spinal cord, furnishes the nerves to the remaining members. It appears to be composed of two parts near its origin, but there is no division till it has passed beyond the sternum of the second pair of natatories. Previous to this division, a short distance below the sternum, this spinal cord gives off from each side a large nerve which goes to the apron. These nerves are seldom exactly opposite in their origin; as is also the case with the nerves, r and s, fig. 20.

The nerves to the apron, just before entering it, give off a branch exteriorly, which is distributed to the outer portions of the apron, or more properly its terminal joints. Soon after entering the apron the main nerve again divides, and one branch is distributed to the basal part, and the other to the muscles of the following portion of the apron.

The spinal cord, after giving off the nerves to the apron, soon divides. Thus divided, it gives off a pair of nerves to the remaining thoracic legs, and on entering the abdomen, furnishes a pair of nerves which branch in this segment. It thence continues to the last segment, and distributes fibres to the terminal portions of the body.

IV. Nutritive System.

a. *Organs of digestion.*

The alimentary canal, (fig. 9, Pl. V,) is composed of three distinct parts, corresponding to the esophagus, the stomach and the intestine.

The *esophagus* constitutes one sixth the whole length of the alimentary canal, and in large individuals is about one sixteenth of an inch long. It extends in the form of a long slender tube of uniform diameter to the stomach, and passes a short distance into its cavity. Its insertion in the buccal mass may be seen in fig. 17, which is an under view of this organ. The anterior opening is closed by two fleshy folds, which have already been described when speaking of the organs and muscles of the buccal mass. At its commencement, there is an oblong enlargement, (fig. 10,) longitudinally striated, which may be considered a pharynx. The communication with the stomach is closed, but whether by a sphincter or valve is undetermined. The peristaltic motion frequently seen in the stomach and intestine, never extends into the esophagus.

This portion of the alimentary canal is readily separated into two membranes. The inner, the mucous coat, is thin and transparent, and very smooth. The outer is much thicker, and scarcely semi-transparent; its muscular fibres are not apparent. When highly magnified, its exterior surface appears very uneven. If the mouth is detached from the body with care, the esophagus often continues attached to it, and presents the appearance exhibited in fig. 17. The inner coat is usually entire to its termination in the stomach, while the outer which is continuous with the exterior membrane of the stomach is invariably torn off, not far from the base of the esophagus, as in the figure.

The *stomach* has a broad cordate form, and is a little shorter than the esophagus, and when expanded is somewhat wider than long; vertically it is quite narrow. The anterior extremity lies between the prehensile legs, and posteriorly it extends under the furcate process on the venter. The lateral margin is very deeply crenated, owing to the peculiar arrangement of its muscles. The teguments of the stomach are composed of the same coats as the esophagus, and they present the same general character. The inner appears uniformly smooth and even. The outer contains several muscular bands, which connect the opposite crenations; in their contraction the crenations are rendered more prominent. These muscles are connected by other slender muscles irregularly arranged, which contract the stomach longitudinally. The lateral portions of the stomach are connected on each side with the shell adjoining, by ligamentous or cellular attachments, as is represented in fig. 9. There is no valve between the stomach and the intestine, and when the peristaltic motion is reversed, as often happens, the fluids frequently return into the stomach.

The *intestine*, at its commencement, is between three and four times the diameter of the esophagus, and about one fifth the diameter of the stomach. It is slightly enlarged below the second pair of natatories, where there are two pairs of glands, contracts again as it passes below the apron, and thence continues of uniform size to the rectum. Its structure is very similar to that of the stomach, both in its inner and outer coat. The arrangement of its muscles in regular bands is represented in fig. 11; during their action the canal is crenated as in the figure. The intestine is attached by distinct ligaments at several places; near the glands, d, and the glands, e and f, we have distinctly seen these attachments.

The *rectum* occupies the terminal half of the last abdominal segment, and is about one half the diameter of the intestine. Its communication with the intestine, is closed in the natural state of the parts. This rectum, if it may be so called, appears to have a longitudinal opening below, extending its whole length and its walls are usually in close contact. The external opening or anus is situated at its extremity.

This portion of the alimentary canal is opened laterally by seven pairs of slender muscles. The first pair at the extremity pass directly outward along the margin of the joint; the second are inserted near the extremity, and pass upward and a little outward. The following three pairs, are attached near the middle, and pass outward and a little upward; the remaining two pairs, are inserted near the opening to the intestine, and have the same direction as the last. The muscles have often been seen in action, in expelling the fæces; the two sides move either simultaneously or alternately, according to the necessity of the case, in the act of expulsion.

The intestinal fluids are usually light yellow; occasionally they present a deep wine yellow color, especially below the sternum of the second pair of natatories. Solid vermiform masses of a brown color, are often seen floating in the fluids.

Along the alimentary canal, there are several small glands, which have a granulous structure and are in general but slightly colored. Their particular functions, are mostly conjectural.

The central projection between g, g, fig. 12, is the termination of a gland of considerable size, which is situated beneath the posterior extremity of the buccal mass, and is usually detached with it, on dissection. It is represented in fig. 9, a, where its size corresponds to the mouth in fig. 9. When separated from the mouth, a duct may be seen on each side, entering the mouth near the esophagus. Anterior to the mouth, another collection of glands is observed, (fig. 9, b, see also fig. 1,) which also communicate with the mouth by ducts. These are probably salivary glands.

The esophagus, especially near its base, is furnished with a large number of exceedingly minute, transparent globules, supported on short pedicels, (fig. 10, Pl. IV.) These appear to be glands, and their pedicels ducts.

Below the stomach in the thorax, there are four pairs of glands. One pair of nearly spherical form, are situated at the lower extremity of the stomach, (c, fig. 9.) The second pair, larger, of an oblong form, (d,) occur just below the sternum of the first pair of natatories, and are connected with the intestine by a duct under the following sternum. The third and fourth pairs, (e, f,) are situated on the enlargement of the intestine, below the sternum of the second pair of natatories. The functions of a liver are probably performed by some or all of these glands.

Two other pairs of small glands are situated in the abdomen, which we presume to be connected with the intestine; we have not however distinguished their ducts, neither have we by dissections obtained more than one of them separate from the body. They are possibly urinary glands.

The Caligi have heretofore been supposed to live by sucking the blood of the fish on which they are found. It is however apparent from the structure of the mouth, that they are wholly unfitted for this mode of life. There is no organ which can perform the functions of a sucker. Moreover, we have never detected any blood in the stomach of these animals, although we have often examined them, immediately on taking them from the fish. On the contrary, the fluids always have a light color.

We have not fully satisfied ourselves of the nature of its food, but presume that it lives on the mucus which covers the body of the fish. The mucus is one of the natural secretions of the fish, and is always abundant. The organs of the mouth are well formed for the collection of it, and the free motion in the whole buccal mass seems peculiarly fitted for this purpose.

Several specimens of the Caligus, when confined on their backs in but a small portion of water, just sufficient to cover them, have been observed to elevate the buccal mass, and take in globules of air, which passed down the esophagus into the stomach, and thence through the intestine. Occasionally the globules of air have been so numerous and taken in such rapid succession, as to fill the stomach, and very much inflate it. In their passage through the esophagus they usually stop for a short time at the entrance to the stomach, indicating the existence of a valve or sphincter at this place.

b. *Circulation.*

The blood of the Caligus, as in other Articulata, is a limpid fluid, containing suspended in it numerous minute colorless particles. These particles are very various in their form and size. The smallest scarcely equal $\frac{1}{3000}$ of an inch. We have observed one particle the length of which was about $\frac{1}{150}$ of an inch, and its breadth $\frac{1}{4}$ its length; another had nearly the same length and a breadth equal to $\frac{1}{2}$ its length. These particles can accommodate themselves to the size of the passage through which the blood is flowing, becoming narrow and elongated if the passage is narrow, and again resuming their former proportions when they have reached a free open space.

The circulation in the Caligus is wholly lacunal; it appears to consist of broad irregular streams, passing through the spaces left among the internal organs, and in no part have we discovered distinct vessels. These streams have in general definite directions, yet are seldom uniform, continuous currents. They mostly advance by successive vibrations, depending on the palpitating action of the body. A single centre of circulation, or a *heart*, this animal can scarcely be said to possess. There are two points in the medial line where there is a valvular action, and each has its claims to be considered as performing the functions of this organ, though neither is entitled to that name. One of these systems of valves, the more perfect of the two, is situated in the apex of the posterior thoracic joint, (fig. 6 a, b.) There are at this place three distinct valves; two laterally on the back, situated in the dorsal currents which are flowing *towards* the tail, and one centrally below, giving passage to the ventral current flowing *from* the tail. The dorsal and ventral valves open alternately. Their action may be seen in the figures above referred to; a, represents the dorsal valves as shut, and the ventral open, and b, the dorsal relaxed or open, and the ventral shut. The action of these valves is very regular, and the currents which pass them are more uniform than those in other parts of the body. The number of palpitations has been found to vary from thirty to forty per minute.

The blood coming down the back* from the head, and also in two lateral currents from the point of intersection of the head, thorax and epimeral segments, (fig. 7,) passes the dorsal valves. It continues posteriorly; a part into the terminal joint of the body, and then up the venter, entering the ventral current at the extremity of the intestine; another part, into the same ventral current near the centre of the abdomen, and at other varying points. The ventral current passes through the ventral valve under the anterior margin of the apron, and continues up the body—washing, at the same time, freely over the intestine and stomach, to the thoracic ganglion, where it divides, and passes each side of this organ. Each of these branches goes off laterally; one portion (A) enters the adjoining prehensile legs, and returns down the body, uniting with another current which we shall soon mention; a second (B) passes a little forward and outward, gives off blood to the third pair of maxillipeds, continues outward, accompanies the muscles of the mandible, and runs down the body near its margin; a third (C) goes forward outside of the base of the first pair of maxillipeds, continues to the antennæ, to which it gives a portion of its blood, turns inward passing into the anterior cephalic segment, and along its articulation to the medial line. At this place the currents meeting from the two sides, flow down the medial line to the mouth.

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* The course is marked by arrows on figs. 1 and 7.

The *second* instance of valvular action occurs in this last medial current, between the second joints of the first pair of maxillipeds, (fig. 1.) There is a single valve, composed of a membrane, playing backward and forward, and thus preventing the return of the blood that has passed it. Between this valve and the mouth there appears to be a large cavity for the reception of the blood, from which it is propelled by a palpitating motion or powerful muscular action in the buccal mass, and surrounding parts. It acts in the following manner: the current enters through the valve while the posterior part of the mouth is elevated; the valve then closes, and immediately the buccal mass is brought down, and forces it out in a current on each side. This very extraordinary action is carried on uniformly, and is absolutely necessary for the flowing of the blood. Indeed, the blood flows *in* by the out-currents, until the action of the buccal mass throws it out. We presume that the depression of this organ is produced by the muscular band which has been described as passing across the posterior part of the mouth, to an attachment in the shell on each side, (fig. 12.) If the mouth be cut off, the blood flows out in a large free current, and the animal soon dies from exhaustion.

A current passes from this cavity each side of the mouth, and others on the back. One portion of the side-current unites with the current C, before described, of which it forms the greater part, and thus soon returns to the buccal cavity. Another portion flows outward, following the muscle of the mandible, and unites with B; this current, thus much enlarged, passes near the margin to the posterior extremity of the cephalo-thoracic segment, returns up by the epimeral articulation, crosses the same just above the junction of the head and thorax, and then turns suddenly backward; a part flows on the back, forming the lateral current on the back before referred to; the remaining portion below flows to the base of each of the natatory legs and the apron, and enters them, and at the same time and place, passes in part on the back; the current from the apron flows laterally down the abdomen.

Another portion of the side-current leaves the buccal cavity just along side of the mouth, unites with it, and flows to the base of the first pair of natatories. The union of these currents is somewhat peculiar: the blood vibrates upward on the venter, to a spot near the base of the prehensile legs, where a portion remains, although the main current vibrates back on the venter; at this moment, the current comes from the buccal cavity and carries the whole below.

The irregularity in the circulation in this animal is even greater than will be inferred from the above description. These currents are merely main directions; the blood flows into them or from them, through all their extent. The current coming laterally down to the base of the second pair of natatories, besides going into the natatory and on the back, is carried up the venter at each of the upward vibrations of the ventral current. The current from the apron also passes into the same current, in addition to its backward course. When it is considered that the currents of blood occupy merely the spaces left by the muscles and other internal organs, it will be readily seen that similar irregularities must occur in various parts of the body. These directions are occasionally subject to singular deviations. One of the two currents which run from each side in front, and unite on the medial line, has been observed to cross the medial line into the other current, and thus continue flowing for some time with considerable force; soon after, each flowed by vibrations towards the centre, but with alternate motion. This was observed immediately on taking the Caligus from the water, when it was apparently very lively. As the cod, however, had been for several days confined in the harbor near the market, all the specimens examined may have lost part of the activity usual in the open sea. At times, the blood in some parts merely vibrates back and forward, without advancing in either direction; and occasionally the blood flows in a direction exactly the contrary to its usual course.

We have not fully satisfied ourselves of the mode of respiration in the Caligus. The natatory pinnulæ—to which we must add those of the tail, as they are identical in their structure—have been supposed to supply the place of branchiæ. When the animal is attached to any object, these legs keep up a very regular action, which appears to correspond to the palpitations in the body.* We have not, however, observed the blood to flow into their setæ, and the currents passing into the legs are among the least regular. We are disposed to believe that these pinnulæ are not the special organs for this function, but that aeration takes

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* This action is not so rapid and branchial-like as in the Argulus, but takes place at intervals of about one and a half seconds.

place over the whole surface of the body. It is stated by STRAUS, that on separating the branchiæ of a lobster, the body absorbed nearly one half the oxygen usual before the removal of these organs. The thin envelop of the Caligus, and the extent of its external surface, must render its body a far more perfect substitute for branchiæ than the solid covering of the lobster. The vibrating action of the natatory legs serves to keep up a constant current of water, and thus affords continually a new portion to undergo the respiratory action of the body. It might be remarked that these legs, on account of their breadth, could not act so as to produce this current of water, when the whole margin around is attached. Probably the animal is not thus attached except when it is rendered necessary by the swift motion of the fish; under which circumstances, there is a sufficient current, without the action of these legs. We may presume that the special object of these marginal cups is to enable the animal to attach itself, and still keep the principal part of its body free, so that these natatory legs, when the fish is motionless, may have space to act, and sustain a continued current.

V. ORGANS OF REPRODUCTION.

On each side of the stomach, there is a large pyriform organ, (Pl. V, fig. 18,) of a glandular appearance internally, and provided with a distinct duct, which at first we unhesitatingly pronounced the liver. Subsequent observation proved that the duct, which we had supposed to enter the intestine, extends through the whole length of the thorax into the abdomen, where it is continuous, in the male, with organs known to be seminal, and in the female, with the egg-bearing vessels. These organs, thus shown to be connected with the organs of generation, have been since proved to correspond with the spermatic glands in the male and the ovaries in the female.

In the male, they are rather larger than the buccal mass, (Pl. V, fig. 21,) and are situated just anterior to the stomach, in part beneath the base of the prehensile legs and the spine of the preceding pair. Their small posterior extremity is produced into a short ligament, by which it adheres above the stomach; the anterior portions are so enveloped in their cellular or membranous attachments, that they are separated with great difficulty. In general appearance, it resembles a pyriform membranous sac, with an internal granulose structure. The duct, which is attached on the outer margin, is a slender vessel, of a thin membranous nature. It continues of a uniform size through the thorax to the central parts of the abdomen, where it gradually enlarges and undergoes a few convolutions.

A short distance below the convoluted portion, there is a small oval gland, with well-defined limits, contained within a distinct sac. It is apparently composed of several concentric parts, of which three are very apparent; there are two less distinct. Its interior is a transparent globule; the outer coats are less transparent, and the one adjacent to the interior, the least so. The central part of this gland is connected with a small sub-corneous tube, which gradually enlarges, and passes into the anterior extremity of the above convolutions. On one occasion, when we had separated this gland and its duct from the abdomen, a fluid, containing particles similar in appearance to those in the blood, rapidly poured out. The convoluted vessel appears therefore to receive the secretions of two seminal glands, and probably corresponds to the vas deferens. Though much time has been employed in searching for the exit of the vas deferens, we are yet uncertain on this point. It is presumed, from the appearance of the parts, that it terminates either on the outer surface of the lappet at the extremity of the abdomen, or beneath this organ.

The ovaries in the female have the same situation and attachments as the spermatic gland in the male. (Pl. V, fig. 18.) They are however much larger, and extend above the stomach nearly to its centre. They may be distinctly seen through the back shell. They appear to contain a long convoluted vessel, which gradually diminishes in size, from its anterior to its posterior extremity; but whether this be truly its nature, cannot be determined. The duct arising from its margin, extends without any variation in its size, till it reaches the posterior joint of the thorax, where it enlarges gradually, and continues to increase as it enters the abdomen. In the gravid female, it passes through the abdomen, with a few convolutions, and extends out at the vulva, in the form of a long, whitish, nearly cylindrical membranous tube. This external portion of the oviduct is often a little longer than the animal.

The vessel in the ovary does not appear to contain divisions indicating the presence of eggs; but the oviduct usually contains eggs through its whole extent. Where exserted, it is very distinctly divided by membranous partitions into narrow compartments, each containing an egg, though not quite filled with it. The eggs in the anterior slender portion of the oviduct are oblong and uniformly transparent. As they increase in size, they present a clouded appearance, and become divided into two parts, corresponding to the *white* and the *yolk.* The latter appears clouded and composed of albuminous globules. The several portions are represented in the exserted portion of the oviduct, (fig. 18.) The eggs have the form of short cylinders with rounded edges.

In the advanced eggs, at the extremity of the ovary, we observed in one instance, that there were two distinct eyes at their outer extremity; they were approximate, but not situated on the same black ground. In these eggs, the yolk occupied nearly the whole space.

In addition to the ovaries above described, there is a pair of organs in the abdomen, connected with the system of generation. They are straight, flat-cylindrical organs, usually as broad as the external oviduct, and lie along the central portions of the abdomen. At the lower extremity, they are connected with the oviduct a short distance above the vulva, and at the upper, they terminate in a cul-de-sac. They contain a single series of transparent, flattened globules, (fig. 18,) occupying, like beads, their central line, and in width about one half the width of the ovary. These false ovaries, when torn or cut, do not emit an albuminous fluid, like the true oviducts, but appear to have a gelatinous consistence. They are as much developed in the young, as in the old females.

The eggs in females of the same size present very different degrees of development. We have seen full grown individuals with no eggs in the abdomen, and consequently, instead of the swollen appearance usual in the adult female, their abdomens could scarcely be distinguished from those of the male sex. Occasionally, very young individuals have had external ovaries; the smallest observed was scarcely one sixth of an inch long. May we not infer from this, that a single coition is sufficient to impregnate the individuals of at least *one* succeeding generation?

A few instances have come under our notice, of a very extraordinary irregularity in these organs. The extremity of the *false ovary* has been seen hanging externally in the place of the regular external ovaries, and no eggs, nor the internal oviduct, were discoverable in the interior on that side. Moreover, the corresponding ovary near the stomach was discovered with difficulty, and appeared like a folded empty sac. At the same time the ovary and the ovarian tube on the other side presented their usual appearance. This singular derangement was observed in a full grown female, which was perfect in all its other organs.

An additional peculiarity as yet inexplicable, has been observed in some females. The lappets at the extremity of the abdomen, each side of the tail, have been already described as very short in the female. On their lower surface there is an irregular osseous process, from which a slender corneous organ, which we suppose to be a duct, runs forward and a little inward, gradually diminishing, and terminates with a few irregular curves, (fig. 18, Pl. V.) The peculiarity we refer to, is an appendage to this lappet, arising from the termination of the internal duct, (fig. 22.) It is a long corneous duct, wholly external, terminating in an oval sac of similar texture, and usually filled with a whitish fluid. These appendages have been observed in a few instances, hanging each side of the terminal joint of the body, (fig. 22.) In one instance the ducts were crossed over the adjacent articulation, and each attached by its sac to the lappet of the opposite extremity. These are the only facts that have been discovered respecting these singular organs. They were found attached to very few individuals, and in these the eggs were scarcely developed.

On account of the many similarities between this animal and the Argulus, it may be interesting to trace a few of its analogies.

The number of legs or organs for locomotion is the same, being eight in each. Of the four pairs of natatories in the Argulus, two are similar in their use in the Caligus, while a third is expanded into an apron, and a fourth is attached to a distinct joint, and has but little strength. The anterior pair of maxillipeds in the Argulus very much resemble in general form the same organs in the female Caligus. The fourth pair is large and prehensile in each, though very different in form. There is a distinct suture in the former, near the anterior margin of the animal, which corresponds to the articulation between the two cephalic segments in the latter; but this segment, which in the Caligus is furnished with antennæ, is wholly without even rudiments of these organs; we may hence infer that the Argulus is destitute of antennæ, as is

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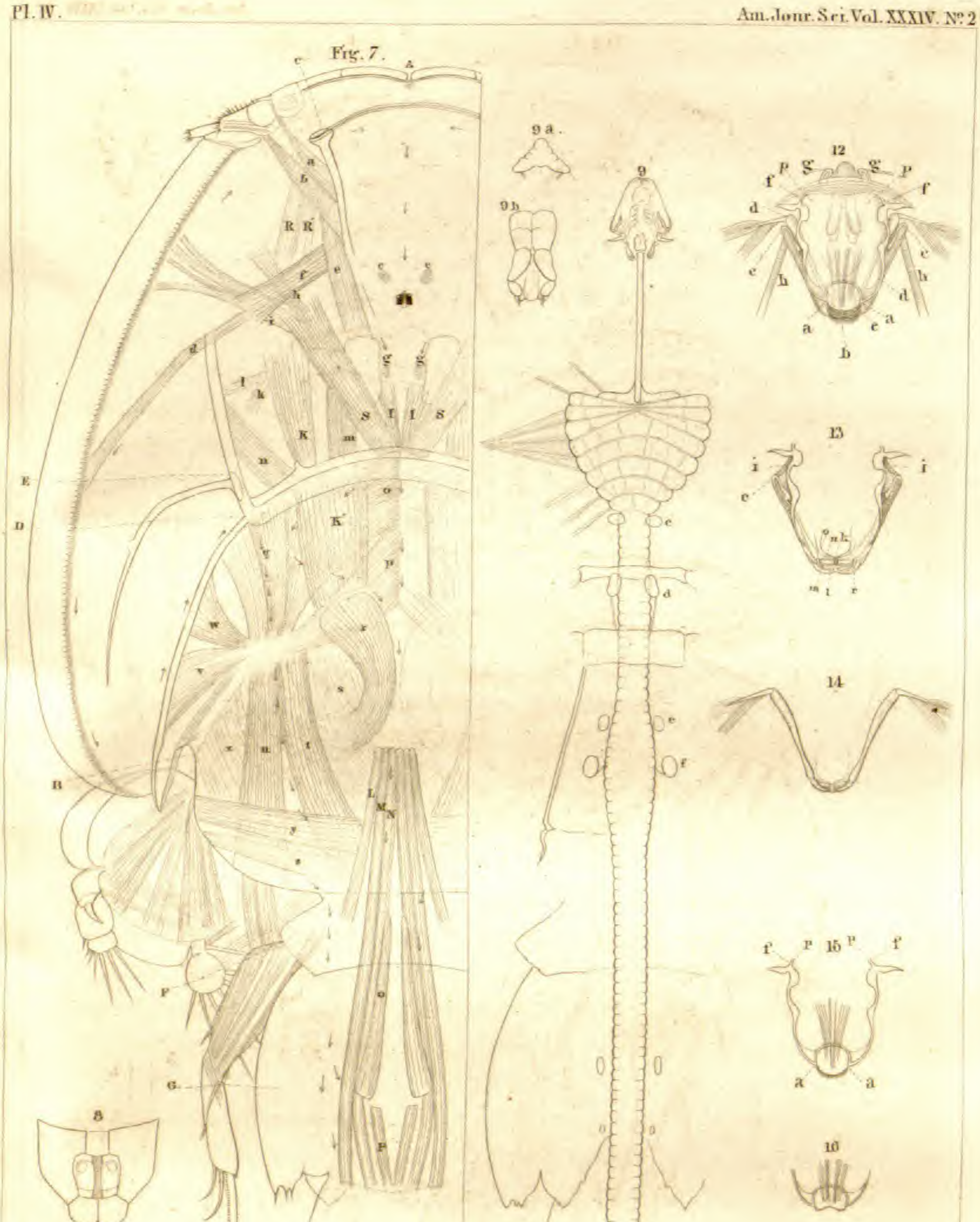
CALIGUS AMERICANUS



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CALIGUS AMERICANUS

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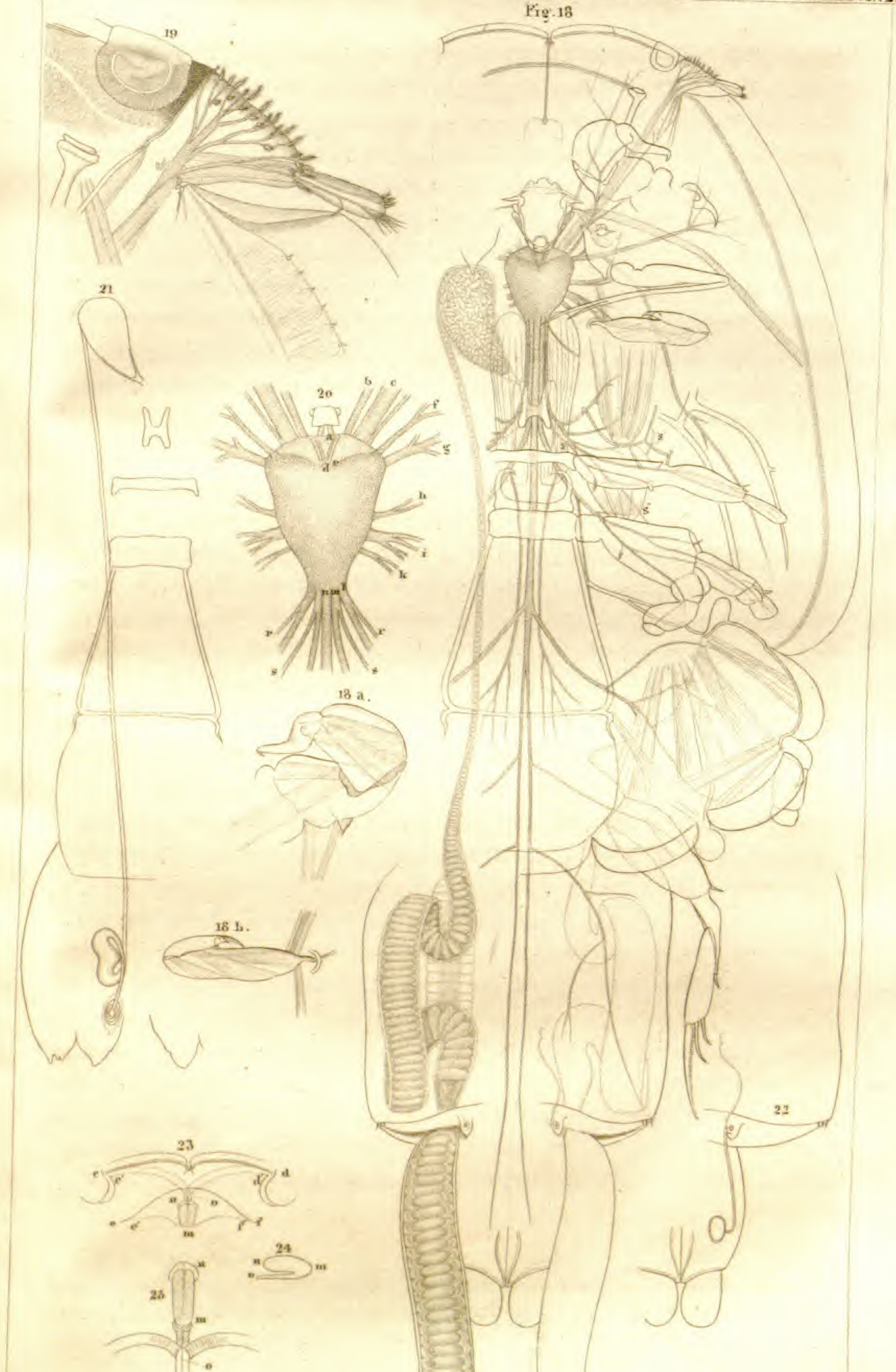

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CALIGUS AMERICANUS

also evident from the nature of the organs that follow. The space contained within the U suture in the Argulus is the analogue of the much larger and more distinctly separated segment, which we have called the cephalic in the above description. The anterior abdominal joint of the Caligus is wholly wanting in the Argulus; and the valves in the circulation which occupy the posterior thoracic joint, *far* from the extremity of the body, have an analogous situation in the Argulus, *close* to the *last* joint of the body. This joint being small in the Argulus forms a very distinct and regular heart, and serves to keep up a much more active circulation than in the Caligus, where the corresponding part is large and less energetic in its action. It is remarkable that the circulation in the two should be the reverse in almost every particular; the ventral current instead of being upward in the Argulus runs towards the terminal joint of the body; instead of meeting from the two sides in front and returning down the medial line, it goes out in two currents near the medial line and returns in the wings of the shell. This however will not appear so extraordinary when we consider that the animals are the reverse of one another in some particulars. The cephalic segment in the Caligus is very large and broad, and there is therefore space for the current furnished to the antennæ and cephalic organs, to flow along the sides, and return along its centre; but in the Argulus, this portion is so small that there is only room for the out-current, and the blood is compelled to turn outward into the wings of the shell or thoracic portion, which is very much larger than in the Caligus. The currents are much more definite in their limits in the Argulus, and more uniform in their velocity and course; the particles of the blood are also less variable in size and form, being about $\frac{1}{2500}$ of an inch, in length. The organs of the mouth are also similar in position and in the form of the mandibles. This analogy might be traced much farther; but we reserve further remarks for a future occasion.

EXPLANATION OF THE PLATES.

Plate III.

Fig. 1. Under view of a male, exhibiting the various organs, and the muscles that move them. A, minute papillæ, supposed to correspond to inner antennæ; I, a cup, for the attachment of the animal; L, antennæ; d, one of the muscles moving the mandibles. The arrows point out the course of the blood.

Fig. 2. Back view of male, natural size of one of the largest individuals.

Fig. 3. A female, natural size.

Fig. 4. a. View of the rudimentary or second pair of legs, or maxillipeds; b, termination of third pair.

Fig. 5. a. Ventral muscle, exhibiting its subdivision between the sternums of the two pairs of natatory legs; b, a second subdivision in the same muscle, below the posterior of the above sternums.

Fig. 6. a and b. View of the posterior thoracic joint, (see fig. 7,) with the valves in the circulation; the two lateral valves on the back and the central on the venter.

Plate IV.

Fig. 7. Back view of a male, with the muscles seen in this view. Those marked with capital letters, move the segments of the body; those with small letters, move the several organs below. F, the posterior thoracic segment; G, the anterior abdominal; H, the posterior abdominal.

Fig. 8. A portion of the shell about the eyes, shewing the areolets exhibited by it; the dotted line marks the limits of the dark ground on which the eyes are situated, and the dotted circles the eyes themselves.

Fig. 9. Alimentary canal, exhibiting the esophagus, the stomach and the intestine, with its glands, and the muscles of the rectum. The mouth at the upper extremity is represented as turned back, so as to show its under surface.

Fig. 10. Anterior extremity of the esophagus.

Fig. 11. A portion of the intestine.

Fig. 12. View of the *buccal mass*, in its natural position. Between the line a a, and a b a, is the opening to the mouth. d, the outer extremity of the mandibles, with the tendon and its muscles attached.

Fig. 13. The same with a portion of the upper membrane and the mandibles removed.

Fig. 14. The mandibles, together with some of the organs adjacent to their inner extremities, showing their relative position.

Fig. 15. The upper lips, with its two pairs of muscles.

Fig. 16. The same, with the extremity retracted by the inner pair of muscles.

Fig. 17. Under view of the buccal mass, with the esophagus attached. h h are processes lying in the teguments of the body, with which the buccal mass forms an articulation at their anterior extremity. g the processes in which the elevators of the buccal mass are inserted.

Plate V.

Fig. 18. Under view of *female*, exhibiting the nervous system, and the ovaries, and ovarian tubes. Fig. 18, a, the first pair of maxillipeds in the female; 18, b, the fourth pair in the same.

Fig. 19. A view of the cup and an antenna, together with a portion of the lateral margin of the animal, exhibiting its spines. The dotted lines in the antenna represent the nerve with which this organ is largely supplied.

Fig. 20. The cephalic and thoracic ganglions, exhibiting their close union, and the nerves they give out; the outlined organ in front, represents the eyes, attached to the ophthalmic nerves.

Fig. 21. Genital system in the male.

Fig. 22. Part of the abdomen of a female with an appendage to the same.

Figs. 23, 24, 25. Illustrate some facts connected with the change of skin.

Art. II.—*On the Aurora Borealis of November* 14, 1837; by Frederick A. P. Barnard, A. M., Prof. of Mathematics and Natural Philosophy in the University of Alabama, Tuscaloosa.

The splendid display of auroral glories which took place on the 14th of November, 1837, was undoubtedly one of the most extensive and most beautiful on record. It accordingly attracted the attention of a great number of observers, of whom many, in this country, have communicated to Mr. E. C. Herrick, of New Haven, and to Professor Olmsted, of Yale College, the particulars of their observations. It was the intention of Professor Olmsted to offer, in the April number of the Journal, an abstract of these communications, but the pressure of other engagements has compelled him to commit to another, the task of preparing such an abstract.

Observations on the Aurora, to be valuable as the means of detecting the laws which regulate this phenomenon, and of affording data, from which to determine or to conjecture its causes, should, of course, be extended through a long period of time, and embrace a vast number of particular facts. They should be conducted by many observers, in different places, simultaneously and with concert. They should, moreover, be regulated according to a system, previously understood by all who take part in the observation.

It follows, therefore, that from the collected accounts of a single display of this brilliant meteor, especially if these are expressed in language generally too vague, in regard to directions and times, to allow of an identification of its particular phases as observed from different points of view, little can be inferred as to the nature of the phenomenon itself, or the altitude of the luminous cloud above the surface of the earth. Such records may, nevertheless, in the progress of science, be discovered to possess a value, which we are unable at present properly to appreciate.

The city of New Haven had been visited, during the day of the 14th of November, with a moderate storm of snow, which began to subside between the hours of five and six in the evening. The heavens continued, however, to be more or less obscured by clouds during the entire evening; on which account the splendors of the aurora, as they manifested themselves to observers more favorably situated, were here in a great degree concealed. The veil of snow clouds, which, at sunset, and for some time afterward, covered the sky, was nevertheless exceedingly thin; and it was through this, and even through the falling snow itself, that the first visible indications of the presence of an aurora were discovered. It is impossible to state the exact time at which the action commenced. There is no doubt that it had been going on for a while, before the intensity of the light became sufficient to penetrate the screen. The first evidence of its existence consisted in a strong rosy illumination of the entire arch of the heavens. In a communication prepared by Professor Olmsted, at the time, for the New Haven Herald, this appearance is described as follows:—

"The snow of yesterday, which at sunset had covered the earth and all things near it, with a mantle of the purest white, closed, early in the evening, with a most curious and beautiful pageant. About six o'clock, while the sky was yet thick with falling snow, all things suddenly appeared as if dyed in blood. The entire atmosphere, the surface of the earth, the trees, the tops of the houses, and, in short, the whole face of nature, were tinged with the same scarlet hue. The alarm of fire was given, and our vigilant firemen were seen parading the streets in their ghostly uniform, which, assuming the general tint, seemed in excellent keeping with the phenomenon.

"The light was most intense in the northwest and northeast. At short intervals it alternately increased and diminished in brightness, until, at half past six, only a slight tinge of red remained on the sky. It is presumed that places favored with a clear sky, enjoyed a splendid exhibition of the Aurora Borealis, the light of which was transmitted to us through the snowy medium and a thin veil of clouds, and was thus diffused like the light of an astral lamp, covered with a red shade of ground glass. That the stratum of clouds was very thin, was inferred from the fact, that before half past six, a few stars were discernible as when seen through a fog; and such was the appearance of the moon which rose about the same time."

The memoranda of Mr. E. C. Herrick, recorded at the time, correspond very nearly with the account given by Prof. Olmsted. Mr. Herrick says: "The sky was overcast and snow was falling in small quantities, when about twelve minutes before six (mean time) the heavens began to assume a fiery appearance. Within ten minutes, the whole clouded hemisphere shone with a brilliant red light. The snow on the ground reflected a fine rosy tint, and greatly enhanced the glory of the scene. The auroral flush overspread all parts of the sky almost instantaneously; yet there is some reason to believe that it started mainly from a spot near the W. N. W. as did the great aurora of Jan. 25, 1837. In a few minutes the light began to fade, and within a half hour, the exhibition ended. During the whole display, the clouds prevented our seeing even a single streamer.

"After the first fit was over, and during the remainder of the evening, the view of the heavens was much obscured by clouds. There was undoubtedly a return, partially observable here between nine and ten; but it seems to have been inferior to the previous display."

Had there been no farther visible indications of auroral action, however, Mr. Herrick would still have inferred the existence of a very powerful aurora, from the violent agitation of the magnetic needle during the evening. His observations on this instrument were continued for several hours. They were made with the assistance of Mr. A. B. Haile, of Yale College. The experience and accuracy of both these gentlemen in observations of this nature, are well known. Mr. Herrick remarks: "The needle was more disturbed between 6 and 10 P. M., than I ever before knew it to be during an aurora. It often moved thirty minutes in three seconds of time. Its entire range was nearly *six degrees!* At 6h. 26m. it stood at 3° 10′ west, and at 9h. 10m. at 9° 7′ west. Its mean position in its present situation and at the present time, is 5° 50′ west."

The number of magnetic observations made by Messrs. Herrick and Haile during the evening, amounted to seventy six. An interval of nearly an hour and a half occurred, from 7h. 45m. till 9h. 9m., during which no observations were made. All visible indications of an aurora had at that time disappeared; and the oscillations of the needle had become so much less remarkable, that it was not considered important any longer to watch them. It was, therefore, with no little surprise, that the observers, on returning to their post at a few minutes past nine, found the variation to be nearly two and half degrees greater than the mean. The following is the entire table of their observations.

***Observations on the magnetic needle at New Haven, (Conn.) during the great Aurora Borealis of Tuesday, Nov.* 14, 1837 ; by E. C. Herrick and A. B. Haile.**

Mean time.	Needle west.	Mean time.	Needle west.	Mean time.	Needle west.	Mean time.	Needle west.
h. m.	° '	h. m.	° '	h. m.	° '	h. m.	° '
5 49	4 57	6 19⅚	6	7 2	5 45	9 15½	5 22
51	6	22	4 0	4	5 50	‡16	
53	5 25	23	3 48	9	5 50	17	6 30
55½	6 50	Min. 26	3 10	12	6	18½	7
*55¾	5 30	28½	4	13¾	6 5	22	7 7
57	5 35	30	4 40	15	6 10	30½	6 0
6 0	5 30	32	4 45	17	6	36	5 52
2¾	4 30	35	4 45	21	6 5	47	5 45
3	5	39	5	23¾	5 55	52	5 58
4	5 45	40	5 15	34½	5 50	56½	5 10
4½	6	40½	5	41	5 15	10 1	5 32
†6		43½	4 35	45	5 15	4	5 45
7	5 7	47	4 30	* *	* *	17	5 30
7½	4 45	49	4 25	9 9	8 15	22	5 30
10½	4 15	50¼	4 30	9½	8 30	38	5 22
11	3 55	52	4 45	Max. 10	9 7	47	5 37
11½	4 3	54	5	11	8 30	11 0	5 45
12	4 15	55⅓	5 15	12½	7 15	Ceased to observe.	
15½	4 45	56	5 30	13	6 45		
19	5 10	7 0	5 40	14½	5 45	76 observations.	

[The instrument employed was the variation compass, described by Professor Loomis, at p. 221, vol. xxx. of this Journal. It is not strictly on the meridian; but the usual position of the needle at this period, at its station in the room, at this hour of night, is about 5° 50′ west. The next morning (15th) from 7 to 9, the needle was at its usual place.]

The foregoing table will be examined with interest. It corresponds with the results of numerous observations made by the same gentlemen on other occasions, in shewing that the influence of the Aurora Borealis upon the magnetic needle is not uniform in producing a deflection in the same direction. In the London Philosophical Transactions, for 1832, Mr. Faraday has demonstrated the fact of a necessary tendency of electricity from the equator of the earth towards the poles, in consequence of the diurnal rotation. Without an escape of the electric fluid from the northern latitudes, it is obvious that such a tendency, however great, would be a *tendency* only ; without producing any actual flow of elec-

* Splendor fading. † Going east rapidly. ‡ Going west rapidly.

trical currents. Mr. Faraday suggested, that such an escape might possibly take place occasionally, thereby producing the phenomena of the Aurora Borealis. Were this the case, there would exist below the needle a flow of electricity northward, and above it, southward. According to the laws of electro-magnetism it should seem, therefore, that the disturbance observed should, in every part of the northern hemisphere, take place invariably towards the east. During the great aurora of July 1, 1837, the general deflection, according to a statement inserted by Mr. Herrick in the New Haven Herald, was obsėrved to be in that direction. The fact that it is not uniformly so, however, proves us to be still in ignorance of some, at least, of the causes by which it is produced. There yet exists a necessity for much careful observation. Observations too, on the variation of the intensity of terrestrial magnetism, and on the disturbance of the dipping needle, during the existence of auroral action, are much to be desired.

Observations made in other places.

The aurora of Nov. 14, was observed in the city of New York by the writer of this article, in company with Mr. John H. Pettingell of that city. The position of the observers was three and a half miles north of the City Hall, and one and a half beyond the limits of the city proper; being upon an eminence which commands an unobstructed view of the horizon in every direction.

At about a quarter before six, their attention was attracted by a very unusual appearance of the heavens. The sky was wholly overcast, as in New Haven, at the same hour; but the cloud was not sufficiently dense, absolutely to obscure all the stars; of which quite a number were observed from time to time, faintly glimmering through. A few light flakes of snow continued, also, still to fall. At the time of the first observation, the whole heaven was suffused with a lovely carnation, brightest, apparently, at the commencement in the zenith, but soon afterward rather toward the northeast. This tint, reflected on the snow, clothed all nature with a roseate flush, beautiful beyond description. It gradually faded; but at the end of an hour was still slightly perceptible.

The sky then rapidly cleared, and all traces of the aurora passed away. But at about half past seven, the north and east being still overcast, and some stratified clouds extending themselves along the horizon around toward the west, a brightness began to appear in the northwest, which, in a very short time, extended itself upward forty five degrees, in a column of diffused light, quite broad at the base, and tapering to a point. This column moved very slowly southward, and at length became divided into two of similar character. But in the mean time, in all the north, and especially in the northwest, numerous streamers began to make their appearance. They became faintly red at the height of about 30°, and the redness of the whole blended itself into one general cloud, while the columns continued distinct and white below. The changes were rapid, as is usual; but the red tint covered the heavens nearly to the zenith for a long time. No corona was formed. The moon, emerging from the clouds a little before eight, detracted from the brightness of the display, which was at no time very intense. The whole subsided, or nearly so, shortly after eight, and observations were discontinued.

But, at a few minutes before nine, the writer was summoned to witness a new exhibition of auroral magnificence, the glories of which no tongue can tell. The heavens were at this time wholly unclouded, with the exception of a single very small and faint cirrus high in the northwest. Innumerable bright arches shot up from the whole northern semicircle of the horizon, and from even farther south; all converging to the zenith with great rapidity. Their upper extremities were of the most brilliant scarlet, while below they were intensely white. At the formation of the corona, the appearance of the columns below, which were exceedingly numerous and brilliant, resembled what we may conceive would be that of bright cotton of long fibre, drawn out at full length. The comparison though humble, is more strikingly descriptive than any other the observer could invent. To attempt in language, a picture of the magnificence of the corona, would be utterly idle. It surpassed that of every other, that the writer has ever had an opportunity of observing. The intermingled hues afforded each other a mutual strong relief; and exhibited the most brilliant contrasts ever beheld. The stellar form was wonderfully perfect and regular. Toward the west, there was a sector of more than twenty degrees of unmingled scarlet, exceedingly magnificent.

The duration of this display was quite remarkable. For three quarters of an hour after its formation, which took place about nine o'clock, the corona continued, with variable brightness, to maintain its position a little to the south of the zenith. At about half past nine, the northern columns had become disconnected from it, and had subsided very low, the heavens being clear between. But long before this, and indeed, within a few minutes after nine, the south was as completely filled with corresponding columns as the north. For a time, therefore, we were over-arched by a perfect canopy of glory. The southern columns, which seemed to proceed downward from the corona, rested on an arch of diffused light, extending in a great circle from east to west, or nearly so, and being about twenty degrees, or a little more, above the horizon, in the centre. All below the arch was of the strange darkness so usual at such times in the north. The southern columns were at no time so bright as the northern, but they maintained their position, after these last had retired; extending still from the corona to the arch which formed their base. The appearance was at this time that of an Aurora *Australis;* and this continued for more than a quarter of an hour. Streamers, for a while, continued to shoot up irregularly in the north, but they did not again reach the zenith. By half past ten, the whole was over, and the charmed observers reluctantly abandoned the watch.

The numerous observations of Mr. Herrick, have demonstrated the probability, if not the certainty of a return, after midnight, of an Aurora occurring before. Although, therefore, three distinct and strongly marked *fits* of the phenomenon had already occurred on the evening of which we are speaking, the writer was curious to ascertain whether there was not another yet to come. Accordingly a watch was kept, and at about half past one, the north was observed to be illuminated with a strong diffused light, like the dawn, from which occasional streamers shot up faintly, so high as forty degrees. Before half past two these appearances gave place to a flickering light, which ascended in broad waves half way to the zenith. At a quarter before three, this began to subside, and observations were discontinued.

The presence of the moon detracted, undoubtedly, very much from the splendor of these successive exhibitions of celestial magnificence. But for this circumstance, it is believed that the display at nine o'clock would have been gorgeous, beyond any yet recorded by observers in this latitude. Indeed, the writer is disposed to believe that it was such, notwithstanding this disadvantage. None, at any rate, of the magnificent exhibitions of this nature, by which the past few years have been distinguished, have produced upon his mind an impression of so unmingled admiration and delight.

It is a fact not a little remarkable, and one which may serve to show how little the negative testimony of persons, not systematically observers, can be depended on, in regard to the occurrence even of the most magnificent and striking celestial phenomena, that of all the daily papers in the city of New York, amounting to nearly or quite twenty, the Commercial Advertiser alone, contained a notice of the later and more splendid appearances of this Aurora, while almost every one explicitly stated the fact of the flush which overspread the face of nature early in the evening. We quote a few sentences from the Commercial :— "The glories of the Aurora have been so often displayed to us of late, that we scarcely think of mentioning each nightly exhibition; but that of last night was so eminently lovely, that we cannot let it pass unnoticed. * * * *

"Our news collector, Capt. Siscoe, who resides at Staten Island, says that he never beheld so magnificent a spectacle. During the continuance of the auroral light, he could see as distinctly outside of Sandy Hook, as at mid-day—a circumstance he never knew before, and he believes that the oldest men on the island are of the same opinion. The illumination was so great, he says, that, at one time, the city of New York appeared to be within a mile or two of Staten Island."

The display at nine o'clock was observed in the town of Fonda, Montgomery Co., N. Y.. by Mr. Oran W. Morris of New York City. His account of its general appearance accords very well with that which has just been given. At one time, however, Mr. Morris observed two arches of diffused light in the south, below that on which the columns rested. Mr. Morris noticed particularly a bright red sector, similar to that already mentioned, on the west side of the corona. His position was at least one hundred and sixty miles, a little west of north, from that of the writer.

By a letter addressed to Mr. Herrick by Mr. Azariah Smith, Jr., from Geneva, N. Y., it appears that the first approach of the Aurora was at that place, unobscured by clouds. The following is an extract :—

"At 5h. 45m. a purple bow or streamer appeared in the W. N. W., at first, rising but about 10°. At about the same time another rose in the N. N. E. Both gradually increased in height until they reached the zenith, and at 5h. 55m., a complete corona was formed. The eastern beam, soon after its appearance, extended in breadth at its base, assuming a triangular form of a purple or carnation hue, with a golden colored streamer passing up through its centre. Streamers were general at this time in the north; but directly north, as well as nearly over head, the heavens were of a light greenish tinge. Soon after this, a purple cloud in the E. was peculiarly brilliant, and at 5h. 57m. a bright white streamer passed the north star, on its way to the west. At 5h. 59m. the whole appearance began to decline in brilliancy, especially the radiating point, and, at this time scarcely any light was observable 20° E. of N. * * * At 6h. 7m. bright carnation clouds appeared each side of the radiating point, which continued nearly fixed for three or four minutes, and gradually faded away—the radiating point having now nearly disappeared." Time in Geneva is about 16½m. earlier than in New Haven.

Mr. Smith gives very minute observations on the phases of the Aurora, continued until 8h. 8m., when clouds for the most part, obstructed the view of the heavens, and no auroral phenomena were visible. Faint appearances of the Aurora, seem, from his notes, to have continued until nearly half past seven; when they subsided only to re-appear almost immediately. A faint corona was formed at 7h. 35m.

Mr. Smith seems, also, for about five minutes, to have had a glimpse of our splendid exhibition at a later hour, though not sufficient to inform him of its magnificence.

From a communication inserted in the Daily Commercial Advertiser, of Buffalo, by Mr. R. W. Haskins, it appears that the Aurora was observable also at that place, at its first approach. Mr. Haskins states that, at 5h. 15m., the heavens being clear in the north, and for 50° both east and west of that point, an unusual ruddy appearance was noticed, not in this region, but still farther toward the east and west. Mr. Haskins continues as follows: "This soon faded, leaving barely a perceptible tinge; and instantly, when nearly all color had disappeared elsewhere, a space of some 15° in diameter, immediately west of Cassiopeia and Andromeda, and north of Pegasus, was lighted up with red of a deeper hue than any we had yet seen. This was entirely disconnected, on every side, from any auroral light or appearance whatever; and, from its centre, pencils of white radiated to the periphery on every side.

"This continued some five minutes, when, the white lines disappearing, the whole space in question assumed an uniform red color, which was almost instantly thereafter extended, in an arch of the same width, through our zenith, and down to the horizon about 60° W. of N. On the east, this light did not extend itself. During all this time, the clear space in the north which has been mentioned, retained its usual color and appearance."

Deep red streams, pencilled with white, then began to appear and fade in the north, but without the tremulous motion of *merry dancers*. Those in the N. E. maintained their brightness longest, and moved slowly toward the eastern point of the horizon, near which they disappeared at a given vertical line. The usual haziness in the north began first to appear at 5h. 43m. Difference of time between Buffalo and New Haven, 23m. 48s.

Mr. Haskins proceeds: "At 5h. 47m. the clouds had become more dense and dark, (though still in detached masses,) particularly throughout that portion of the heavens which had been occupied by the red arch above mentioned, and these isolated clouds now assumed an appearance at once novel and striking. Those west of our zenith, and lying within the track of the crimson arch already described, suddenly exhibited the most vivid red along their entire *southern borders;* while the like clouds east of our zenith, and following the same track, and prolonging it quite down to the eastern horizon, assumed the same vivid color upon their *northern borders;* while no other portion of these clouds exhibited the least appearance of auroral light, in any of their parts. South of this line, there was at no time any auroral light whatever; and at the moment in question, there was very little in any other parts of the heavens, save on the borders of these clouds. At 5h. 51m. the red edgings of these clouds began to fade, and immediately a wide space in the N. E. that was still free from clouds, was most brilliantly lighted up. The color was of the same deep red, but it did not extend down to the horizon; and this had scarcely endured four minutes, when the whole region N. of our zenith, to within about 8° of the horizon, was again reddened and glowing: while, beyond these limits, either

N. or S., no vestige of the Aurora was visible. At 5h. 58m. the moon appeared above the horizon, and as it was only two days past the full, its beams soon surpassed in brightness those of the Aurora, and farther observation of these last became impossible."

It is to be regretted that Mr. Haskins did not repeat his observations at a later hour, as it is hardly to be doubted that the subsequent displays observed at Geneva, and at Hudson, as well as elsewhere, would have been at least partially visible to him. Mr. Haskins says, that he was unable to detect any disturbance of the magnetic needle. The instrument used, was a common surveyor's compass; which was, moreover, compared with another, both being considered good instruments. The apparatus was, undoubtedly, not sufficiently delicate; but it is a fact which has led to much discussion, that the needle is often greatly disturbed in one place by an Aurora, when in another, it is scarcely affected at all. Thus it is stated in the second Report of the British Association, for 1832, that during the great Aurora of the 7th Jan., 1831, M. Arago observed the magnetic needle to be powerfully affected, while Mr. Sturgeon of Woolwich, could not observe it at all.

At the Western Reserve College, Hudson, Ohio, some of the earlier displays of the phenomenon were noticed by Professor Elias Loomis, but the exhibition at nine o'clock, and after, (in New York,) was concealed by clouds. Professor Loomis says: "This evening at about five minutes after six, I observed the commencement of an Aurora. A small pile of light, of a reddish hue, lay upon the horizon, in a direction a little north of N. W., and a similar pile in the E. N. E. Between these there was a low faint cloud, bounded by a somewhat ill defined arch, rising in its centre about ten degrees from the horizon. Above this arch, a diffused light streamed upward toward the zenith, in one or two places, being somewhat more condensed, forming beams. This light increased rapidly in brightness, it became of a more decided crimson color, extended up to the zenith, and at the same time, light began to shoot up from several points in the east, and somewhat south of east. At a quarter past six, mean time, a pretty regular arch was formed, extending from the above-mentioned pile of light in the N. W., a little north of *alpha Lyrae*, south of *alpha Cygni*, about half way between Markab and Scheat, and about 15° S. of *alpha Arietis*. This arch was rather irregular in its outline, and had a slightly crimson color. In about five minutes another arch of white light partially formed in the southern sky, rising about 10° above Fomalhaut, and having nearly the same direction with the preceding. This arch was never complete, and soon vanished entirely. The great arch I have before described, brightened up again, in very nearly the same position as before, being perhaps a little more regular in its outline. * * * * About half past eight, light of a crimson color was observed to shoot from the eastern horizon toward and beyond the zenith, nearly in the position of the former arch. The heavens were now nearly covered with thin cirro-cumulus clouds, and the contrast of the ordinary clouds with this crimson auroral light, produced a very singular effect. The sky remained cloudy during the night, and the next morning there fell a few flakes of snow."

The time at Hudson, is about thirty-four minutes earlier than at New Haven. From the accounts given by Mr. Smith, Mr. Haskins, and Professor Loomis, it seems impossible to identify any particular phases as having been noticed by any two of the observers. Professor Loomis was probably mistaken in supposing that he saw the commencement of the Aurora. At the time of his first observation, a corona had already formed itself, and faded away at Geneva. The accounts just given, hardly satisfy us in regard to the splendor of the first auroral display. We are forced to believe that, but for the clouds, it would have been much more magnificent in the cities of New Haven and New York, than it is here represented to have been.

The Aurora, (to go still farther west,) was observed in the city of St. Louis, Mo. The Republican of that city remarks: "This beautiful and interesting phenomenon, was visible during nearly the whole night, and was particularly brilliant between the hours of twelve and one, when the moon was near its zenith." Time in St. Louis being rather more than an hour earlier than in New York, this last display was contemporaneous with the latest return of the Aurora in our longitude: but this, which was the least energetic here, appears there to have been the most remarkable.

From places north of New Haven, we should, of course, anticipate accounts of the appearance of this phenomenon. A letter from Professor A. W. Smith, of the Wesleyan University at Middletown, Conn., to Mr. Herrick, describes the heavens as they appeared, from half past five till half past six, in terms very nearly corresponding to those used by Professor Olmsted, and already quoted. Professor Smith adds: "About nine o'clock there was a corona formed a little south of the zenith, highly colored, as on the 17th November, 1835. Streams of auroral light were also faintly visible at the same time in the north." It is very obvious that the magnificence of the exhibition at nine was by no means so great in Middletown as in New York.

Professor O. P. Hubbard, of Dartmouth College, Hanover, N. H., in a letter to Professor Silliman, also mentions the appearance of the Aurora at that place; but without giving a particular description.

East of New Haven, the snow storm seems to have been more protracted than in this city. The rosy flush observed here at six o'clock, was nevertheless seen in New London, in this state, though the snow was falling copiously at the time. A letter to Professor Olmsted, from Mr. J. Hurlbut, of the latter place, dated Nov. 14, says: "The snow has fallen incessantly since five o'clock this morning, and up to this hour (eight o'clock, P. M.) the storm has not in the least abated. But, at about six o'clock, it seemed as if the heavens were on fire. A lurid light on all sides, from the zenith to the horizon, cast a most vulcanean hue on the fallen snow. This lasted about half an hour, and then disappeared. The light seemed the same in every portion of the heavens, but without any apparent cause."

South of us, the distance to which this beautiful exhibition was visible, at one time or another, during the course of the evening, was very unusual. From a large number of notices we select a few of the more circumstantial, and present them in the geographical order of the places from which they come, proceeding southward. The United States Gazette, published at Philadelphia, after noticing the early appearance of the heavens, which was not dissimilar to that observed at New York, continues: "At a later period, the lights were again visible, and between nine and ten o'clock, exceeded in extent and brilliancy, any thing of the kind ever before witnessed in this latitude. A broad field of crimson flame, stretching from nearly a western course, and reaching the eastern hemisphere, encompassed the heavens with a brilliant glory, of indescribable beauty and magnificence, hanging, as it were, suspended from the blue vault above, like an immense curtain over the earth—while, from almost every point of the compass, shot up rays of rich and gorgeous light, spreading and intermingling with a wavy tremulous motion, and exhibiting every hue which the rain-bow can boast. The richness, variety, and delicacy of the colors, were surprisingly beautiful, as was their prismatic brilliancy.

"The sky itself was remarkably clear and cloudless—and through the celestial phenomena, a full moon and innumerable stars were, all the while, distinctly visible. We never had the satisfaction of witnessing a display so truly grand and magnificent, and only regret our inability of conveying even a faint idea of the sublime wonder, and beauty of the scene."

Other persons seem to have observed a greater variety of *colors* than were visible to us. Red, orange and golden yellow, with sometimes a shade of pale green, doubtless an optical illusion, as being the color complementary to the first, were all that were remarked in New York.

Professor L. Obermeyer, of Mt. St. Mary's College, Emmittsburg, Md., writes to Professor Olmsted, under date, Nov. 18, as follows: "On the evening of the 14th inst., a brilliant display of an Aurora Borealis was witnessed. The first indication of its approach was given as soon as it became dark, by the singular redness of the cumulo-stratus clouds, now entirely covering the sky. Those in the north, south, east and west, all partook of the redness; and the reflection from them was strong enough to give a red tinge to the snow, still several inches deep. The heaviest clouds retained their dark color in the centre, but they were bordered with red. During the hour in which this state of things existed, there were no streamers, streaks of light, nor merry dancers. Indeed, where the sky could be seen between the clouds, there were no signs of an Aurora, but rather a deep green sky. By seven, the moon being risen, and the clouds having vanished, nothing remained to show that there had been any unusual occurrence. A little after nine, however, the sky being perfectly clear, an Aurora suddenly sprung up, which, for magnificence has seldom been equalled in this latitude. The streamers from the east, west and north, converged a few degrees south of the zenith, forming a beautiful auroral crown, red as scarlet, but intermingled with streaks of pale light. There were no *merry dancers*. All the other appearances usually witnessed on such occasions were noticed. In little more than half an hour, the grand display was over. A few traces were seen for a little time longer, when every vestige disappeared." The time at Emmittsburg is 18½m. earlier than at New Haven.

A letter from President Humphreys, of St. John's College, Annapolis, Md., to Professor Olmsted, speaks of the Aurora of Nov. 14, as "more magnificent than any that has ever before occurred" there. Mr. Humphreys proceeds: "It [the Aurora] extended many degrees farther south than the great one in January. It came on in waves, as before, at about a quarter before six, and returned at seven, at eight, and at nine. The first arch was formed suddenly, and became vertical in a very few minutes, from the first appearance of the columns at the N. W. and S. E. It was crimson, traversed by white pencils. The magnetic variation was diminished 1° 5′. It is here, west." A communication also appears in the Republican, of Nov. 18, published at Annapolis, proceeding, likewise, probably from President Humphreys, and giving a more particular account of the returns at eight and nine. It is remarked that, "the color of the light at 8h. was not red, but dusky, and formed from the N. W. point to the pole star, a broad column, which kept its position for half an hour. A succession of fine cirrous clouds floated off from the lower parts of the column to the south. At 9h. the recurrence of the crimson light was more in patches, and of intense brightness, accompanied by cirro-cumulous clouds, which were formed suddenly over the whole sky, and were borne swiftly to the east by the wind, and at apparently a greater elevation in the atmosphere than that of the Aurora."

The latter opinion of President Humphreys, in regard to the comparative altitude of the auroral and the ordinary clouds, is undoubtedly a mistaken one. But for the presence of these latter, he would unquestionably have observed something more than patches of crimson light, since the corona was seen by persons in almost every direction from Annapolis. Difference of time between New Haven and Annapolis, 15m.

From Fairfax Co., Va., near Alexandria, Professor R. Tolefree writes, of the early display: "From E. S. E. to W. S. W., was exhibited a rich orange red color, extending even to the zenith, and covering all the heavens north of these points." Professor Tolefree observed the return, in a brilliant and fiery form, toward nine o'clock; but he observes that, "by a quarter past nine, the

Aurora was no longer visible." It is probable that the clouds of which he previously speaks, obstructed the view. The time at Alexandria is about 16½ minutes earlier than at New Haven.

At Richmond, Va., the magnificent corona formed between eight and nine o'clock, was observed by many persons, but from that place, no statements in detail have reached us.

We come now to two communications from points much farther south than any of the preceding, and situated in latitudes so low, that the occurrence of an Aurora Borealis is there a phenomenon of exceedingly rare occurrence. The first of these is a letter to Mr. Herrick, from Mr. W. A. Sparks of Society Hill, S. C., in latitude 34° 35′ N., nearly. Mr. Sparks observes: "My attention was directed towards the north early in the evening, (about six o'clock,) by an unusual luminous appearance, and after gazing intently for a while, I distinctly recognized what I had long and earnestly sought for without success, a "bank or storehouse" of auroral vapor. * * * When I first observed it, a space of about 15° above the horizon was strongly marked by a pale white light, above which the crimson hue peculiar to this phenomenon began to be distinctly visible. At this time, the greatest degree of brightness was to the east of north, assuming no very definite form, but extending, as well as I could judge, about eight or ten degrees east, and reaching in height to the constellation of Cassiopeia's chair, the lower portion of which was enveloped in its reddening glow." The action then subsided, but at about eight o'clock, another bright crimson column ascended due north, attaining an altitude some degrees greater than that of the polar star, and maintaining its place about half an hour. After this had faded away, no return was observed till about half past nine, when Mr. Sparks observes, "I again perceived another broad arch of crimson light, ascending several degrees to the west of north. The altitude of this latter column was greater than that of any of the preceding, but I regret to say that my ardent desires to see it 'scan the blue vault, and in the zenith glow,' were not fully realized." Time at Society Hill is about 27½m. earlier than at New Haven. At the moment of this last mentioned return observed by Mr. Sparks, the crisis of the action in our longitude was past.

The other communication just alluded to, is a letter addressed to Professor Silliman by Mr. J. Darby of Culloden, Geo., latitude about 32° 45′, N. Mr. Darby writes: "Immediately after dark, or at about six o'clock, the sky a little to the north of the star Capella, began to appear luminous, and a luminous arch was soon formed, of about 6° or 8° in breadth, and extending over to the north-western horizon, having the pole-star in its highest point. Soon after the arch was formed, that part of it in the N. E. horizon became much brighter, and somewhat broader than the rest; and this luminous portion gradually rose, and passed on in the arch; its densest part culminating a little below the north star. It continued its motion to the western horizon.

"The passage of the luminous part of the arch occupied an hour and a half. It became somewhat fainter, after it had passed the meridian. The arch gradually passed off, beginning first to disappear in the east, so that not a vestige remained at nine o'clock, three hours from its first appearance. * * * The color of the arch was that of light scarlet, and the most luminous part a little darker, and much more intense. It appeared to be a semicircle, having for its base about 60° of the horizon. It differed from the Aurora in its regular outline, and its regular motion from east to west. It was observed with wonder by many in this region, and was such as no one had ever witnessed before." Time at Culloden, 45m. earlier than at New Haven, nearly.

At the date of this letter, Mr. Darby was not aware of the contemporaneous occurrence of the Aurora at the north. The appearances he describes are certainly very unusual; but must, of course, be attributed to the phenomenon which was at the time exciting so great admiration and astonishment, throughout all the northern states.

We learn from some of the English journals, that this Aurora was seen in Great Britain. It is mentioned in a number of the Cambridge Chronicle, published in November, and also in Loudon's Magazine of Natural History, No. XII, Dec. 1837. Its splendors seem to have been in a great measure concealed by clouds, and the Aurora of Nov. 12, two days previous, attracted a much higher degree of attention. A notice of this latter phenomenon, by J. H. Stanway, Esq., of Brookfield, near Manchester, dated Nov. 15, and published in Loudon's Magazine, contains this incidental mention of the Aurora under consideration:

"My attention was also last night directed, by the oscillations of the needle, to the existence of an Aurora Borealis; but, by reason of the interference of clouds, it was not long visible. The variations noted, were as follows :—

h. m.		h. m.	
11 15	28° 25′	12 30	28° 30′
" 45	27 24	" 45	25 26."

The mean variation for the month of November, had been determined to be 26° 48′ 45″. The writer continues :—

"At half past twelve, a patch of the most intense blood red colors which I have ever seen, was visible, free from the interposition of clouds. The whole of the sky had an awful appearance; for the tinge of red which pervaded *the whole expanse*, assumed, in many points, from the depth of colors above, and the density of the clouds below, the dark copper tint, which is seen on the disk of the moon during a lunar eclipse."

The time here mentioned would correspond nearly to a quarter before eight in New Haven; and the display which seems to have been observed at its height, must have been almost contemporaneous with some of the earlier appearances noticed in this country. The time included between the earliest and latest observations on the needle, is equivalent to that from half past six to eight, here.

None of the scientific periodicals published on the continent of Europe, of a date sufficiently recent to contain notices of this Aurora, have yet reached us. Considering the intensity of the auroral action in England, as observed by Mr. Stanway, we cannot doubt that the phenomenon manifested itself over a great part, if not the whole, of the continent.

General Remarks.

In considering the various accounts, not only of this, but of all great Auroras, we are not the least astonished at their vast extent. There can hardly be a doubt that often, at the same moment, the auroral action is going on in every longitude of our hemisphere; and possibly, at the same time, quite as extensively in the southern hemisphere also. True, there is commonly believed to be some mysterious connection between this phenomenon and the absence of the sun, or, in other words, the night; but to what can this be owing, save to the fact, that, during the day, the light of the Aurora, like that of the stars, is necessarily swallowed up in the overpowering radiance of the sun? On one occasion during the last autumn, the writer, being on Manhattan Island, a little north of New York city, was fully persuaded that a powerful auroral action was going on, between the hours of eleven and twelve, A. M. The sun was, in the mean time, shining, without the slightest cloud to obscure his lustre; but along the north there lay a heavy bank of haze, above which a flickering or wavy light was obvious to the eye for more than half an hour. The same appearance was also noticed by Mr. J. H. Pettingell, of New York, who continued to observe it after the writer's attention was withdrawn. No magnetic needle was at the time accessible; and accordingly it was impossible to verify the truth of the observation, by an appeal to that instrument.

In a paper appended to a Report of the Regents of the University of the State of New York, for 1836, it is stated by Professor Joslin, that, on the day following the great Aurora of Nov. 17, 1835, "there was such a display of auroral clouds as almost to justify us in considering it a proper *Aurora seen in the day-time.*" But if the Aurora be exclusively a nocturnal phenomenon, it is desirable that the fact should be established. This will be one step, at least, toward the development of its causes. By a series of observations, the truth can be ascertained, either positively or negatively; but the needle must, from the nature of the case, be the chief means of bringing it to light.

The agitation of the needle during the existence of an Aurora, unobserved at the time, in consequence of clouds, but subsequently ascertained by observations elsewhere made, has been repeatedly noticed. An extract of a letter from M. Humboldt to M. Arago, contained in the *Comptes Rendus* of the French Academy of Sciences, No. 1, Jan. 1837, cites a statement of M. Gauss, inserted in the *Journal Astronomique de Schumacher*, No. 276, that the disturbance of the needle at Göttingen, on the seventh of February, 1835, was greater than ever before known; and adds that, at the same time, a beautiful Aurora was observed by M. Feld, Professor of Natural Philosophy, at Braunsberg, in Eastern Prussia. It is stated also in the *Comptes Rendus* of April 17, 1837, that, on the sixth of the same month, an Aurora was observed by M. Morren, of the College Royal d'Angers; and that, at Paris, in the mean time, the sky was covered with clouds, but the needle violently disturbed.

It is stated by M. Wartmann, of Geneva, in the *Bibliothèque Universelle* for October, 1836, that "an illustrious philosopher, M. Arago, has often announced in advance, the early appearance of an Aurora Borealis; being apprised of its approach by the extraordinary oscillations of the magnetic needle, which is regularly observed every day at the Royal Observatory of Paris; and that the event has confirmed his prediction on the same day, though frequently the phenomenon has occurred at such a distance as not to be observable at Paris." It would hence appear, that auroral action *has been* detected during the day, by the aid of the needle: and it is quite probable that the light would also have been observed in the absence of the sun.

Although the Aurora undoubtedly manifests itself, on many occasions, contemporaneously in places situated in every direction from the pole, there is no reason to believe that its intensity is, in the same latitude, every where the same at any given moment; nor that its successive *fits* come on, or reach their height, in different longitudes precisely at the same time. There is great reason, however, for the contrary opinion; as is manifest, indeed, from the various accounts which we have condensed in the present article.

Nor does it seem that the disturbing influence of the Aurora upon the magnetic needle is similar in different longitudes. There are three observations, of the four recorded in the extract above cited from Loudon's Magazine, which we are able to compare with corresponding observations made in New Haven. After making ample allowance both ways, for possible errors in time, we are able nevertheless to say with positiveness, that, while the needle in New Haven was deflected to the east; in Brookfield, near Manchester, its disturbance was in the contrary direction; the ordinary variation in both places being westward.

Not only are the causes of the Aurora as yet a sealed book to us, but we have not been able to ascertain, otherwise than conjecturally, the altitude of the illuminated substance above the earth's surface. It is even a question whether this substance is within or beyond the limits of the atmosphere. The question is one which it is exceedingly difficult to settle. To identify positively, particular beams seen from different situations, is not so simple a matter as it may seem. The same beams observed from different points of view, may present very different phases; while their fleeting existence and their mutability while they do exist, the great numbers which, in every striking display, commonly spring up and fade incessantly, and finally, the restlessness with which they are momentarily changing their positions, till at length they vanish, are all circumstances precisely suited to confound all simultaneous observation, and to render it next to impossible to obtain a parallax. These remarks apply to columns seen laterally. If to both the observers, the Aurora is coronal or vertical, the difficulty becomes still greater. Since the corona seems, every where, to settle itself at a point in the heavens in the line of the dipping needle, it follows that every place, during a vertical Aurora, must have its own corona, which can be seen from no other position. Were it not so, the distance of the Aurora might be determined at once; since the corona, if its apparent form were real, would present a most striking object, visible at the same time to a multitude of observers; while the steadiness of its position would afford abundant time for accurate observation.

There is one mode, and, as it seems to the writer, only one, in which the question admits of being settled. It may, after all, lead only to an approximation to the true altitude of the Aurora; still it may unquestionably determine the limit, beyond which the luminous vapor cannot be. This is to institute a series of observations along the same meridian, in order to determine, as accurately as possible, the lowest latitude at which the auroral columns, on a given occasion, reach the zenith. Let an observer, then, situated at any given distance due south, observe the greatest altitude at any time attained by the columns directly north of him, and a parallax may be obtained, by means of which the problem may be solved. For instance, on the occasion we have been considering, a corona was formed at Richmond, Va., and perhaps even farther south. At Culloden, Geo., the greatest altitude observed during the evening, was about equal to that of the pole star. Were these two places on the same meridian, we should be able to say, from knowing their difference of latitude to be 4° 47′ 17″ very nearly, that the height of the Aurora could not be much greater than two hundred geographical miles.

At Society Hill, the greatest observed altitude appears to have been about 40°. A similar calculation founded on this observation, would reduce the extreme height of the Aurora at its summit, to about one hundred and sixty geographical miles. It must be observed, however, that we know not how far south of Richmond the Aurora was vertical. If it extended a single degree farther south, we should infer an altitude of but very little more than one hundred miles.

The result of a calculation similar to the foregoing, made in Europe upon the Aurora of Oct. 18, 1836, by M. Wartmann of Geneva, is stated in the *Comptes Rendus* of April 17, 1837, to give an altitude of two hundred leagues, or about six hundred miles.

Two observers may obtain a parallax of the summit of the highest column observed due north, or of the extreme altitude in that direction of the general mass of illuminated vapor, when the Aurora is vertical to neither. This will give the distance of the Aurora from either observer, and by consequence its perpendicular height at the point where it is vertical. The mode of calculation, it must, after all, be confessed, is far from being so accurate as could be desired.

Mr. Dalton, in his Meteorological Essays, estimates the altitude of the summits of the auroral columns, at about one hundred and fifty English miles. Mr. Dalton's observations were made upon an auroral arch, at right angles to the magnetic equator, and he assumes this arch, and all others similar, without proof, to have an altitude equal to that of the highest extremities of the ordinary columns. Mr. Dalton supposes the auroral columns to be cylindrical, to stand nearly parallel to each other, in the line of the dip, and to have a length about ten times as great as their diameter, and about equal to the height of their bases above the surface of the earth. Allowing the auroral columns to be all of equal dimensions, a concession, however, which we cannot possibly make, Mr. Dalton's conclusions are pretty well sustained by observation, and by mathematical demonstration.

Mairan supposes the mean altitude of the Aurora to be one hundred and seventy-five leagues, or about five hundred miles; while Euler places it more than one thousand miles above the surface of the earth. On the other hand, we have estimates which give it an elevation no greater than that of the ordinary upper clouds, or confine it within the limit of a few miles. Such is that of Mr. Farquharson, of Scotland, who supposes the ordinary elevation of the Aurora to be 2000 feet at the base, and 4000 or 5000 at the summit. Such also is that of Professor Joslin, who supposes an intimate connection to exist between clouds of certain forms, and auroral phenomena. But these seem to find little support in mathematical computation, founded on the observation of parallax.

During the expedition of Capt. Franklin to the polar regions, however, in 1820, contemporaneous observations were made on three Auroras, by Lieutenant Hood and Dr. Richardson, in latitude 64° 2′ 24″, from points eighteen leagues distant from each other; and from the parallactic angles obtained by them, an altitude was deduced of two or two and a quarter leagues—equal to six or seven English miles. It is possible that the height may diminish as we approach the poles.

According to the theory of M. Hansteen, the auroral cloud is an emanation from the earth, which rises directly upward, but becomes luminous only on escaping from the atmosphere, at a height of forty five or fifty miles.

But there have been differences of opinion in regard to the origin of the auroral vapor, as to whether it is terrestrial or celestial. That it partakes of the motion of the earth, in its diurnal revolution, is sufficiently evident. Whether this fact alone will demonstrate it to be a terrestrial emanation, may possibly be disputed; but it is certainly an argument in favor of that belief.

The Aurora has been represented to be attended with rustling or crackling noises. In our latitude we have no very good evidence of the occurrence of these: and, indeed, if the auroral vapor be, in truth situated as far above the earth as our computations as yet compel us to place it, we know not how such audible evidences of its action can reasonably be expected. The case would be somewhat different, if the sounds described were heavy peals or explosions, like the reverberations of thunder. These sounds are represented as being more remarkable, and of more frequent occurrence in the higher latitudes. This circumstance might result from the more violent action of the Aurora, as we approach the poles; but it may, also, be in part, a consequence of the greater proximity of the phenomenon to the earth's surface. M. Mairan, believing the auroral matter to ascend from the earth, and during a coronal Aurora, from the immediate region of the observer, supposes these sounds to be occasioned by its upward passage through the lower regions of the atmosphere.

Thus far, however, the reality of such sounds, in any latitude, is seriously questioned. The Aurora is a phenomenon well suited to terrify the ignorant, and thus predispose them to connect with it a thousand marvels, which have no existence : and it may even so far excite the imaginations of the better informed, as to incapacitate them fairly to judge of the fact; since for the most part, their impressions are previously formed.

The world is, after all, very much in the dark, in regard to all that relates to this wonderful phenomenon. It is perhaps somewhat doubtful, whether, in our day, this darkness is to be enlightened. We certainly live in a remarkable era, as it respects the frequency and the splendor of auroral exhibitions; and the philosophers of the present time will grievously neglect their duty, if they fail to take every possible advantage of the opportunities of observation, which they are so happy as to enjoy.

New Haven, Conn., Feb. 22, 1838.

ART. III.—*On the Variation and Dip of the Magnetic Needle in different parts of the United States;* by ELIAS LOOMIS, Professor of Mathematics and Natural Philosophy in Western Reserve College.

ABOUT three years ago, I formed the design of collecting as far as possible all the observations which had ever been made on the variation of the magnetic needle within the limits of the United States. I was of opinion that such a work would contribute something to the cause of science, and might also be of practical utility to public surveyors, who very generally in this country make use of the magnetic needle in their surveys. The Connecticut Academy of Arts and Sciences, gave me permission to write in their name to gentlemen in different parts of the country requesting information on the subject. A great number of letters were written, and to most of them, answers have been received. The amount of information they embodied was not so great as had been expected. I therefore hesitated about prosecuting my original plan, and this, together with an absence of more than a year from the country, is the reason that those observations have not sooner been made public. Although the article which is here presented is very imperfect, being deficient in the number, and frequently in the accuracy of the observations, still it is thought that its publication may prove useful at least in two respects if in no others. First, some do not seem to regard it as settled beyond dispute, that the magnetic needle has at present a retrograde movement compared with its motion the last century. I trust the observations I have here brought together, may be considered as finally settling this important question. And secondly, it is hoped that this article may remind men of science of the importance of observations of this kind, and of the need there is of multiplying them to a much greater extent than has been hitherto done. And it is hoped moreover that they will not be content with simply making their observations, but that they will see to their publication. Probably many individuals who have taken observations sufficient to determine the magnetic variation in their respective places, have deferred publishing them because they did not regard the observations as of sufficient consequence. But although it is of little importance to the theory of magnetism to be informed of the variation of the needle at one place alone, yet when like observations are collected from every part of the country, their united value is immense. It is hoped then, that whoever has accurate magnetic observations which have not been published, will see that they are recorded in this or some other public journal. Such a record may be made within the space of two or three lines, and if the practice were extensively followed, we should have the materials for laying down with considerable accuracy the lines of equal variation throughout the United States.

The substance of the letters which I have received, may be gathered from the following observations. Mr. John Johnson, Surveyor General for Vermont, thus writes from Burlington: "In the year 1817 I determined the latitude of the source of the St. Croix, 45° 55′ N., and longitude about 67° 55′ W. The variation of the magnetic needle was here 14° W. Proceeding due north to latitude 48° 1′ N. I found the variation 17° 45′ W. In 1818, near Timiscuata Lake, latitude 47° 38′, longitude about 69° W., the variation was 16° 31′. In 1818 at the Matwaska settlement, on the river St. John, latitude 47° 12′, longitude about 68° 10′, the variation was 16° 45′ W.

"At the University of Vermont, in Burlington, near where I reside, lat. 44° 28′, long. about 73° 14′, I found in 1818, the variation 7° 30′ W.; in 1822, 7° 42′ W.; 1830, 8° 10′; 1831, 8° 15′;

1832, 8° 25′; in 1834, 8° 50′ W. The town lines north of Onion river, Vermont, were run from 1784 to 1787 at N. 36° E. About twenty years after, the same lines were N. 35° E., and the last summer I tried and found the same lines N. 37° 50′ E."

Prof. Farrar, of Harvard University, Massachusetts, writes thus: "I endeavored in 1810 to ascertain the variation of the needle in this place as accurately as I could. I made it 7° 30′ W., at 10 o'clock, A. M. I have now (July, 1835) observed the needle with great care almost every day for the last two months. The mean of my ten o'clock observations gives 8° 51′ W."

Prof. Hitchcock of Amherst College, determined the variation of the needle at Deerfield, Mass., in 1811, to be 5° 28′ W.

Mr. George Gillet, Surveyor for the state of Connecticut, determined the variation of the needle at Hebron, Conn., to be in 1805, 4° 50′ W., and in 1835, 6° 10′ W.

Prof. R. M. Patterson of Virginia University, lat. 38° 2′ N., long. 78° 31′ W., states that the needle there, in 1835, had no sensible declination.

Mr. John Bethune, surveyor for the state of Georgia, gives the variation at Milledgeville, lat. 33° 7′ in 1805 at 5° 30′ E., and in 1835 at 4° 40′ E.

Prof. James Hamilton of Nashville University, Tennessee, states the variation at that place to have been 7° 7′ E. in 1835, and adds, "I have lost the record of observations made several times since the year 1827, and have forgotten what the variation has been heretofore. The city surveyor however assures me that in the year 1829 I gave him the variation 6° 50′ E., and that he has it on record."

Mr. James H. Weakly, surveyor for the state of Alabama, writes from Florence: "The variation of the needle is here 6° 28′ E. During the years 1817, 8, 9, it was about 6° 35′ E. About the year 1809, it was 8° 10′ E. at Mobile; at this time it is about 7° 12′ E. During the survey of the Creek Territory in 1832, which lies on the eastern border of the state, it was found in some places in the northern part of the survey 5° 25′ E., and in the southern part about 6° 30′ E."

In addition to the preceding, the Hon. Timothy Pitkin, of Connecticut, has kindly put into my hands a collection of documents containing many very valuable observations. In 1810, a representation on the subject of the variation of the magnetic needle was laid before congress, by Mr. Shaw of Maryland. This representation was referred to the consideration of a committee of the House of Representatives, of which Mr. Pitkin was chairman. The committee deemed the subject of sufficient importance to merit investigation, and accordingly directed circular letters to men of science in different parts of the country, requesting information on the present declination of the magnetic needle. The answers to these circulars embodied considerable information of which the following is a summary.

President Wheelock of Dartmouth College, New Hampshire, states that in 1765, the declination of the needle was at Hanover about 7° W.; at present (1810) 4° 15′ W.

James Whitlaw, a surveyor in Ryegate, Vermont, lat. 44° 10′ N. and long. 72° 10′ W., states the declination at that place in 1801 to have been nearly 7° W.

President Messer of Brown University, Rhode Island, states the variation there in 1769 at 6½° W.; but in 1790 it was, *if the variation compass made use of could be relied on*, only 3° 46′ W. [I have myself italicised the above clause to intimate my conviction that there must have been some error in this observation, or else that the compass did not in both instances occupy the same spot. It is not credible that the needle had changed 2¾° in twenty one years.—E. L.]

Mr. Asher Miller of Middletown, Conn., states the variation at Danbury for 1810, at 5° 41′ W.; at Lyme 4° 30′; Pomfret 5° 5′; Hebron 4° 50′; East Hartford 4° 46′.

President Smith of Princeton College, New Jersey, gives the variation at that place for 1810 at 7° W.

Andrew Ellicott, surveyor of the United States, gives the variation of the needle at various points on the western boundary of Pennsylvania. But as these observations are published in the Memoirs of the American Philosophical Society, they are not here repeated. Mr. Ellicott adds however, " the line of no variation in the United States at present, (1810,) crosses the west boundary of Pennsylvania, about thirty miles south of Lake Erie, and enters that lake near to Presque Isle."

Nicholas King, public surveyor, states the variation at Washington, Dec. 23, 1809, to have been 52′ W.

Bishop Madison of William and Mary's College, Williamsburg, Virginia, lat. 37° 15′, long. 76° 35′, states the variation there to have been 43′ E. 1809. Other observations about the same time made it 23′ E. In 1694, the variation was 5° W. At Norfolk, lat. 36° 51′, long. 76°, he found no variation in 1809. At Richmond, lat. 37° 27′, long. 77° 25′, nearly 57′ E. In 1728, on the boundary between Virginia and North Carolina, lat. 36° 31′, long. 76°, nearly, the variation was settled at 3° W. In 1732, at Cape Henry, lat. 37°, long. 75½°, the variation was 4° 40′ W.

Jonathan Price, of Newbern, N. C., lat. 35° 7′ N., states the variation of the needle to have been there, in 1796, 2° 40′ E.; in 1806, it was less than 2° E., and in 1809, he found it 1° 45′ E.

Jared Mansfield, Surveyor General of the United States, gives the following observations:

"S. E. corner of Western Reserve, lat. 41° N., long. 80° 37′ W.,	variation,	1° 21′ E.
10 miles west on the same parallel of latitude,	"	1 37
20 " " "	"	1 48
33 " " "	"	2 4
43 " " "	"	2 22
57 " " "	"	2 30
123 " " "	"	3 57
In latitude 40° 55′ and longitude 81° 48′,	"	2 36
Marietta, lat. 39° 25′, long. 81° 26′ W.	"	2 36
Detroit, lat. 42° 30′, long. 82° 56′,	"	2 48
Rapids of the Miami, lat. 41° 30′, long. 83° 30′,	"	3 25
Fort Defiance, lat. 41° 15′, long. 84° 23′,	"	4 30
Cincinnati, lat. 39° 7′, long. 84° 27′,	"	5 0
Mouth of Miami River, lat. 39° 8′, long. 84° 45′,	"	5 10
Latitude 38° 45′ N., longitude 85° 15′ W.,	"	5 25
Latitude 38° 10′, longitude 86° 30′,	"	6 30
Near the Falls of the Ohio, lat. 38° 20′ N., long. 85° 40′ W.,	"	5 50
Vincennes, lat. 38° 42′, long. 87° 20′,	"	6 45
11 miles north of the mouth of the Wabash River,	"	7 10
Mouth of the Ohio River, lat. 37° 4′, long. 89° W.,	"	7 20
Cahokia, Ill., lat. 38° 36′, long. 90° 9′,	"	8 25

Nearly all of the foregoing observations have been made within the four or five last years (from 1810.) They go to the establishment of a principle which will be found of considerable use to surveyors, viz. that the quantity of variation easterly in the same parallel, increases gradually and nearly equally in advancing westward at the rate of a degree in about 60 English miles."

Mr. Edward Livingston states that the first observation made in Louisiana by Father Laval, in 1720, determined the variation at New Orleans to be 2° E.; and that by sixty-two observations made by Lason in 1806, who employed in each six different needles, which made 372 observations, he had found a mean of 8° 2′ 39″ East variation.

The following were copied from the returns made to the Treasury department by the public surveyors.

Mouth of the Scioto, - -	variation	5° E.	in 1805.
Augusta, on the Ohio, - -	"	5 E.	1805.
Jeffersonville, - -	"	6 45′ E.	"
Natchez, - - -	"	9 E.	1802.
In Louisiana, lat. 31°, long. 92° 10′ W.,	varia.	9 20 E.	1807.
On the Washita river, lat. 34°, lon. about 92° W.		8 20 E.	*1804.
Amelia Island, lat. 30° 44′, long. 81° 20′ W.		2 W.	1775.
Mouth of St. Croix, lat. 45° 5′, long. 67° 12′,		12 19 W.	1797.
Pensacola, lat. 30° 25′, long. 87° 12′ W.		4 30 E.	1780.
Port Royal, S. C. long. 79° 30′ - -		3 E.	1777.
Charleston, S. C. - - -		3 48 E.	1777.
Nantucket, - - - -		6 30 W.	1776.
Plymouth, - - - -		7 W.	1776.
Boston Harbor, - - - -		7 40 W.	1776.
Penobscot Bay, - - - -		9 W.	

Besides the preceding observations, few of which have ever been published, I have endeavored to collect together all the published observations I could find. In Douglass' History of the British Settlements in America, Vol. I, pages 270–2, is given the variation for several places in the United States; and in Kalm's Travels in North America, Vol. I, page 43, are given some more observations. In Samuel Williams's History of Vermont, 2d edition, 1809, is given a table of all the magnetic observations

* By William Dunbar.

in the Eastern States with which he was acquainted; and in the Memoirs of the American Philosophical Society, as well as in those of the American Academy, various observations are recorded. The substance of all of these is given in the general table which follows.

In the Aurora, a paper published at Philadelphia, July 27, 1813, is a communication from David M'Clure, stating the variation in Philadelphia at that time to be 2° 25′ W. In the same paper for Sept. 12th, is a communication from Thomas Whitney, mathematical instrument maker, stating the following facts. It appears that the variation was here 8° 30′ W. in 1710. In 1793, it was observed by R. Brooks to be 1° 30′ W. In 1804, it was observed by several men of science to be 2° W. An anonymous communication in the same Journal for Sept. 15th, states the variation at Lewis, in Delaware, in 1795, to have been 55′ west.

The following facts I have learned from various sources. Mr. N. Goodwin, surveyor in Hartford, Ct., determined the variation at that place in 1824, to be 5° 45′ W.; in 1828, 6° 3′ W.; and in 1829, 6° 3′ W. He also determined the variation in New Haven for 1828 to be 5° 17′ W.

The variation at Pensacola, Florida, was stated to me in 1835, by an officer of the navy, to be 6° E.

The variation for New York is given at 4° 40′ W. in 1824, on Blunt's map of that year.

The variation at New Haven is also given at 5° 10′ W. in 1811, on a map of that city.

The variation at Montpelier, Vt., in 1829, was 12° 25′ W., as given in Executive Documents, Vol. IV, No. 190, page 23.

Variation at Kaskaskia, Ill., in 1809, 7° 20′ E., according to American State Papers—Public Lands, Vol. II, page 195.

Variation at Alton, Ill., was given me at 8° E. in 1835.

Variation at Athens, Ga., in 1837, 4° 31′ E., as determined by Prof. McCay.

Variation at South Hanover, Indiana, in 1837, 4° 35′ E., as determined by Prof. Dunn.

Variation at West Chester, Pa., in 1832, was 3° 25′ W., as observed by Prof. Bache.

The Annual Report of the Regents of the University of the State of New York for 1837, contains the observations made at eleven different places in the State. These are all to be found in our general table.

Dr. H. H. Sherwood, of New York city, has politely furnished me with several statements of the declination in different parts of the country, which are also incorporated in the table.

Besides the preceding, I have been furnished with various additional observations, by the kind assistance of Mr. E. C. Herrick, of New Haven. Some of these are extracted from "Long's Expedition to the Rocky Mountains," and "Long's Expedition to the Source of St. Peter's River." These are all to be found in our general table, and need not be repeated here. The remaining observations are as follows: Mr. Jedediah Herrick, of Hampden, Penobscot county, Maine, in a letter of April, 1837, says: "Thirty-two years ago, I found the declination at this place, by an ordinary semicircle, 11¼° W., and, during the past month, have made a series of observations with a better instrument and much care. Declination 13° 4′ W. In 1825, at the Forks of the Penobscot, lat. 45° 30′, found the declination 14° 45′ W."

An almanac, by Nathan Wilde, for 1836, published at Keene, N. H., contains the declination of the needle for each year, from 1812 to 1836. The observations were made by Mr. Wilde with a needle two feet long, at Chesterfield, lat. 42° 53′, long. 72° 20′. They are all shown in our table. In June, 1837, the variation at the same place was determined, by Mr. A. C. Twining, to be 8° 5′.

The variation at Barton, Vt., was determined July 8, 1837, in the evening, at 10° 51′ W., by Mr. Twining; and at St. Johnsbury, July 22, 1837, at 11 P. M., 9° 16′ W.

At Burlington, Vt., the variation is stated by Prof. Benedict at 9° 45′, or 9° 50′ W.

The Gazette and Mercury, published at Greenfield, Mass., Dec. 19, 1837, states: "It has recently been determined in Deerfield, Mass., by a number of observations with accurate instruments, that the variation of the needle is at present 7° 57′ W."

At New York city, about three years ago, the variation was 4° 50′ W., as stated by Mr. W. C. Redfield.

Mr. G. C. Schaeffer, of New York city, states that Prof. Renwick, of Columbia College, determined the magnetic variation in the summer of 1837 at Constable's Point, about five miles S. W. of the City Hall, under favorable circumstances, being on a sandy point, far away from local attraction. Variation, 5° 40′ W.

At Philadelphia, Sept. 1837, variation 3° 52′ W., as stated by Mr. Walter R. Johnson.

In the preceding enumeration, I have not included a table of magnetic variations which is given in Vol. xvi, page 63, of this Journal. This table professes to give the variation of the needle at intervals generally of five years, from 1673 to 1800, for Boston, Falmouth, and Penobscot. I have rejected the table, because I am satisfied it is a *calculated* table. This assertion will sound strange to some, for I have more than once been referred to it by men of science, as a repository of exceedingly valuable observations, and they seem never to have suspected that the observations were not genuine. But there is no room for the shadow of a doubt, that those numbers were mostly *calculated*. The evidence is as follows: The table is a very old one, being found in the Almanac for 1771, by Nathaniel Ames. A copy of this almanac is in possession of Mr. William Lyon, of New Haven. There is also in the possession of Mr. Adam Winthrop, of Louisiana, grandson of Prof. Winthrop of Harvard University, a small printed sheet, in the form of a handbill, containing the same table. It is without date, but bears marks of age, and was found among the papers of Prof. Winthrop. It is my opinion that this is the original from which the table in the almanac was copied, and as it is a document to which circumstances have given considerable consequence, I have here transcribed it verbatim. "A table, exhibiting the variation of the compass in Boston and the parts adjacent, from the earliest accounts of it to the end of the 18th century; agreeable to the actual Observations distinguished by Obs. By John Winthrop, Esq., Hollisian Professor of Mathematics at Harvard College, in Cambridge, in New England.

Years.	Variation at Boston.	Falmouth.	Penobscot.
1673	11° 15′	12° 00′	12° 08′
1678	11 0	11 45	11 53
1689	10 30	11 15	11 23
1700	10 0 Obs.	10 45	10 53
1705	9 46	10 31	10 39
1710	9 32	10 17	10 25
1715	9 18	10 3	10 11
1720	9 5	9 50	9 58
1725	8 51	9 36	9 44
1730	8 37	9 22	9 30
1735	8 23	9 8	9 16
1742	8 0 Obs.	8 45	8 53

Years.	Variation at Boston.	Falmouth.	Penobscot.
1745	7° 56′	8° 41′	8° 49′
1750	7 42	8 27	8 35
1757	7 20 Obs.	8 5	8 13
1761	7 7	7 52	8 0 Obs.
1763	7 0 Obs.	7 45 Obs.	7 53
1770	6 46	7 31	7 39
1775	6 32	7 17	7 25
1780	6 18	7 3	7 11
1785	6 4	6 49	6 57
1790	5 50	6 35	6 43
1795	5 36	6 21	6 29
1800	5 22	6 7	6 15"

The table which is given in Ames's Almanac for 1771, is exactly like the preceding, with six exceptions, viz. the variations for Boston are given 9° 45′ for 9° 46′; 8° 57′ for 8° 51′; 6° 45′ for 6° 46′; and 5° 35′ for 5° 36′. In the column for Falmouth is given 10° 12′ for 10° 17′, and in the column for Penobscot 8° 32′ for 8° 35′. I have no doubt that these were typographical errors in the almanac, and that the sheet in the possession of Mr. Adam Winthrop, which was doubtless printed under the eye of Prof. Winthrop, is the correct copy. It is evident that the preceding table was entirely *computed*, with the exception of those numbers marked Obs. For (1.) the table was published before 1771. One quarter of the numbers were then certainly computed. (2.) The variations for Falmouth are constantly 45′ greater than those for Boston, and those for Penobscot 8′ greater than those for Falmouth. To one who has ever made magnetic observations, this will amount to an absolute demonstration that those numbers were never observed. (3.) The observations from 1700 to 1800, with the exception of those marked *Obs.*, all occur at intervals of five years, and the change of declination for this period is constantly 14′ or 15′. The observations of 1742 and 1763, showing a change of one degree in 21 years, or somewhat more than 14′ in five years, doubtless furnished the data for the table. (4.) Penobscot and Falmouth, during the first years contained in the table, were small settlements. Penobscot was little more than a military post, and Falmouth was devastated by the Indians in 1692, and the town entirely broken up. The inhabitants did not return until about 1708. Who then is this indefatigable observer, that, with clock-like regularity, at the expiration of every five years, returns to measure the magnetic variation; and how does his zeal reprove the sluggishness of the scientific institutions in our country, at many of which the variation of the needle has not been even once observed? (5.) The table does not purport to be *a table of observations*, but to be "*agreeable* to the actual observations distinguished by Obs." The numbers marked Obs. were then observed, and the others were computed from them, so that six observations were the foundation of the whole table. The matter appears to me so plain, that it seems useless to argue the question further. The table which is given in volume sixteenth of this Journal, has copied the errors of Ames's almanac, and thus, by introducing a little irregularity into the numbers, has given them more the air of actual observations. The table is still further disguised, by omitting the *Obs.* which marks certain numbers in the original table. If now I have succeeded in showing that this "interesting document," as Mr. De Witt terms it, contains but six actual observations, I shall consider that I have effected no small object; for it certainly is a fact not very creditable to American science, that a table which Prof. Winthrop, nearly three quarters of a century ago, computed for his own amusement, should now be referred to as composed of genuine observations. I have taken the more pains to expose this imposition, (for imposition I think it may be called, although a perfectly honest one on the part of Prof. Winthrop,) because it is necessary to be particularly on our guard against confounding *calculations* with observations, and because in the progress of my investigations, I have met with other tables similar to the preceding one of Prof. Winthrop.

I have now mentioned all the new magnetic observations which I have been able to collect, and have also stated where other published observations are recorded. The results of all these are embraced in the following general table:

Table, exhibiting the Variation of the Magnetic Needle in different parts of the United States, from the first settlement of the country.

Place.	Lat. N.		Lon. W.		Variation.		Date.	Authority.
	°	′	°	′	°	′		
MAINE.								
N. boundary of State,	48	1	67	55	17	45 w.	1818	Mr. John Johnson.
Timiscuata Lake,	47	38	69	0	16	31	1818	" "
Matwaska,	47	12	68	10	16	45	1818	" "
Source of the St. Croix,	45	55	67	55	14	0	1817	" "
Forks of Penobscot,	45	30	68	30	14	45	1825	Mr. J. Herrick.
Mouth of the St. Croix,	45	5	67	12	12	19	1797	Chart.
Hampden,	44	40	68	55	11	15	1805	Mr. J. Herrick.
"	"	"	"	"	13	4	1837	" "
Pownal,	43	51	70	10	8	0	1761	Prof. Winthrop.
Falmouth,	43	39	70	19	7	45	1763	" "
Kittery,	43	6	70	35	7	46	1771	Holland.
NEW HAMPSHIRE.								
Hanover,	43	41	72	10	7	0	1765	Pres. Wheelock.
"	"	"	"	"	4	15	1810	" "
Portsmouth,	43	5	70	45	7	48	1771	Holland.
Chesterfield,	42	53	72	20	6	26	1812	Nathan Wilde.
"	"	"	"	"	6	25	1813	" "
"	"	"	"	"	6	17	1814	" "
"	"	"	"	"	6	7	1815	" "
"	"	"	"	"	6	3	1816	" "
"	"	"	"	"	6	2	1817	" "
"	"	"	"	"	6	0	1818	" "
"	"	"	"	"	6	3	1819	" "
"	"	"	"	"	6	0	1820	" "
"	"	"	"	"	6	7	1821	" "
"	"	"	"	"	6	12	1822	" "
"	"	"	"	"	6	30	1823	" "
"	"	"	"	"	6	40	1824	" "
"	"	"	"	"	6	35	1825	" "
"	"	"	"	"	6	35	1826	" "
"	"	"	"	"	6	45	1827	" "
"	"	"	"	"	6	52	1828	" "
"	"	"	"	"	7	0	1829	" "
"	"	"	"	"	7	6	1830	" "
"	"	"	"	"	7	10	1831	" "
"	"	"	"	"	7	15	1832	" "
"	"	"	"	"	7	30	1833	" "
"	"	"	"	"	7	35	1834	" "
"	"	"	"	"	7	40	1835	" "
"	"	"	"	"	7	45	1836	" "
"	"	"	"	"	8	5	1837	Mr. A. C. Twining.
Hinsdale,	42	46	72	17	6	0	1772	Wright.
VERMONT.								
Barton,	44	44	72	3	10	51	1837	Mr. A. C. Twining.
Burlington,	44	28	73	14	7	38	1793	Dr. Williams.
"	"	"	"	"	7	30	1818	Mr. John Johnson.

Place.	Lat. N. °	′	Lon. W. °	′	Variation. °	′	Date.	Authority.
VERMONT.								
Burlington,	44	28	73	14	7	42 w.	1822	Mr. John Johnson.
"	"	"	"	"	8	10	1830	" "
"	"	"	"	"	8	15	1831	" "
"	"	"	"	"	8	25	1832	" "
"	"	"	"	"	8	50	1834	" "
"	"	"	"	"	9	45	1837	Prof. Benedict.
St. Johnsbury,	44	26	71	55	9	16	1837	Mr. A. C. Twining.
Montpelier,	44	17	72	36	12	25	1829	Executive Doc'ts.
Ryegate,	44	10	72	10	7	0	1801	James Whitlaw.
Rutland,	43	37	72	46	7	3	1789	Dr. Williams.
"	"	"	"	"	6	4	1810	" "
"	"	"	"	"	6	1	1811	" "
Pownal,	42	46	72	59	5	52	1786	" "
MASSACHUSETTS.								
Newburyport,	42	48	70	52	7	18	1781	" "
Williamstown,	42	45	73	15	5	52	1786	" "
Deerfield,	42	34	72	29	5	28	1811	Prof. Hitchcock.
"	"	"	"	"	7	57	1837	Gaz. and Mercury.
Salem,	42	31	70	54	7	2	1781	Pres. Willard.
"	"	"	"	"	5	57	1805	Dr. Bowditch.
"	"	"	"	"	5	20	1808	" "
"	"	"	"	"	6	22	1810	" "
Cambridge,	42	22	71	7	7	30	1810	Prof. Farrar.
"	"	"	"	"	8	51	1835	" "
Boston,	42	21	71	4	9	0	1708	Mr. Brattle.
"	"	"	"	"	8	0	1742	Prof. Winthrop.
"	"	"	"	"	7	20	1757	" "
"	"	"	"	"	7	14	1761	Dr. Williams.
"	"	"	"	"	7	0	1763	Prof. Winthrop.
"	"	"	"	"	6	46	1782	Dr. Williams.
"	"	"	"	"	6	38	1788	" "
Plymouth,	41	57	70	41	7	0	1776	Chart.
Nantucket,	41	17	70	6	6	30	1776	"
RHODE ISLAND.								
Providence,	41	49	71	26	6	30	1769	Dr. West.
Newport,	41	29	71	21	6	0	1776	Chart.
CONNECTICUT.								
Pomfret,	41	52	71	57	5	5	1810	Asher Miller.
East Hartford,	41	46	72	48	4	46	1810	" "
Hartford,	41	46	72	40	5	25	1786	Dr. Williams.
"	"	"	"	"	5	45	1824	N. Goodwin.
"	"	"	"	"	6	3	1828	" "
"	"	"	"	"	6	3	1829	" "
Hebron,	41	38	72	18	4	50	1805	George Gillet.
"	"	"	"	"	6	10	1835	" "
Danbury,	41	22	73	23	5	41	1810	Asher Miller.
Lyme,	41	18	72	17	4	30	1810	" "
New Haven,	41	18	72	58	5	47	1761	Pres. Stiles.
" "	"	"	"	"	5	25	1775	Prof. Strong.

Place.	Lat. N. °	′	Lon. W. °	′	Variation. °	′	Date.	Authority.
CONNECTICUT.								
New Haven,	41	18	72	58	5	15 w.	1780	Pres. Stiles.
" "	"	"	"	"	5	10	1811	Nathan Redfield.
" "	"	"	"	"	4	35	1819	Prof. Fisher.
" "	"	"	"	"	5	17	1828	N. Goodwin.
" "	"	"	"	"	5	52	1835	Prof. Loomis.
" "	"	"	"	"	5	55	1836	Mr. E. C. Herrick.
NEW YORK.								
Potsdam,	44	40	75	1	7	25	1835	Regents' Report.
Utica,	43	6	75	13	4	10	1834	" "
"	"	"	"	"	3	35	1836	" "
Johnstown,	43	0	74	23	6	2	1818	" "
Cazenovia,	42	55	75	51	3	25	1834	" "
Auburn,	42	55	76	28	3	43	1833	" "
Buffalo,	42	53	78	55	1	25	1837	Mr. R. W. Haskins.
Geneva,	42	52	77	5	3	49	1833	Regents' Report.
Albany,	42	39	73	44	5	44	1817	Mr. De Witt.
"	"	"	"	"	5	45	1818	" "
"	"	"	"	"	6	0	1825	" "
"	"	"	"	"	6	40	1834	Regents' Report.
"	"	"	"	"	6	47	1836	" "
Oxford,	42	28	75	33	3	52	1834	" "
"	"	"	"	"	4	9	1836	" "
Ithaca,	42	27	76	30	2	51	1833	" "
Oblong,	42	3	73	30	5	3	1786	Dr. Williams.
West Point,	41	25	73	56	6	32	1835	Prof. C. Davies.
East Hampton,	41	0	72	19	6	8	1834	Regents' Report.
New York City,	40	43	74	1	8	45	1686	Mr. Welles.
" "	"	"	"	"	7	20	1723	Geo. Burnet.
" "	"	"	"	"	6	22	1750	Mr. Alexander.
" "	"	"	"	"	5	0	1755	Evans.
" "	"	"	"	"	4	20	1789	Encyc. Met.
" "	"	"	"	"	4	40	1824	Blunt's Map.
" "	"	"	"	"	4	50	1834	Capt. Owen.
" "	"	"	"	"	5	40	1837	Prof. Renwick.
Jamaica,	40	41	73	56	4	0	1835	Regents' Report.
Flatbush,	40	37	73	58	4	25	1834	" "
"	"	"	"	"	4	45	1835	" "
NEW JERSEY.								
Princeton,	40	22	74	35	7	0	1810	Pres. Smith.
PENNSYLVANIA.								
W. boundary of state,	41	8	80	27		25 E.	1786	Andrew Ellicott.
" "	41	0	"	"		19 E.	"	" "
" "	40	50	"	"		17 E.	"	" "
" "	40	42	"	"		51 E.	"	" "
" "	40	14	"	"	1	7 E.	"	" "
" "	39	59	"	"	1	12 E.	"	" "
" "	39	51	"	"	2	10 E.	"	" "
Norriton,	40	10	75	26	3	8 w.	1770	W. Smith.
Philadelphia,	39	57	75	11	8	30 w.	1710	Thomas Whitney.

Place.	Lat. N. ° ′	Lon. W. ° ′	Variation. ° ′	Date.	Authority.
PENNSYLVANIA.					
Philadelphia,	39 57	75 11	5 45 W.	1750	Kalm's Travels.
"	" "	" "	1 30	1793	Thomas Whitney.
"	" "	" "	2 0	1804	" "
"	" "	" "	2 25	1813	David M'Clure.
"	" "	" "	3 52	1837	Walter R. Johnson.
West Chester,	39 57	75 41	3 25	1832	Prof. Bache.
DELAWARE.					
Lewistown,	38 44	75 0	55	1795	Aurora.
Washington City,	38 53	77 2	52	1809	Nicholas King.
VIRGINIA.					
Charlottesville,	38 2	78 31	0 0	1835	Prof. Patterson.
Richmond,	37 32	77 25	57 E.	1809	Pres. Madison.
Williamsburg,	37 15	76 35	5 0 W.	1694	" "
"	" "	" "	50 W.	1780	" "
"	" "	" "	33 E.	1809	" "
Cape Henry,	37 0	75 30	4 40 W.	1732	Douglass' History.
Norfolk,	36 51	76 19	0 0	1809	Pres. Madison.
S. boundary of state,	36 31	76 0	3 0 W.	1728	Commissioners.
NORTH CAROLINA.					
Newbern,	35 20	77 5	2 40 E.	1796	Jonathan Price.
"	" "	" "	2 0 E.	1806	" "
"	" "	" "	1 45 E.	1809	" "
SOUTH CAROLINA.					
Charleston,	32 47	79 57	3 48 E.	1777	Chart.
"	" "	" "	2 54 E.	1837	Capt. Missroom.
GEORGIA.					
Athens,	34 0	83 20	4 31 E.	1837	Prof. McCay.
Milledgeville,	33 7	83 20	5 30 E.	1805	John Bethune.
"	" "	" "	4 40 E.	1835	" "
FLORIDA.					
Pensacola,	30 28	87 12	6 0 E.	1835	Officer of Navy.
Tallahassee,	30 27	84 36	5 12 E.	1835	Mr. P. Mitchel.
ALABAMA.					
Florence,	34 50	87 47	6 35 E.	1818	James H. Weakly.
"	" "	" "	6 28 E.	1835	" "
Mobile,	30 40	88 11	8 10 E.	1809	" "
"	" "	" "	7 12 E.	1835	" "
MISSISSIPPI.					
Natchez,	31 34	91 25	9 0 E.	1802	Mr. Dunbar.
LOUISIANA.					
Cheneyville,	31 0	92 15	9 20 E.	1807	Public Surveys.
New Orleans,	29 58	90 7	2 0 E.	1720	Laval.
" "	" "	" "	8 3 E.	1806	Lason.
ARKANSAS.					
Wachita River,	34 0	92 0	8 20 E.	1804	Wm. Dunbar.
TENNESSEE.					
Nashville,	36 10	86 49	6 50 E.	1829	Prof. Hamilton.
"	" "	" "	7 7 E.	1835	" "

Place.	Lat. N. °	′	Lon. W. °	′	Variation. °	′	Date.	Authority.
KENTUCKY.								
Augusta,	38	50	83	50	5	0 E.	1805	Public Surveys.
OHIO.								
Rapids of Maumee,	41	30	83	30	2	48	1810	Jared Mansfield.
Hudson,	41	13	81	30	1	14	1837	Prof. Loomis.
Defiance,	41	15	84	23	4	30	1810	Jared Mansfield.
Poland,	41	0	80	37	1	21	"	" "
Canfield,	41	0	80	50	1	37	"	" "
Berlin,	41	0	81	3	1	48	"	" "
Atwater,	41	0	81	21	2	4	"	" "
Suffield,	41	0	81	34	2	22	"	" "
Coventry,	41	0	81	48	2	19	"	" "
Norton,	41	0	81	53	2	30	"	" "
Seneca,	41	0	83	20	3	57	"	" "
Chippeway,	40	55	81	48	2	36	"	" "
Marietta,	39	25	81	26	2	36	"	" "
"	"	"	"	"	1	29	1838	Prof. Loomis.
Mouth of Miami river,	39	8	84	45	5	10	1810	Jared Mansfield.
Cincinnati,	39	7	84	27	5	0	"	" "
Portsmouth,	38	48	82	50	5	0	1805	Public Surveys.
INDIANA.								
Madison,	38	45	85	15	5	25	1810	Jared Mansfield.
South Hanover,	38	45	85	23	4	35	1837	Prof. Dunn.
Vincennes,	38	42	87	20	6	45	1810	Jared Mansfield.
Falls of the Ohio,	38	20	85	40	5	50	"	" "
On the Ohio river,	38	10	86	30	6	30	"	" "
Mouth of the Wabash,	38	0	88	0	7	10	"	" "
ILLINOIS.								
Chicago,	42	0	87	40	6	12	1823	Long's Expedition.
Jacksonville,	39	45	90	18	8	45	1833	Prof. Sturtevant.
Alton,.	38	52	90	12	8	0	1835	Mr. Loomis.
Cahokia,	38	36	90	9	8	25	1810	Jared Mansfield.
Kaskaskia,	37	57	89	55	7	20	1809	Public Surveys.
Mouth of Ohio river,	37	4	89	0	7	20	1809	Jared Mansfield.
MISSOURI.								
Franklin,	38	57	92	57	11	42	1819	Long's Expedition.
St. Louis,	38	36	89	36	10	47	"	" "
"	"	"	"	"	8	49	1835	Col. Nicolls.
MICHIGAN.								
Detroit,	42	30	82	58	2	48	1810	Jared Mansfield.
MISSOURI & WISC. TER'S.								
Lake of the Woods,	49	0	94	0	11	1	1823	Long's Ex. St. Peter's.
Camp Monroe,	48	59			13	17	"	" "
Island in Rainy Lake,	48	35	92	30	8	15	"	" "
N. coast of L. Superior	47	58	90	0	6	21	"	" "
Fort of Colum. Fir Co.	45	39	96	34	12	29	"	" "
Mouth of St. Peter's R.	44	53	93	8	10	29	"	" "
Encamp. on St. Peter's	44	41	97	0	12	21	"	" "
Fort Crawford,	43	3	90	52	8	49	"	" "
Engineer Cantonment,	41	25	95	44	12	59	1819	Long's Exp. Rocky Mts.
Cow Island,	39	25	94	0	11	32	"	" "

From an attentive examination of the preceding table it will be seen, that from the time of the earliest observations down to about the commencement of the present century, the westerly variation was decreasing and the easterly increasing in every part of the United States; that more recently, the reverse has taken place, that is, that a retrograde movement of the needle has commenced. The precise year when this change took place cannot be certainly known. To determine this, we need more numerous and more accurate observations. All the observations, however, agree in this, that the change began as early as 1819, while the Philadelphia observations would make it as early as 1793, and those at Newbern, N. C. not far from the same year. The annual motion is much greater in the eastern states than in the south and west. I have carefully compared all the observations contained in the preceding table, and without giving the particulars of this discussion, will state at once the conclusion at which I have arrived, viz. that *the westerly variation is at present increasing and the easterly diminishing in every part of the United States; that this change commenced between the years* 1793 *and* 1819, *probably not every where simultaneously; and that the present annual change of variation is about* 2′ *in the southern and western states, from* 3′ *to* 4′ *in the middle states, and from* 5′ *to* 7′ *in the New England states.*

Having thus assembled together all the observations in my power, and deduced from them as far as possible the law of the needle's motion, it remained to reduce all the observations to one epoch, 1838, by applying the correction for the annual motion. They were then all carefully marked down upon a map of the United States, and the probable position of the lines of equal variation determined. Where no particular reason has been perceived to distinguish between the observations, the lines have been so drawn as to make the positive equal to the negative errors. This chart then is intended to represent all the observations contained in the preceding table reduced to the present time. In making this comparison some of the observations were found to present strange anomalies. Of these, the most considerable are the observations at Hanover, N. H. for 1810, those at Montpelier, Vt., and at Princeton, N. J. The first of these, according to my chart, is too small by nearly three degrees; and the others too large by nearly four degrees. I infer that either they were very bad observations, or were very much influenced by local attraction. This chart can of course lay claim to no greater accuracy than that to which the individual observations are entitled; yet it has the advantage of presenting to the eye at one view a distinct summary of all the observations, and moreover it shows at a glance the approximate variation at places where observations have never been taken. It is of course desirable that the chart should be verified as extensively as may be, and if it should be the means of stimulating a single individual to undertake a series of accurate magnetic observations, taking care to present them to the public, the labor which this work has cost me will not have been expended altogether in vain.

I had originally contemplated merely a collection of observations on the variation of the needle. In the course of my inquiries, however, I met with a few observations of the dip, and concluded to unite them all in the same article. All which I have been able to collect are contained in the following table. Those made by Professors Bache and Courtenay are from the Transactions of the American Philosophical Society, Vol. V. New Series; those made at Cambridge are from the Memoirs of the American Academy, Vol. I. p. 68; those made by Sir John Franklin, Captains Sabine and Back, are given in the Philosophical Transactions of London; the observation at Charlottesville was communicated in a letter by Prof. Patterson; those in Ohio were received from Prof. Locke, of Cincinnati; and the remainder are from Long's Expedition to the Rocky Mountains in 1819 and 1820, and were furnished me by Mr. Herrick.

Table exhibiting the Dip of the Magnetic Needle in different parts of the United States.

Place.	Lat. N. °	′	Lon. W. °	′	Dip. °	′	Date.	Authority.
MASSACHUSETTS.								
Cambridge,	42	22	71	7	69	51	1780	Mr. Williams.
"	"	"	"	"	69	41	1782	" "
"	"	"	"	"	69	41	1783	" "
Springfield,	42	6	72	36	74	11	1834	Prof. Bache.
RHODE ISLAND.								
Providence,	41	49	71	25	74	3	1834	" "
NEW YORK.								
Albany,	42	39	73	45	74	51	1833	Profs. Henry and Cram.
"	"	"	"	"	74	40	1834	Prof. Bache.
West Point,	41	23	74	1	73	26	1833	Courtenay and Henry.
"	"	"	"	"	73	37	1834	Prof. Courtenay.
New York City,	40	43	74	1	73	5	1822	Capt. Sabine.
"	"	"	"	"	73	27	1825	Sir John Franklin.
"	"	"	"	"	72	49	1834	Capt. Back.
"	"	"	"	"	72	52	1834	Prof. Bache.
PENNSYLVANIA.								
Philadelphia,	39	57	75	12	72	0	1834	Bache and Courtenay.
Pittsburgh,	40	32	80	2	78	12	1819	Long's Expedition.
MARYLAND.								
Baltimore,	39	17	76	38	70	59	1834	Prof. Courtenay.
VIRGINIA.								
Charlottesville,	38	2	78	31	71	9	1834	Prof. Patterson.
OHIO.								
Urbana,	40	3	83	42	71	39	1838	Prof. Locke.
Columbus,	39	55	83	3	71	5	1838	"
Springfield,	39	53	83	47	71	29	1838	"
Dayton,	39	45	84	9	71	23	1838	"
Cincinnati,	39	6	84	27	70	46	1838	"
KENTUCKY.								
Shippingport,	38	15	85	30	70	15	1819	Long's Expedition.
MISSOURI.								
Eng. Cantonment,	41	25	95	44	71	7	1820	" "
Cow Island,	39	25	94	0	69	50	1819	" "
Charaton,	39	10	92	20	69	50	1819	" "
Fort Osage,	39	10	94	18	69	18	1819	" "
Franklin,	38	57	92	57	69	30	1819	" "
St. Charles,	38	46	89	48	70	5	1819	" "
Belle Fontaine,	38	43	89	36	70	0	1819	" "
St. Louis,	38	36	89	36	70	30	1819	" "
Cote sans Dessein,	38	36	91	56	70	50	1819	" "
Merrimack river,	38	26	89	36	70	0	1819	" "

From the preceding observations it seems impossible satisfactorily to determine what changes the dip of the needle has experienced in this country. From the course of the observations made in other places by Prof. Bache, it may be inferred that the dip in 1834 was at Cambridge 73° 33′, being an increase since 1783 of 3° 52′, or about four and a half minutes per year. It may be considered as established, that the dip has increased in this country since the earliest observations, but whether it is still increasing at the present time seems more uncertain. The observations made at Albany and New York may excite a suspicion that such is not the fact. It is hoped that so important a question will not long remain doubtful. From this table of observations I have laid down the lines of equal dip for every five degrees upon the chart as well as I was able. These lines being deduced from a small number of observations, can only be considered as very rough approximations to the truth, and lay no claim to great precision. The observation at Pittsburgh seems utterly irreconcilable with the others. I can only explain the difference by supposing it to be a wretched observation, or else that there was a very remarkable local attraction, or finally, that there is some typographical error. If we read 73° for 78° the observation will agree tolerably well with the others. Few observers in the United States have instruments suitable for determining the dip; yet it is to be hoped that such as are thus furnished will make a faithful use of them, so that we may soon be able to prepare a much more accurate magnetic chart of the United States than the one which is now presented to the public.

Art. IV.—*On the Latitude and Longitude of Yale College Observatory;* by Elias Loomis, Professor of Mathematics and Natural Philosophy in Western Reserve College, Ohio.

In the summer of 1835, being then at New Haven, I undertook a series of observations for determining the latitude and longitude of the College Observatory. The observations were made under many disadvantages, with instruments poorly calculated for the purpose; yet as it is believed that the results are more to be relied upon than those which have hitherto been adopted, they are here summarily presented to the public. I know of no attempt worth mentioning, which had ever been made to determine the latitude or longitude of the College before the year 1811. President Day, at that time made a few observations for the latitude, by means of the declination circle of a portable Equatorial, the mean of which was about 41° 18′; yet as this circle was graduated only to half degrees, and read by means of a vernier to minutes only, and the mean was derived from but twelve observations, this determination might be easily liable to an error of half a minute. President Day, assisted by Professor Kingsley, observed the solar eclipse of Sept. 17, 1811, with great care, and determined therefrom the longitude of the College 4h. 51m. 50s. This was doubtless a very good observation; yet as it was a solitary observation, and moreover the eclipse was not visible in Europe, the longitude deduced might still be erroneous to ten or fifteen seconds of time. There was therefore room to hope, that by additional observations, greater accuracy might be attained; and although the results I here present fall far short of my wishes, still, as I am no longer in a situation to prosecute them further, I have concluded to publish them.

The observations for the latitude were made with a sextant graduated to 10′, and reading by a vernier to 10″. The mean of fifty observations on Polaris made the latitude 41° 19′ 3.9″. The mean of thirty observations on southern stars made it 41° 17′ 51.1″. Mean of northern and southern stars, 41° 18′ 27.5″. Difference of the results from northern and southern stars, 1′ 12.8″. This difference must arise mainly from the error of graduation. I had anticipated such an error from the first, and therefore selected such southern stars as had about the same altitude with the pole-star, in order that all the observations might be made upon the same part of the arc. To test the instrument, I now selected two stars whose places were well known (α Cygni and α Bootis,) and from their right ascensions and declinations computed their angular distance from each other, which distance was very nearly equal to the double altitude of Polaris. I then watched the opportunity when they were both in the same vertical plane, and when, being on opposite sides of the zenith, the whole effect of refraction was to diminish their distance from each other. I made repeated and careful measurements of their distance on two successive evenings, which made the error of the instrument 1′ 11″, being very nearly the difference in the results from the northern and southern stars. This difference was not owing to index error, which had been carefully measured and allowed for, but was certainly an error of the graduation. The instrument was very neatly made, and I was not prepared to find so great an error; yet the sextant had received a blow by which the arc was slightly bent, and although it was subsequently straightened by an experienced workman, it would be by no means strange if the limb were still somewhat distorted. The deduced latitude, however, could not be greatly affected by this error, because the observations were all made upon nearly the same part of the limb, and this part was carefully tested. I take therefore 41° 18′ 28″ as the latitude of the Observatory, and think it improbable that this result should be five seconds in error.

To obtain the longitude, I made several observations of moon culminating stars. They were made with a small transit instrument, the same which is mentioned in Volume xxx. p. 214 of this Journal. As the instrument, from its position, commanded only a low range in altitude, it was impossible to observe the transits of the moon except at particular stages. The observations were for this reason much less numerous than they would otherwise have been. In Volume IX. of the Memoirs of the Royal Astronomical Society, pages 254—256, I find corresponding observations made on some of the nights at Greenwich, Cambridge, and Edinburgh. Each set of corresponding observations has furnished one determination of the longitude, as is shown in the following table:

GREENWICH AND NEW HAVEN.

Date. 1835.	Observed increase of AR of Moon's first limb.		Computed Difference of Meridians.		
	m.	s.	h.	m.	s.
June 7	11	34.77	4	51	33
" 8	12	21.79			45
July 6	12	26.28			28
" 7	13	13.42			43
August 4	13	10.94			44

CAMBRIDGE AND NEW HAVEN.

Date. 1835.	Observed increase of AR of Moon's first limb.		Computed Difference of Meridians.		
	m.	s.	h.	m.	s.
June 7	11	35.37	4	51	49
" 8	12	22.56			64
August 4	13	11.97			67

EDINBURGH AND NEW HAVEN.

Date. 1835.	Observed increase of AR of Moon's first limb.		Computed Difference of Meridians.		
	m.	s.	h.	m.	s.
June 8	11	49.96	4	38	69
July 6	11	53.68			40

The longitude of Cambridge is taken at – 23.54s.; and that of Edinburgh at + 12m. 43.6s.; and the mean of the preceding ten observations gives the longitude of New Haven from Greenwich 4h. 51m. 37.7s. Mean difference, ± 8.4s.

In addition to these observations, on the 9th of August, 1835, two occultations were observed, viz. of τ^1 and τ^2 Aquarii. The immersion of the former occurred at 19h. 13m. 51.5s. sidereal time; that of the latter, at 20h. 57m. 12.5s. I failed to note the emersions with sufficient accuracy to be of any use. To derive any valuable result from these observations, we need to know the true places of the moon and the above stars. From observations made at Greenwich, and published in Vol. IX. of the Memoirs of the Royal Astronomical Society, it appears that 1.11s. should be subtracted from the moon's right ascension, as given in the Nautical Almanac for August 9th. How great may be the error of the moon's declination as given by the tables, I have no satisfactory means of determining. From the observations of Prof. Henderson, however, (Mem. Ast. Soc. Vol. IX. p. 273.) it may be presumed that this error is well nigh insensible. The places of both of the stars are taken as they are given in the Nautical Almanac, and from observations at Greenwich, it appears that the right ascension of the latter at least was very correctly computed. The longitude resulting from the observation of τ^1 Aquarii, is 4h. 52m. 17s., and from τ^2 Aquarii, 4h. 51m. 58s. The first of these differs 39s. from the mean of my former determinations, which would seem to indicate either that the star's place was somewhat different from what it was assumed, or that the observation was a poor one. Finally, the longitude deduced from the eclipse of 1811, according to the computation of Dr. Bowditch, is 4h. 51m. 51s. Bringing then together the results of all the different observations, we have:

June 7, 1835, Greenwich observation, 4h. 51m. 33s. W. long.
" Cambridge " 25 "

June 8,	1835,	Greenwich	observation,	4h. 51m. 45s.	W. long.
"	"	Cambridge	"	40	"
"	"	Edinburgh	"	53	"
July 6,	"	Greenwich	"	28	"
"	"	Edinburgh	"	23	"
July 7,	"	Greenwich	"	43	"
Aug. 4,	"	Greenwich	"	44	"
"	"	Cambridge	"	43	"
Aug. 9,	"	τ^1 Aquarii	"	77	"
"	"	τ^2 Aquarii	"	58	"
Sept. 17,	1811,	Solar eclipse	"	51	"

The mean of these thirteen determinations is 4h. 51m. 43s., and the mean difference is $\pm$ 10.5s. If we reject the observation of τ^1 Aquarii, as I think we must, the mean longitude will be 4h. 51m. 40.5s., and the mean difference, $\pm$ 8.9s.

I think therefore we may assume for the Observatory of Yale College,

North Latitude, 41° 18′ 28″.
West Longitude, 4h. 51m. 40s.

and I believe these values may be regarded as tolerable approximations to the truth.

Art. V.—*Notice of Warwickite, a new mineral species;* by Charles Upham Shepard, M. D., Prof. of Chemistry in the Medical College of the State of South Carolina.

The mineral here announced, is one which has for many years been known to the mineralogists of this country as occurring at Warwick, Orange county, N. Y., where it exists in limited quantity along with brucite and yellow idocrase, imbedded in a highly crystalline white dolomitic limestone. It has passed under the name of hypersthene, on account of the very brilliant copper-red reflections afforded by its cleavage planes. The size of the crystals at the locality first discovered, is in general very diminutive,—they for the most part being quite slender, and only a quarter or half an inch in length. A second depository of the mineral however, was observed by Drs. Young and Horton in the vicinity of the first, in which several forms half an inch in diameter have occurred, although the last discovered crystals are wanting in lustre when compared with those first mentioned, and are moreover in a somewhat decomposing condition. They are associated with large crystals of black spinel, which are also dull from partial disintegration, a change apparently induced from the intermixture of serpentine.

A more close attention to the mineral above mentioned, both as relates to its mineralogical and chemical properties, than I have heretofore been able to bestow upon it, has convinced me that it is fully entitled to constitute a new species, which I designate *Warwickite*, from its original locality.

Mineralogical Description.

Primary form. Oblique rhombic prism. M on M = 93° to 94°.

Secondary form. The primary having its obtuse lateral edges truncated, and its acute ones, beveled. The summits rounded.

Cleavage parallel with the longer diagonal perfect. The cleavage planes thus obtained are finely striated vertically, and exhibit very distinct, oblique cross cleavages. Fracture uneven.

Lustre eminently metallic-pearly, of a copper-red color on the perfect cleavage-faces; in other directions, only vitreous in moderate degrees. Color dark hair-brown to iron-gray. Opake, except in very thin fragments, when it is translucent and transmits a reddish-brown light. Streak dark chocolate-brown. Decomposing crystals are nearly iron-black with a faint tinge of purple.

Brittle. Hardness = 5.5 . . . 6.0. Sp. gr. 3.29.

Chemical Description.

When heated on charcoal before the blowpipe, it does not fuse, but simply assumes a lighter shade of color. With borax, it dissolves with effervescence, affording while hot a yellow semi-opake glass, which on cooling changes to a pale green and becomes clear. It renders carbonate of soda opake, at the same time imparting to it a dull yellow tinge. In microcosmic salt, it melts with effervescence, the globule being blood-red while hot, from which it passes through orange-yellow as it cools, and finally becomes reddish-gray and opake. On being pulverized and heated in a glass tube, it emitted moisture and hydro-fluoric acid. The corrosion of the tube became still more distinct on the addition of a few drops of sulphuric acid.

Its powder is feebly attacked by long digestion in dilute hydro-chloric acid. Heated for half an hour with five times its weight of anhydrous carbonate of soda in a platina crucible, a light brown, cohering, porous mass was obtained, which was treated with dilute hydro-chloric acid and digested for some time; a bulky, heavy brown precipitate remained undissolved, which grew paler however towards the end of the digestion. The whole was thrown upon a filter: an abundant milky substance continued to pass the paper so long as water was on the filter, and which (considered along with the blowpipe indications) was regarded as titanic acid. A portion of the hydro-chloric acid liquor (obtained clear by decantation) was treated with a saturated solution of sulphate of potassa without obtaining any precipitate, even after twenty four hours standing. Another portion was examined for silica, lime, magnesia, and alumina, but without detecting either of them. Iron and manganese appeared to be the only bases present.

As the result of the foregoing examination, therefore, I conclude that Warwickite is a fluo-titaniate of iron and manganese; but I must add that my chemical trial was made upon a sample in a decomposing state, though it was still endued with considerable hardness and a faint lustre. As my cabinet at Charleston embraces a large and fresh crystal, I purpose on my return to that city to occupy myself still farther with the elucidation of its chemical properties.

New Haven, May 22d, 1838.

ART. VI.—*Considerations upon the Nature of the Vegetables that have covered the surface of the Earth, at different epochs of its formation;* read before the Academy of Sciences of Paris, on the 11th September, 1837, by Mons. ADOLPHE BRONGNIART.

Translated from the French, and communicated for this Journal, by R. W. HASKINS,* of Buffalo, New York.

CURIOSITY is one of the most distinctive faculties of the human mind; one of those that most clearly mark the distance between man and the brute creation; and for this reason it may be desig-

* Mr. Haskins prefers an orthography in some cases peculiar, and retains also certain French idioms.—EDS.

nated one of his most noble faculties, whenever directed to any end really worthy of his being.

It is this which continually excites us to extend the field of our knowledge, and to fathom the most hidden mysteries of nature, without being able to hope, for the most part, any other reward than the good which will result to all intelligent beings, in proportion as they are able to form ideas more exact upon the nature of the phenomena which surrounded them. These phenomena appear the more difficult of investigation in proportion as, by their nature and position, they are farther removed from our direct observation; and in like manner we are struck with the results to which profound researches have conducted those men who have made these investigations the object of their studies.

The invention of the telescope, by opening to our view what is passing in the elongated regions of space; and of the microscope, by revealing to us the existence of numberless beings so minute as, but for this instrument, would forever have escaped our observation, have made, upon the human imagination, the most vivid impression.

The sciences have made such rapid advances, within late years, that no one can reasonably expect to open new views and to disclose new truths equally exciting to human curiosity as those disclosed by the telescope and the microscope; but still, the study of the soil upon which we daily tread, has become, within the last half-century, in the hands of Werner, of Cuvier, and the crowd of learned and able men who have assiduously followed these illustrious pioneers, one of the sciences the most fruitful in results, not only of high interest to the professionally learned, but well calculated vividly to interest the imagination of all persons who love to reflect upon the great phenomena of nature.

In investigating the layers which compose the superficial strata of the earth, their order of super-position, their nature, and the animal and vegetable remains which they contain, Geology traces for us the history of the earth during the long periods of time that have preceded its present condition; it makes known to us the beings which have successively inhabited its surface, the revolutions that have conduced to their destruction, and those which have given birth to the mineral layers the earth contains, and the modifications to which this surface itself has been subject by reason of these revolutions; it discloses to us, in short, that all these phenomena, which have necessarily required so many centuries for their accomplishment, were prior, in point of time, to the creation of man. It conducts us alike to appreciate events, and to re-construct beings which have preceded, many thousand years, not only the most ancient historical traditions, but also the very existence of our race.

This prolonged history of the formation of the superficial strata of the earth, is constituted, like the history of nations, of periods of repose, or of tranquility sufficiently great, at least, for the waters and the dry land of the surface to become peopled by a variety of inhabitants; and of periods of revolution, during which resistless forces have agitated this surface, elevating mountains, submerging lands previously dry, and causing ancient beds of oceans to issue from the bosom of the deep; in short, pouring over pre-existing rocks the materials for new layers which, enveloping the ruins of living beings, destroyed by these violent convulsions, have thus preserved their remains as precious monuments which now reveal to us, after so many thousand years, the nature of the ancient inhabitants of our globe, and the order in which the several races of beings have succeeded each other.

The study of the periods of these revolutions, and of those of repose, are alike of the most vivid interest: but the first are entirely the province of the geologist; while the second, on the contrary, necessarily require the light of the zoölogist or the botanist; for these alone are able, by an exact comparison of the fossil remains of former beings with the corresponding parts of such as are now existent, to determine the relations which exist between the inhabitants of the globe, at various and distant epochs. It was thus Cuvier, in his admirable researches upon fossil bones, basing his investigations upon the positive data which comparative anatomy furnishes, was enabled to re-construct the skeletons of the greater part of the animals of which the remains had then been discovered, and also to determine, with the greatest probability, their exteriour forms, and their analogy to those animals with which we are now acquainted.

Botany, notwithstanding it has long furnished fewer documents upon the ancient state of the globe, ought, nevertheless, to be equally laid under contribution, by the geologist; and it is even able to cast more light than zoölogy upon the state of the terrestrial surface, during the most ancient periods of its formation.

Indeed, at that epoch when life first began to be manifested upon our globe, the animals were all confined to the interiour of the waters, and even these presented but diminished specimens of their kinds; while a powerful vegetation, forming vast forests, covered, at that early period, all such parts of the earth as were not submerged by the sea; and each succeeding period of repose has had its own peculiar vegetation, more or less varied, and in greater or less abundance, according to the circumstances which influenced the development of the beings that composed it, and perhaps, also, in proportion to the duration of these periods; but almost always entirely different from those of either the preceding or succeeding epochs.

Of the different associations of vegetables which have successively inhabited our globe, there are none which so pointedly merit our attention as those which seem to have been first developed upon its surface; which appear, during a long space of time, to have covered with dense forests all those parts of the earth that rose above the general level of the waters, and of which the remains of successive growths, heaped one upon another, have formed our layers of coal, so deep, extensive and numerous; and in this form the remains of these primeval forests, which have preceded, by so many centuries, the existence of man, and which now supply us with fuel, in place of our more modern forests, of which the great increase of the human family is causing a rapidly augmented destruction, have become one of the principal sources of the prosperity of nations.

None can doubt that coal owes its origin to accumulated masses of vegetables, changed and modified, as probably the layers of peat in our marshes would be, if they had been overlaid by thick coverings of mineral substances, compressed under the weight of these, and subsequently exposed to an elevated temperature. If farther confirmation of this origin were necessary, it is found in the almost ligneous structure which coal sometimes presents, and in the numerous remains of plants contained in the rocks which accompany it.(1)

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(1) The most complete and valuable collection of plates of impressions of these coal plants which is generally accessible, in this country, will be found in this Journal, Vol. xxix, No. 2. This volume contains Dr. Hildreth's valuable paper upon the coal deposites of the valley of the Ohio, which he has accompanied with some thirty pages of excellent drawings of fossil remains and impressions, mostly vegetable, found in the accompanying rocks.—*Translator.*

But the study of the impressions of stems, leaves, and even fruit, which are in general contained, in so great quantities, in these rocks, proves not only the vegetable origin of this substance, but even enables us to determine the nature of the vegetables of which it has been formed, and which, consequently, at the period of such formation, occupied the surface of the earth.

Among these vegetable imprints, the most frequent are those produced by the leaves of the Ferns ; yet these Ferns of the primitive world are not those which now grow in our climates ; for Europe, at this time, does not produce more than from thirty to forty species, while the same regions then nourished more than two hundred, all much more analogous to those now found between the tropicks than to those of the temperate climates.

In addition to the leaves of Ferns, the same earths contain trunks, the dimensions of which render them comparable to the most gigantick trees of our forests, while their form is wholly dissimilar ; and indeed all the ancient naturalists, struck with this dissimilarity, and yet desiring to find analogous productions still existent, referred them to arborescent vegetables, then imperfectly known, as the Bamboos, Palms, and the great Cactus, sometimes designated *Torch-thistle.* But a more attentive comparison of these products of the equinoctial regions with those trunks, the growth of the ancient world, suffices to dissipate all relations, which are founded only on some resemblances in the general aspect, that have been attempted to be established between them ; and a more profound examination, either of these trunks or of the leaves which accompany them, readily shows that the vegetables which formed these primitive forests are not identical with any trees still found flourishing upon the earth.

The arborescent Ferns which, by the elegance and magnitude of their exteriour, now form one of the principal ornaments of the equatorial regions, are the only arborescent vegetables which are recognized, even in small number, among the trees of this antique vegetation.

As to the other fossil stems, remains of these primitive forests of the ancient world, it is among the most humble vegetables of our epoch that we must seek their analogues.

For instance, the Calamites, which attained from four to five mètres (a little more than 13 to 16 feet) of height, and from one to two décimètres (not quite four to eight inches) of diameter, have almost a complete resemblance, in all the points of their organization, with the Equiseta (Horsetails) which grow so abundantly in the marshy situations of our climates, and of which the stems, hardly as large as the finger, rarely surpass one mètre (about 39⅓ inches) in height. The Calamites, then, were arborescent Equiseta, a form under which these plants have wholly disappeared from the surface of the earth.

The Lepidodendrons, of which the numerous species appear to have mainly constituted the forests of this ancient epoch, and which have probably contributed more than all other vegetables to the formation of coal, differ very little from our Lycopodiæ. We recognize in their trunks essentially the same structure, the same mode of ramification; and in short we see inserted upon their branches leaves and fruits analogous to those of these vegetables. But, while the Lycopodiæ of the present day are small plants, most frequently creeping, and similar to the great mosses, attaining very rarely one mètre (about 39⅓ inches) in height, and covered with very diminutive leaves, the Lepidodendrons, preserving the same form and aspect, elevated themselves to twenty or twenty-five mètres (a little more than 65 to 82 feet,) having, at their base, near one mètre (about 39⅓ inches) of diameter, with leaves which sometimes attained to half a mètre (over 19½ inches) in length. These were, consequently, arborescent Lycopodiæ, comparable, by their stature, to the largest Firs, of which they enjoyed the rank, in this primitive world; forming, as these now do, immense forests, in the shade of which were developed the Ferns, so numerous at that period.

How different this powerful vegetation from that which now clothes, in ever-varying tints, the surface of the earth! Magnitude, strength, and activity of growth, constituted its essential characteristicks; the smallest plants of our epoch were then represented by gigantick forms; and yet, what simplicity of organization, and what uniformity in the midst of a vegetation so enormous!

At the present day, even in those regions where nature has suffered no change at the hand of man, the eye reposes with delight upon trees which are immediately distinguishable by the diversity of their form, and the tints of their foliage; and which often support flowers or fruits of the most dissimilar colours. This variety of aspect is still more strongly illustrated by a contemplation of the diversified shrubs and plants which fringe the borders of our forests, or adorn our meadows, and of which the flowers exhibit to us almost all the tints of the prism. Finally, there result from this diversity of structure, among these plants, many varieties suited to the nourishment of man or of animals; and indeed such as are even indispensable to their existence.

The variety in the organization and aspect of the vegetables which at present cover our globe is indicated by the number of natural groups into which they are capable of being divided. These groups or natural families amount to more than two hundred and fifty, of which about two hundred belong to the class of the Dicotyledons, (which consequently present the greatest variety of structure,) and thirty to that of the Monocotyledons. Now the first of these classes, that is, the two hundred families which they contain, are completely wanting in our primitive flora, and seldom can we there recognize any indications of the Monocotyledons.

The class which constituted, almost alone, the vegetation of this primitive world is that of the vascular Cryptogamia, which at present comprehends no more than five families; almost all of which had parallels in the ancient world; such are the Ferns, Equiseta and Lycopodiæ. These families constitute, thus to speak, the first degree of ligneous vegetation: they present, like the arborescent Dicotyledons or Monocotyledons, trunks more or less developed, of a solid texture, although more simple than those of these trees, and garnished with numerous leaves; but they are deprived of those reproducing organs which constitute the flowers, and they present, in place of fruit, organs much less complicated.

These plants, so simple, so little varied in their organization, and which, by their number and dimensions, rise not above a very inferiour rank, in our present vegetation, constituted, in the dawn of the creation of organized beings, almost the entire vegetable kingdom, and formed forests so immense that we find not their analogy in modern times. The rigidity of the leaves of these vegetables, the absence of fleshy fruits and farinaceous seeds, would have rendered them very unfit to have served as aliment to animals: but terrestrial animals, at the time of their growth, had not yet existence; the seas alone offered numerous inhabitants; and the vegetable kingdom, at that period, maintained undivided sway over all the undeluged portions of the earth; upon which it seems to have been called to play another part, in the economy of Nature.

We cannot doubt, in truth, that the immense mass of carbon accumulated in the bosom of the earth, in a state of coal, and which is the product of the destruction of those vegetables which grew at that ancient epoch, upon the surface of the globe, has been imbibed, by those vegetables, in the carbonick acid of the atmosphere—the only form under which carbon, not derived from the destruction of preëxisting, organized beings, can be absorbed by plants.

Now, a proportion, even very feeble, of carbonick acid, in the atmosphere, is generally an obstacle to the existence of animals, and particularly of the most perfect classes of them, as mammifers, and birds; while, on the contrary, this proportion is highly favourable to the growth of vegetables: and if we admit that there existed a proportion very much greater of this gas in the primitive atmosphere of our globe than the present atmosphere is found to contain, we may consider this one of the principal causes of the powerful vegetation of these ancient epochs.

This collection of vegetables, so simple, so uniform, and which would consequently have been so little fitted to furnish suitable aliment for animals of diversified structure, such as those existing at the present day, in purifying the atmosphere of the carbonick acid which it then contained in excess, would have prepared the conditions necessary to a creation more varied: and if we still wish to indulge that sentiment of pride which has caused man to assume that all in nature has been created exclusively for him, we may suppose this primitive, vegetable creation, which preceded, by so many centuries, the appearance of man upon the earth, was, in the economy of nature, designed to prepare the atmospherick conditions necessary to his existence, and at the same time to accumulate those immense masses of combustibles which his industry was in future time to apply to his necessities.

But, independently of this difference in the nature of the atmosphere, which the formation of these vast depots of fossil carbon renders extremely probable, may not the nature of the vegetables themselves, that have produced them, furnish some data upon the other physical conditions to which the surface of the earth was subjected during this period? The operations of nature now going on in different regions of the globe, may throw some light upon this question.

The study of the geographical distribution of those plants appertaining to the same families which alone composed the vegetation of the coal period, may, indeed, indicate to us the climacterick conditions and consequently the physical causes which favoured the increase of stature as well as the great frequency of these vegetables; and we may conclude from these, with much probability, that the same causes determined their preponderance at that epoch.

We see, for example, that the Ferns, Equiseta, and Lycopodiæ attain a more lofty stature in proportion as their geographical position approaches the equator. Thus it is only in the hottest regions of the globe that we find those arborescent Ferns which combine with the towering and majestick mien of the Palms, the elegant foliage of the ordinary Ferns, and of which we have indicated the existence in the coal formations. In these same regions the Equiseta and Lycopodiæ attain to a stature double or triple that which the largest of these species present in temperate climates. A second condition appears to have a still more marked influence upon their preponderance, in reference to the vegetables of other families, namely, humidity and uniformity of climate; conditions which are united in the highest perfection, in the small islands situated far distant from continents.

In such islands, indeed, the extent of the surrounding oceans fixes a temperature with but slight variations, and coupled with perpetual humidity; circumstances which appear to favour, in a remarkable manner, the development and the variety of specifick forms among the Ferns and the analogous plants; while, on the contrary, under the influence of the same conditions, the phenogamous plants are little varied, and are far less numerous. From these causes it results, that while on the extensive continents of the earth the vascular Cryptogamick plants, such as the Ferns, Lycopodiæ, Equiseta, &c. often form scarcely one fiftieth of the total number of vegetables, yet in the small islands of the equatorial regions, these same plants constitute almost half, and in some cases, even two thirds of all the vegetables which inhabit them.

The archipelagos, situated between the tropicks, such as the islands of the great Pacifick ocean, or the Antilles, are, then, the points of the globe which at the present time present vegetation the most analogous to that which existed upon the earth when the vegetable kindom commenced, for the first time, to develop itself thereon.

Detailed examination of the vegetables which accompany the coal cannot fail, therefore, to induce the inference that at this remote epoch the surface of the earth, in the countries where are found those vast depots of fossil carbon with which we are most familiar, namely, in Europe and North America, offered the same climacterick conditions which now exist in the archipelagos of the equinoctial regions; and probably a geographical configuration little different.

When we consider the number and thickness of the layers which constitute most of the coal formations, and examine the changes that, from first to last, have taken place in the specifick forms of those vegetables of which they have been constituted, we cannot fail to see that this stupendous primitive vegetation, during a long interval, must have covered with its dense forests all parts of the globe which were at that period elevated above the sea; for all these present themselves with the same characteristicks in Europe and America; and equinoctial Asia, as well as New Holland, seem therefore to have participated, in this general uniformity of the structure of vegetables.

Nevertheless, this primitive vegetable existence promptly disappeared, to give place to a new creation, composed of beings of an organization less extraordinary than the preceding, but almost equally different from such as flourish at the present day.

To what cause can we attribute the destruction of all the plants which characterize this remarkable vegetation?

Is it due to some violent revolution of the globe? Did it arise from a gradual change of the physical conditions necessary to their existence; a change in part arising from the presence of these vegetables themselves? These questions cannot be resolved in the present state of our knowledge upon the subject.

Certain it is, however, that the deposition of the last layers of the coal formation was followed by the destruction of all the species which constituted this primitive vegetation, and particularly of those gigantick trees of peculiar structure, as the Lycopodiaceæ, the Ferns and the Equiseta of gigantick growth; which was an essential characteristick of this primitive creation.(2)

After the destruction of this primitive vegetation, the vegetable kingdom appears for a long period not to have attained the same degree of development. Indeed, in the numerous layers of secondary earths which succeed the coal formations we scarcely ever find those masses of vegetable imprints, a species of natural herbariums, which, in these ancient depots of carbon attest to us the simultaneous existence of a prodigious number of plants. Scarcely in any part of these formations do we meet with thick layers of fossil combustibles; and never are such layers often repeated, or found of such great extent as in the coal deposits. Either the vegetable kingdom at this period occupied more circumscribed portions of the surface of the earth, or its scattered individuals covered but incompletely a soil of little fertility, and of which the revolutions of the globe had not permitted them to become tranquil possessors; or, finally, the condition of the surface of the earth was not favourable to the preservation of the vegetables which then inhabited it.

Yet that long period which separated the coal from the tertiary formations, a period that was the theatre of so many physical revolutions of the globe, and which witnessed the appearance, in the waters of the deep, of gigantick reptiles, types of the fantastical organizations in which we may suppose we often recognize those monsters born of the imaginations of the poets of antiquity; this period, I say, is remarkable in the history of the vegetable kingdom, by the preponderance of two families which are lost, so to speak, in the midst of the immense variety of vegetables with which the surface of the earth is covered, at the present day, but which then predominated over all the others, by their number and their magnitude. These are the *Coniferæ*, of which the Fir, Pine, Yew and Cypress furnish well known examples; and the *Cycadeæ*, vegetables wholly exotick, less numerous at the present day than at this ancient period, and which joined to the leaves and mien of the Palms, the essential structure of the

(2) We find, it is true, in some parts of the secondary formations, a small number of arborescent Ferns and of the gigantick Equiseta, but yet of a stature much less considerable than those of the coal formations; nor do we discover, there, any trace of the arborescent Lycopodiaceæ analogous to the Lepidodendrons.—*Author's note.*

Coniferæ. The existence of these two families, during this period, is of high importance as signalizing an intimate relation between them, by their organization; and they form the intermediate link between the vascular Cryptogamia, which composed, almost alone, the primitive vegetation of the coal period, and the phanerogamick Dicotyledons, strictly speaking, which constituted a majority of the vegetable kingdom, during the tertiary period.

Thus, to the vascular Cryptogamia, the first degree of ligneous vegetation, succeeded the Coniferæ and the Cycadeæ, which held a rank more elevated in the vegetable scale; and to these last succeeded the dicotyledonous plants, which occupy the summit of that scale.

In the vegetable kingdom, as in the animal, there has been, then, a gradual improvement in the organization of the beings which have successively existed upon our earth, from the first which appeared upon its surface even to those that inhabit it at the present day.

The tertiary period, during which were deposited those earths that now form the soil of the principal capitals of Europe, as London, Paris, and Vienna, witnessed transformations, in the organick world, greater than any of those which had taken place since the destruction of the primitive vegetation.

In the animal kingdom: the creation of mammifers,(3) a class which all naturalists concur in placing at the summit of the animal scale, and by which nature seems to have preluded the creation of man; in the vegetable kingdom, the creation of the Dicotyledons, a grand division which, by unanimous consent, botanists have always placed at the head of this kingdom, and which, by the variety of its forms and organization, by the magnitude of its leaves and the beauty of its flowers and its fruits, must, of necessity, have imprinted upon vegetation an aspect very different from that which it had offered through all previous periods.

This class of Dicotyledons, of which we are scarcely able to cite any indications at the close of the secondary, presented itself,

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(3) In placing the first appearance of mammifers at the epoch of the tertiary formation, I do not include the fact, unequalled elsewhere, of the fossil mammifers of Stonesfield; a case which forms an exception to all former experience, and which cannot be detailed in so limited an essay.—*Author's note.*

For drawings and brief descriptions of these fossils, which occurred in *oolite*, see Lyell's Geology, American edition, Vol. I. pp. 154–5.—*Translator.*

all at once, during the tertiary period, with preponderating influence. It then, as at the present day, held dominion over other classes of the vegetable kingdom, both in reference to the number and variety of the species, as well as the magnitude of the individuals. Thus the assemblage of vegetables which inhabited our climates during the deposition of the tertiary formation, which enveloped their ruins in its sedimentary layers, were intimately allied to the mass of our present vegetation, and more particularly to the flora of the temperate regions of Europe and America. The soil of these countries was covered then, as at present, with Pines, Firs, Culms, Poplars, Birches, Elms, Walnuts, Maples, and other trees almost identical with those which still flourish in our climates.

And yet, not only do we not recognize any indications of those singular vegetables which characterized the primitive forests of the coal period, but we rarely encounter, there, even fragments of plants analogous to those which now vegetate between the tropicks.

We do not, however, necessarily infer that the same vegetable forms have been perpetuated from this epoch, still very ancient, (since it preceded the existence of man,) to the present day. No: very sensible differences almost always distinguish these inhabitants of our globe, very recent, geologically, but exceedingly ancient, chronologically, from our cotemporaneous vegetables to which they seem most nearly allied; and the existence in these same earths, in the north of France, of Palms, very different from those which still vegetate upon the borders of the Mediterranean, and of a small number of other plants which appertain to families now limited to the more torrid regions, seem to indicate that at this epoch central Europe enjoyed a temperature more elevated than at present; which, besides, accords very well with what we may deduce from the presence, in the same formations, and the same countries, of Elephants, Rhinoceroses and Hippopotami, animals which are now rarely found to range beyond the tropicks.

What an astonishing contrast between the aspect of nature during modern geological periods, and that which she offered when the primitive vegetation covered the surface of the globe!

Indeed, at the periods in question of the geological history of the world, the earth had already assumed, in great part, at least, the form which it presents at the present day; continents very extended, and mountains greatly elevated, fixed and determined varied climates, and thus favoured diversity of beings. In this way, in countries of little extent, the vegetable kingdom offered us plants equally as diversified, one from another, as those found growing at the present day.

To the Coniferæ, with their narrow durable leaves of sombre green, were joined Birches, Poplars, Walnuts, and Maples, with broad leaves of a more lively tint; and in the shade of these trees, on the borders of waters or upon their surface flourished herbaceous plants, analogous to those which at present embellish our fields by the diversity of their forms and colours, and the variety of which renders them suitable to satisfy the different tastes of an infinity of animals, of all classes.

The forests of the ancient world, like those of our epoch, served, indeed, as a refuge for a vast number of animals, more or less analogous to those which still inhabit our globe. Thus Elephants, Rhinoceroses, Wild Boars, Bears, Lions, and Stags of all forms and of all statures, have successively inhabited them; while birds, reptiles, and numerous insects, complete this map of nature, as she presented herself, upon such parts of the earth as were elevated above the level of the oceans; the whole forming a scene equally beautiful and equally varied as that which is still witnessed upon the emerged portions of our globe.

On the contrary, at the dawn of the creation of organized beings, the terrestrial surface, divided, without doubt, into an infinity of islands, low, and with a climate almost uniform, was, it is true, covered with immense vegetables; but these trees, differing little from each other in their aspect, and the tint of their foliage; deprived of flowers and of those fruits with brilliant colours which so highly adorn many of our large trees, must have imprinted, upon that vegetation, a monotony not interrupted even by those small herbaceous plants that, by the elegance of their flowers, constitute the ornament of our groves.

Add to this that neither mammifer, or bird, nor any animal, in short, was present to enliven these dense forests, and we may be able to form a very just idea of this primitive nature; sombre, cheerless and silent, but at the same time so imposing by its grandeur, and by the space which it has been called to fill in the history of the globe.

Such, gentlemen, is a rude outline of the great revolutions of terrestrial vegetation, as the researches made upon this subject, within the last thirty years, have enabled us to trace them. Each day will doubtless add new traits to these details; but recent discoveries, by confirming the results at which we had previously arrived, seem to assure us that this general delineation will not experience great changes when, thanks to the materials that are being collected on all sides for this object, we shall be enabled to transform this rough draught into a picture more finished and complete.

ART. VII.—*Notice of a second locality of Topaz in Connecticut, and of the Phenakite in Massachusetts;* by CHARLES UPHAM SHEPARD, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

AMONG specimens which I obtained at the China-stone quarry in Middletown two years since, I find one to be invested with above fifty crystals of Topaz. They measure from $\frac{1}{8}$ to $\frac{1}{3}$ of an inch in length, are very slender, and perfectly transparent, being attached by a lateral plane to crystals of albite. Owing to their minuteness, it is difficult to distinguish, except in one or two instances, the leading planes of the forms. In one crystal, I detect the truncation of the obtuse lateral edges, the truncation and bevelment of the acute lateral edges, and the replacement of the acute solid angles by faces inclining to the last mentioned truncating planes under angles of about 153°. In addition to which modifications of the primary form, there are also visible the replacement of the terminal edges by two planes and that of the edges intermediate between these and the angular truncations, by single planes. The future exploration of the quarry will probably lead to the discovery of more perfect crystals of the present species than have hitherto been found in the United States.

The Phenakite, it will be recollected, was first recognized as a distinct species by NORDENSKIOLD, in 1833,—the specimens having been derived from the vicinity of Katherinenberg, upon the eastern slope of the Ural mountains, where it occurs in granitic rock along with emerald and mica. The resemblance of the mineral is said to be very striking to quartz; like that species, it being derived from the rhomboid, in addition to which also, it has the lustre, transparency, and color of quartz. In chemical composition however, it is more nearly related to the beryl, being a bisilicate of glucina.

My first knowledge of the American mineral which I take to be Phenakite, was acquired about fourteen years ago, during a visit to the tourmaline locality in Goshen, (on the farm of Mr. Weeks,) in company with Mr. Nuttall and the late Dr. Hunt of Northampton. My first impression was, that it belonged to iolite,* an opinion I afterwards changed in favor of the species beryl,† under which name, I believe, it has generally passed in cabinets ever since.‡ Prof. Hitchcock, in his Report on the Geological survey of Massachusetts, (p. 506, 1st edit.,) undoubtedly refers to the same substance, when he says, "Beryls are frequently met with in our granite, though in general they are not very delicate. Perhaps the most so is a limpid, large beryl, occurring in Goshen, along with spodumene, &c. It is rare to find it distinctly crystallized, and it is full of fissures. Sometimes it is of a light rose color. (Nos. 1525 to 1528.)" Nor can there be the slightest question that the "rose-colored emerald" alluded to by Col. Gibbs,§ as furnished him from Goshen, pertains to the species under consideration.

It occurs in considerable plenty, distributed through the granite in small crystalline masses, from the size of a pea to a hazel-nut, generally oval in form, and rarely in short hexagonal prisms, some of which present one face or more of the primary rhomboid, in the absence of their alternate angles. Other masses are rounded, and offer occasionally a few roughened faces, which probably pertain to the primary or to a secondary rhomboid. The prevailing color is a pale bluish white, though sometimes a faint rose-colored tinge is observable, especially in the well-formed hexagonal prisms. Lustre vitreous; transparent to translucent only on the edges. When perfectly transparent, it is a very handsome gem, much resembling the euclase, and like that mineral, is filled with fissures, and very fragile, though wanting in its brilliant cleavage. Hardness = 7.5, being barely adequate to scratch quartz.

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* Boston Journal, vol. 13, p. 395. † Idem, p. 607.

‡ It should be remarked moreover, that it was referred by some collectors for a time, to topaz.

§ Vol. I, p. 351 of this Journal.

It is scratched by beryl. Sp. gr.=2.80...2.97—varying in different specimens, chiefly on account of slight intermixtures of grains of quartz, or albite.

Before the blowpipe, in very thin fragments, it phosphoresces, turns white, and fuses with difficulty into a milk white, semi-blebby globule. With borax, it forms a transparent glass; and with the microcosmic salt, fuses into an opaque, white globule. Thirty-three centigrammes, in the condition of an impalpable powder, after heating for fifteen minutes in a platina crucible, lost 0.75 centigramme. It was then mingled with three times its weight of anhydrous carbonate of soda, and ignited for one hour. The mixture shrunk into a somewhat firm, white, porous mass. It was crushed in a mortar and treated with hydrochloric acid. A perfect solution was thereby obtained, with the exception of certain flocculi of silica. The silica was separated and ignited: it weighed 18 centigrammes, or 55.81 p. c. The solution from which the silica had been separated, was precipitated with ammonia. This clear supernatant fluid was tested for lime and magnesia without detecting either of those earths. The precipitate, while moist, was largely treated with a solution of carbonate of ammonia, by which it was almost wholly taken up after a period 18 hours,—frequent agitation having been employed to favor the solution. The undissolved residuum, which was trifling in quantity, compared with the portion taken up, was dissolved in hydrochloric acid, and to it were added sulphuric acid and potassa. No crystals of alum were formed; from whence it was concluded that the undissolved matter was chiefly glucina. Had not other engagements intervened, it would have been easy to have completed the analysis on the portion of mineral first pulverized; but sufficient information has perhaps been gained, to afford a probable corroboration of the opinion originally made up from its natural properties.

I suspect the existence of Phenakite also at Paris, in Maine, where I obtained many years ago, small, white, hexagonal prisms in granite, associated with tourmaline; and which I then supposed to be beryl. I regret that my collection in this city does not furnish me with the means of putting this conjecture to the test.

New Haven, May 29, 1838.

Art. VIII.—*Chemical Analysis of Meteoric Iron, from Claiborne, Clarke Co., Alabama;* by Charles T. Jackson.

Aug. 5, 1834.—Mr. F. Alger handed me this remarkable mineral, which he had received from Mr. Hubbard, who had obtained the specimen during his travels in Alabama, and thought, from the bright streaks in it, that it might be an ore of silver.

On examining this substance, it soon appeared that it was different from any metallic ore of terrestrial origin, and that it is a very peculiar and remarkable meteorite.

Having surmised its probable origin, I was desirous of seeing the gentleman who brought it from Alabama, and at the request of Mr. Alger, Mr. Hubbard called upon me and gave me the following particulars as to its locality.

He found the specimen on the surface of the earth, near Lime Creek, in Claiborne, Alabama. The soil at that place is composed of red marl, or clay, and the rocks in place are sandstones, mostly of a gray color. The mass from which my specimen was broken, was of an irregular triangular shape, rounded at the corners, and was 10 inches long by 5 or 6 inches in thickness. It was extremely heavy, insomuch that he could not conveniently carry with him the whole mass, and therefore employed a negro to break it with a sledge-hammer; which operation proving too difficult for him, Mr. Hubbard took the sledge himself, and with the cutting edge, by many hard blows, he ultimately succeeded in detaching the portion in my possession. It is much to be regretted that he did not bring with him the whole mass, and I desired him to send for the remainder, but have not yet heard from him. He is of opinion, that there are many other similar masses near the spot where this was found; but it is not probable that they abound to the extent imagined. I beg leave, however, to call the attention of travellers to the locality mentioned, where the remainder of the specimen still exists neglected.

Description of the Specimen.—It is of an irregular form, rounded upon all the sides excepting on that where it was fractured, which presents a rough hackly surface, with projecting, bright, silvery streaks, and deep greenish and brown eroded surfaces, from which an exudation of green liquid takes place, on exposing the specimen to moist air.

The rounded surface is coated with a thin layer of the *sub-chloride of iron*, which being removed, the mass is found to consist of *metallic matter*, resembling wrought iron, when the specimen is filed bright. On attempting to break off a fragment, the mass was found to be extremely tough and malleable, so as to require the aid of a file and cutting-chisel.

Sp. gr. on three separate fragments from different parts of the mass, 5.750, 6.400 and 6.500. The whole mass weighs 28 ounces avoirdupois.

Having washed the specimen in distilled water several times, I filed one side of it bright, and left it exposed to the air in my cabinet. In a few days, numerous grass-green drops of liquid began to collect on its surface, and became externally coated with a thin brown film. This liquid had a slight alkaline astringent taste, but gave no alkaline reaction with tumeric paper or Brazil wood solution. A few drops collected in a test tube and diluted with water, gave an *abundant thick curdy white precipitate*, with a solution of *nitrate of silver*, showing the presence of chlorine in combination. *Ferro-cyanate of potash* gave a *blue precipitate*, indicative of iron, and *ammonia* gave a precipitate of the *hydrated peroxide of iron*. Muriate of ammonia having been added to a little more of the exudation, the peroxide of iron was precipitated by ammonia, and the remaining liquid was of a pale blue color, indicative of nickel, and on addition of pure potash, hydrate of nickel formed in a bulky green precipitate.

Thus the green drops in question were proved to be composed of the hydro-chlorates of nickel and iron, and they doubtless form from the action of the moisture of the atmosphere upon the metallic chlorides contained in the meteorite.

Analysis of the mass.—Several fragments of the specimen having been cut off by means of a steel chisel and hammer, their specific gravities were ascertained, and they were then subjected to analysis.

Specimen 1. A fragment weighing 25 grains, sp. gr.=5.750, being placed in a green glass flask, and pure nitric acid poured upon it, no action took place until heat was applied, when a violent effervescence, with extrication of nitrous acid fumes, began, and the solution was rapidly and entirely effected. The solution was then treated with a sufficient quantity of the solution of muriate of ammonia, to prevent the precipitation of the nickel, and then the peroxide of iron was thrown down by means of liquid ammonia. When the precipitate had subsided, the whole was thrown on a filter, and the peroxide of iron was thoroughly washed, dried, ignited in platina capsule, and weighed = 23.5 grs. peroxide of iron = 16.296 grs. metallic iron.

The solution, which had passed the filter, was of a clear blue color, with a slight amethystine tint, indicative of nickel. This solution and the mingled washings were evaporated in a glass vessel to a small bulk, and then treated, while warm, with a hot solution of pure potash, when a dense bulky green precipitate of the hydrate of nickel was thrown down, which being collected on a filter, washed, thoroughly dried and ignited in a platina crucible, weighed 8.8 grains = oxide of nickel = 6.927 grains metallic nickel.

Analysis—2d specimen. A fragment of the meteorite, weighing 50 grains, was found to have a sp. gr. = 6.500.

It was placed in a green glass flask,—perfectly pure nitric acid was poured upon it, and heat was gradually applied until the solution was completed. It was then diluted with pure distilled water, and a solution of nitrate of silver was added, when an abundant curdy white precipitate of chloride of silver took place. When the operation was complete, I filtered the solution, collected the washed chloride of silver, and dried and fused it in a small porcelain capsule. It weighed = 3 grains = chloride of silver = 0.74 gr. chlorine, or 0.76 hydro-chloric acid.

The solution was then cleared of nitrate of silver, by means of hydro-chloric acid, and filtered. Then muriate of ammonia being added, the peroxide of iron was precipitated by pure ammonia, and after washing, drying, and ignition, weighed = 48 grains = 33.28 grs. metallic iron.

The oxide of nickel was precipitated by means of a solution of pure potash, and when collected, washed, dried, and ignited, weighed 15.8 grains oxide of nickel = 31.6 per cent. = 24.708 per cent. metallic nickel. After the separation of the metallic oxides, the solution was treated by means of a solution of acetate of barytes, and a white precipitate of sulphate of barytes was formed, which weighed, after washing and drying, = 27 grains = 2 grs. sulphur.

The presence of chrome and of manganese having been indicated, I took a separate portion of the meteorite, weighing 10 grains, dissolved it in hydro-chloric acid, adding sufficient tartaric acid to retain the oxides in solution, neutralized the acid by ammonia, and precipitated the iron and nickel, by means of a current of hydro-sulphuric acid gas; after filtration, I evaporated the solution to dryness and burned off the tartaric acid in a small platina capsule under the muffle, when a small quantity of chromic acid was obtained, which was recognized by its characters before the blowpipe; its amount was estimated at 3 per cent. The manganese is also estimated.

From the above analyses, it will appear that specimen 1st of the meteoric iron, having a sp. gr. of 5.750, contains in 25 grains,

Metallic iron, - -	16.296 = 65.184 per cent.
" nickel, - -	6.927 = 27.708 " "

And in specimen 2nd, having a sp. gr. of 6.500 in 50 grains we have

		or in 100 grains.
Metallic iron, - - -	33.280	66.560
" nickel, - - -	12.354	24.708
" chrome and manganese,	1.625	3.240
" sulphur, - - -	2.000	4.000
" chlorine, - - -	.740	1.480
	49.999	99.988

It will be remarked, that this meteorite contains an unusual proportion of nickel, and that the occurrence of chlorine, in matter of celestial origin, is here noticed for the first time.

I beg leave therefore, to invite chemists to a careful review of meteorites, since the occurrence of chlorine may have been overlooked in former analyses.

Its occurrence in meteoric matters, is a fact of great importance, in accounting for their chemical phenomena, while passing through our atmosphere.

It must also be remembered, that chloride of iron is readily volatilized at a high temperature, *and that it is abundantly exhaled from the craters of volcanoes*, in various parts of our planet.

Nickel, however, has not to my knowledge been discovered amid volcanic sublimations, but it may be worth while to call the attention of chemists to the subject, that it may be sought for in volcanic craters.

I am however far from believing that we shall be able to prove that all meteorites originate from volcanic sublimations, for there are very evident reasons for believing that our planet, statedly in its course, passes amid numerous detached masses of matter or asteroids, which regularly meet the earth in its orbit on the 13th of November; at least such are the views of Prof. Olmsted, of Arago and Gay Lussac, whose opinions appear to be supported by the facts which they have collected.

Allowing that meteoric matters are projected from cometary masses, which statedly cross the earth's orbit, coming within the limits of its attraction, and are subjected to the oxidizing influence of the atmosphere, so as to take fire and fall in burning masses upon the surface of the earth, we can more readily account for the phenomena exhibited in their splendid coruscations, when we know that the meteors contain ingredients possessing remarkable decomposing powers, if brought into contact with water or aqueous vapor, and such are the effects of the chlorides of iron and nickel.

In several instances on record, we find the meteor first discovering itself, bursting into fire, from the midst of a dark cloud, and throwing off brilliant coruscations of light, and ejecting ignited masses which fall to the earth; while the globe of fire, from which they were thrown off, traverses the heavens, and gradually becomes extinct. May not therefore the moisture of the atmosphere have first kindled the meteor in its passage through the humid clouds? I do not know whether they are generally too distant from the earth to come in contact with clouds, but from the rapidity of these apparent meteors they cannot be very distant, at the moment of their conflagration. Should chlorine prove to be a common or constant ingredient, I suppose, that we should have a ready solution of the phenomena involved in the problem.

With respect to the specimen, which forms the subject of the present communication, if we consider its chemical composition, we are forced to regard it of celestial origin; for we have no similar natural alloy in this world, and it contains elements, which are generally found in meteoric matters, besides the new ingredient which I have discovered as one of its components. It is clearly impossible that this mass should have been factitious; for in all manufactured iron, we can readily detect carbon, which does not exist in our specimen, and the situation in which it was found, is presumptive evidence that it was not manufactured, and the rocks around, not belonging to the class bearing metallic ores, it is impossible for it to have been derived from them, and it could not have been derived from the distant rocks by diluvial transportation, for no such ores exist in any of our mines.

Had it been an ore of iron, reduced by a blast of lightning, we should not have found it alloyed with nickel.

We are therefore led to conclude, that our specimen is of celestial origin, and that it is a fragment of one of those asteroids of cometary matter, which wandering in space, occasionally cross our orbit, and being attracted by the earth, so that they rush through our atmosphere, bursting into fire and descending, take up their abode on this sublunary sphere.

Boston, May 29th, 1838.

ART. IX.—*Table of Greek Correlatives, accompanied with explanations;* by JOSIAH W. GIBBS, A. M., Professor of Sacred Literature in Yale College.

THE name *Correlatives* is given to certain pronouns, pronominal adjectives, and pronominal particles, which have a reciprocal relation and correspondence to each other both in their forms and in their significations.

The name *pronoun*, (from Lat. pronomen, *for a noun;* comp. Gr. ἀντωνυμία,) which has come down from the ancient Latin and Greek grammarians, denotes a word used instead of a noun or name, to prevent its too frequent repetition. Although this appellation does not indicate the true nature of this part of speech, and seems to imply an error as to its origin; yet it is sufficiently accurate for practical purposes, inasmuch as the pronoun is now actually used where otherwise we should employ a noun or name. Whether we use the term *pronoun* or *substitute*, (scil. for a noun,) which some have proposed, is a point of minor importance.

But the name *demonstrative*, which modern writers on general grammar have adopted, is more descriptive of the true nature of this part of speech, which consists in *demonstrating* or pointing out, as it were, with the finger, the object, instead of naming it, as is done by the noun. It is probably more ancient than the noun, as is shown by its appearance in most languages, and therefore not strictly used instead of the noun. It differs from a noun in merely demonstrating, and not naming or describing a thing. It is, therefore, altogether impersonal and unreal, being permanently attached to no person, thing, quantity, quality, but completely abstract or vacillating.

The class of words with which we are now concerned, are therefore all demonstratives, in the general sense, inasmuch as they do not name any person, thing, quantity, quality, time, or place, but only *demonstrate* or point to it, as has been just explained.

	I. Determ.	II. Demonst.	III. Interr.	IV. Indef.	V. Obj. Neg.	VI. Subj. Neg.	VII. Simp. Rel.	VIII. Comp. Rel.	IX. Univ.
1. **Pure Pronoun,**	ἵς or ἴς, ἵς or ἴς, ἵ or ἴ,	ὁ, ἡ, τό,	τίς, τίς, τί,	τὶς, τὶς, τὶ,	οὔτις, οὔτις, οὔτι,	μήτις, μήτις, μήτι,	ὅς, ἥ, ὅ,	ὅστις, ὅτις, ἥτις, ὅτις, ὅ, τι, ὅ, τι,	ὅς ἄν, ὅστις ἄν. ἥ ἄν, ἥτις ἄν. ὅ ἄν, ὅ, τι ἄν.
2. **Adj. of Preference,**	ἕτερος,	———	πότερος, κότερος, Ion.	ποτερός,	οὐδέτερος,	μηδέτερος,	———	ὁπότερος, ὁκότερος, Ion.	ὁποτεροσοῦν.
3. **Adj. of Quantity,**	ἴσος,	τόσος, τοσοῦτος,	πόσος, κόσος,	ποσός,	———	———	ὅσος,	ὁπόσος, ὁκόσος,	ὅσος ἄν, ὁποσοσοῦν.
4. **Adj. of Quality,**	ἷος,	τοῖος, τοιοῦτος,	ποῖος, κοῖος,	ποιός,	οὐδείς,	μηδείς,	οἷος,	ὁποῖος, ὁκοῖος,	οἱοσοῦν, ὁποιοσοῦν.
5. **Adj. of Country,**	———	———	ποδαπός,	———	———	———	———	ὁποδαπός,	———
6. **Adj. of Size or Age,**	———	τηλίκος, τηλικοῦτος,	πηλίκος,	πηλικός,	———	———	ἡλίκος,	ὁπηλίκος,	ὁπηλικοσοῦν.
7. **Conjunction,**	ἵνα,	τό,	τί,	τὶ,	οὔτι,	μήτι,	ὅ,	ὅτι,	ὁτιοῦν.
8. **Adv. of Place** ***whence,***	ἔνθεν, ἐντεῦθεν,	τόθεν,	πόθεν, κόθεν,	ποθέν, κοθέν,	———	μήποθεν,	ὅθεν,	ὁπόθεν,	ὁποθενοῦν.
9. **Adv. of Place** ***where,***	ἔνθα, ἐνταῦθα,	τόθι,	ποῦ, πόθι, κοῦ,	που, ποθί, κου,	οὔποθι,	μήπου,	οὗ, ὅθι,	ὅπου, ὁπόθι,	ὁπουοῦν.
10. **Adv. of Place** ***whither,***	ἐνθάδε, ἐνταυθοῖ,	———	ποῖ, πόσε, κοῖ,	ποι, κοι,	———	———	οἷ,	ὅποι, ὁπόσε,	———
11. **Adv. of Place** ***through which,***	ᾗ, εἰ,	τῇ,	πῇ, πᾶ, κῇ,	πη, πα, κη,	οὔπη, οὐδέπη,	———	ᾗ,	ὅπη, ὅπα,	ὁπηοῦν.
12. **Adv. of Time,**	ἔτι, ἰδέ, ἠδέ,	τότε, τόκα,	πότε, πόκα, κότε,	ποτέ, ποκά, κοτέ,	οὔποτε, οὔποκα, οὐδέποτε,	μήποτε, μηδέποτε,	ὅτε, ὅκα,	ὁπότε,	ὁποτεοῦν, or ὁποτοῦν.
13. **Adv. of Specific Time,**	———	τηνίκα, τηνικαῦτα,	πηνίκα,	———	———	———	ἡνίκα,	ὁπηνίκα,	———
14. **Adv. of Manner,**	———	τώς, ὥς,	πῶς, κῶς,	πως, πω, κως, κω,	οὔπως, ω, οὐδέπω,	μήπως, ω, μηδέπω,	ὡς,	ὅπως, ὅκως,	ὁπωσοῦν.
15. **Adv. of Number,**	ἰσάκις,	τοσάκις, τοσαυτάκις,	ποσάκις, κοσάκις,	ποσακίς,	———	———	ὁσάκις,	ὁποσάκις,	ὁποσακισοῦν.

Each word in this table, it will readily be seen, consists of two parts; viz. the correlative element, which it has in common with other words in the same column, and the modifying element, which it has in common with other words in the same row or series. The tabular mode of exhibition which we have adopted, suggests a natural mode of discussing these words; which is, first, to treat of the correlative element in each column, and then to treat of the modifying element in each series. These elements, moreover, are to be considered severally, both as to their logical import, and as to their grammatical form. By this regular but thorough process, we hope to condense much into a little space, and to arrive at important general principles.

The I. column is incomplete, but very important and interesting, as exhibiting venerable reliques of an ancient and nearly obsolete pronoun. It contains *determinatives*, by which we intend weak or unemphatic demonstratives, like Eng. *he*, *she*, *it*, or Lat. *is*, *ea*, *id*. As the correlative import and form is often obscured, it may be useful to consider each member of this column separately.—1. The existence of a very rare pronominal root ἱ or ἰ, in the sense of Eng. *he*, *she*, *it*, or Lat. *is*, *ea*, *id*, is now admitted by the best Grecists, as Buttmann, (Ausf. Sprachlehre, B. II. p. 413.) and Passow, (Handwörterb. s. v.) Its existence is also confirmed by the analogy of the Sanscrit and other Indo-European dialects, as we shall hereafter see. But it is uncertain, whether the vowel of this root should have the rough breathing, ἱ, which accords best with the pronoun of the third person, οὗ, οἷ, ἕ, or the smooth breathing, ἰ, which accords best with some of the derivatives, as ἴσος, ἴος, etc. and with its form in cognate languages. The form of the pure pronoun was probably ἵς, ἱ, or ἴς, ἰ, like τίς, τί.*—2. The form ἕτερος, *other*, (as if *more* or *other than he*,) without doubt belongs here, although the *i* is lost in *e* (=*ai*;) comp. Sansc. *i-taras*, another, Lat. *i-terum*, again.—3. ἴσος, *like*, *equal*, (as if *so great*,) which we sometimes find as a correlative to ὡς, see Acts 11 : 17.—4. ἴος, *one*, (as if *of this kind*, *such*,) a form occurring in Homer for the numeral εἷς. The numeral for one, in most of the Indo-European languages, is of pronominal origin; as Sansc. *êka*, one, compounded of the demonstrative *ê* and the interrogative *ka;* Zend. *aêva*, one, connected with Sanscrit pronominal adverb *êva*, only; Goth. *ains*, Germ. *ein*, Eng. *one*, Gr. ἕν, Old Lat. *oinos*, Lat. *unus*, all derived from Sansc. *êna*, this.—5. No form extant.—6. No form extant.—7.

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* Max. Schmidt, (Comment. de Pronom. Graeco et Latino, p. 15.) endeavors to distinguish between ἱ demonstrative and relative, and ἰ the third personal pronoun, but I think without success.

ἵνα, primarily i. q. Gr. *ὅτι* or Lat. *quod*, and correctly derived by Passow from the old personal pronoun ἵς, ἵ.—8. Here *i* is lost in *e* (=*ai;*) comp. Sansc. *i-tas*, thence; Lat. *i-nde*, thence.—9. Here *i* is lost in *e* (=*ai ;*) comp. Sansc. *i-ha*, here; Zend. *i-dha*, here; Lat. *i-bi*, there.—10. Here *i* is lost in *e* (=*ai ;*) comp. ἔνθα.—11. The form ἤ, *either, or*, (as if *in this way, in that way*,) probably for ᾗ with subscript Iota, an obsolete dative from the pronominal root ἵ. The form εἰ *if*, (as if *in this way, under these circumstances*,) probably with form of the dative, from the same pronominal root. The vowel *i* in both forms is lost in *e* (=*ai.*) For examples of the derivation of the conditional conjunction from pronouns; comp. Sansc. *yadi*, if, from *yas*, who; *it*, if, neuter of the pronoun *i;* Goth. *ith*, if, for *ita*, neuter of the pronoun *is;* Germ. *wenn*, if, from *wer*, who.—12. The forms ἔτι, *yet*, ἰδέ and ἠδέ, *and*, (comp. Sansc. *i-ti*, also,) we place here, although with some hesitation.—13. No form extant.—14. No form extant.—15. The form ἰσάκις from ἴσος needs no illustration.—It ought here to be observed that ἔνθεν, ἔνθα, and probably the other forms in the 8th, 9th, and 10th series, are capable of the relative signification; comp. Germ. *der* and Eng. *that*, which are both demonstratives and relatives, the ground of which is worthy of further investigation.

Rem. 1. The lengthened forms, as ἐντεῦθεν, (Ion. ἐνθεῦτεν,) ἐνταῦθα, (Ion. ἐνθαῦτα,) ἐνταυθοῖ, (Ion. ἐνθαυτοῖ,) are more emphatic than the others.

Rem. 2. Some of the forms in this column are strengthened or rendered emphatic by the addition of δέ; as ἐνθένδε, ἐνθάδε. Add also ἐντευθενί, ἐνθαδί, ἐνθαυθί.

The II. column is not quite complete. It is, however, regular, beautiful, and worthy of admiration. It consists of *proper demonstratives*, an important and interesting class of words. They have sometimes been called *redditives*, as answering or responding to the interrogatives. But this name is inappropriate, as it would seem to imply an origin posterior to that of the interrogatives. The correlative element is expressed throughout by τ, a sound which is justly believed to have a natural appropriateness to perform this office. Hence it is found with remarkable uniformity in different families of the Indo-European stock of languages, as we shall hereafter see. The irregularity in the masculine and feminine forms of the pure pronoun is only apparent, for the form of the oblique cases, τοῦ, τῆς, τοῦ; τῷ, τῇ, τῷ, etc. plainly show that the nominative was originally τό, τή, τό.—It ought here to be observed in respect to the pure pronoun, that it is sometimes used as a relative, (comp. the remark on ἔνθεν and ἔνθα above;) and, in the genitive and dative singular, also as an interrogative and indefinite; and that although its primary sense is that of a demonstrative, yet it is generally weakened into that of a mere article.—The forms *τόθεν* and *τόθι* are also used as relatives.—*ὥς*, although placed in this column, is from *ὅς, ἥ, ὅ,* used as a demonstrative. Comp. Rem. 6. below.

Rem. 3. The lengthened forms, as *τοσοῦτος, τοιοῦτος, τηλικοῦτος, τηνικαῦτα, τοσαυτάκις,* are more emphatic than the others.

Rem. 4. Many of the forms in this column are also strengthened or rendered emphatic, by the addition of *δέ;* as *ὅδε, τοσόσδε, τοιόσδε, τηλικόσδε, τηνικάδε.* Add also *τοιοσδί, τοιουτοσί, τηλικουτοσί.*

The III. column is complete. It consists of *interrogatives*, which are a very peculiar class of words. An interrogative sentence is not a full or complete proposition in itself, but is an imperfect proposition or assertion, which is offered to another to complete or fill up. The interrogative element in Greek has three forms; viz. initial *τ*, which is found alone in the first and seventh series, initial *κ* and *π*, which are found together in each of the other series, and probably once existed also in the first and seventh series. Of these forms we shall treat separately.—(1.) The oldest of them is *κ*, which is retained in the Ionic dialect, and is found abundantly in the other Indo-European languages. This letter is justly supposed to have a natural appropriateness to perform the function of an interrogative. Hence we are not to regard this column as formed from the second column, but as having a coetaneous origin with it. It differs from it not by inflection or derivation; but, if I may so speak, by correlation. A leading letter of one organ is exchanged for a leading letter of another organ, each having its own natural significancy.—(2.) A second form is initial *π*, which seems to have usurped the place of *κ* in all the Greek dialects except the Ionic. As this form has arisen, not by the commutation of one letter for another of the same organ, but by the commutation of a letter of one organ for the corresponding letter of another organ, it seems to require some illustration and confirmation. The following are examples of the interchange of *k* and *p:* Sansc. *ap*, Lat. *aqua*, water; Sansc. *pangtsha*, Arab. *khams*, Æol. *πέμπε*, Lat. *quinque*, Welsh *pump*, Ir. *kuig*, five; Gr. *ἕπομαι*, Lat. *sequor;* Gr. *ἧπαρ*, Lat. *jecur;* Gr. *λείπω*, Lat. *linquo;* Gr. *ἵππος*, Lat. *equus;* Gr. *πέπω*, Lat. *coquo;* Gr. *πέτορα* for *τέσσαρα*, Lat. *quatuor;* Gr. *λύκος*, Lat. *lupus;* Gr. *σηκός*, Lat. *sepes;* Gr. *σκῦλα*, Lat. *spolia;* Gr. *σφηκάς*, Lat. *vespas;* Oscan *pitpit*, Lat. *quidquid;* Ir. *keann*, Welsh *pen*, the head. There can be no doubt that there is a physiological ground for this change, in the similar state of the organs of speech.—(3.) A third form is initial *τ*, in the first and seventh series, which seem to be formed from the first column by correlation. That *κ* was even here the original form seems to be shown by the analogous

Latin form, *quis*, *quis*, *quid*.—It ought here to be observed, in regard to the interrogatives generally, that they are sometimes employed in the indirect inquiry. Thus 1. τίς, Acts 21 : 33. 2. πότερος, Hom. Il. V. 85. John 7 : 17. 3. πόσος, Acts 21 : 20. 4. ποῖος, John 12 : 33. 6. πηλίκος, Gal. 6 : 11. 7. τί, Mat. 21 : 16. 8. πόθεν, Luke 13 : 25. 9. ποῦ, Mat. 2 : 4. 12. πότε, Mark 13 : 33. 14. πῶς, Mat. 6 : 28. This use of the interrogative makes a sort of transition or approximation to the relative, but must be carefully distinguished from it.

The IV. column, which is nearly complete, consists of *indefinites*, a class of words more easy to apprehend by usage, than to describe by definition. They are said to denote an object, in a general manner, without expressly indicating a particular individual. The Greek indefinites have three shades of meaning, which in other languages are distinguished from each other. Thus 1. τὶς is either (1.) an universal indefinite, i. q. Lat. *quisquam*, Eng. *any one ;* 1 Cor. 6 : 1. Rom. 5 : 7 init. (2.) a particular indefinite, i. q. Lat. *aliquis*, Eng. *some one ;* Acts 3 : 5. Rom. 5 : 7. fin. or (3.) a particular indefinite, so described, although definitely known, i. q. Lat. *quidam*, Eng. *a certain one ;* Luke 8 : 27, 49. 12. ποτέ signifies either (1.) *at any time*, Lat. *unquam*, Eph. 5 : 29. Heb. 1 : 5, 13. (2.) *at some time*, Lat. *aliquando*, Luke 22 : 32. or (3.) *at a certain time*, Lat. *quondam*, Eph. 2 : 13.—The form of the Greek indefinites agrees with that of the interrogatives in every respect, except that the interrogatives have the accent nearer to the beginning of the word, and the indefinites nearer to the end.

The V. and VI. columns consist of *negatives*, which are formed directly from the indefinites in their first and leading import. The V. column is formed by οὐ, (Sansc. *vi*, *vahis*,) to express objective or absolute negation, and the VI. column is formed by μή, (Sansc. *ma*,) to express subjective or conditional negation. I am not aware that this distinction exists in any other language.

Rem. 5. There are other forms compounded of μή interrogative, which must not be confounded with these made up of μή negative; as μήτις, John 4 : 33. μήποτε, John 7 : 26.

The VII. column consists of *relatives*, a class of words which perform a very important office in connecting discourse. As they serve to subjoin one sentence to another which is previous, they have by some writers been properly called *subjunctives*. The relative element in Greek consists of an aspiration or rough breathing, which I regard as a softening of the hard palatal in the interrogative class. In some other languages, as the Latin and the Teutonic, the interrogative and relative agree substantially in form, the principal difference being in the accent or intonation. That the interrogative is prior to the relative, in the order of nature, is shown by the use of the interrogative in the indirect inquiry and as the indefinite, which make, as it were, the transition to the relative. It is also shown by the origin of the compound relative.—The relative pronoun has been explained by some as equivalent to a personal pronoun preceded by a copulative conjunction, and the Lat. *qui* (*quis*) has even been derived from *καί* and *ὁ*, or *que* and *is*. But the philosophical explanation is inadequate, as the sentence introduced by the personal pronoun and copulative conjunction, is co-ordinate, while that introduced by the relative pronoun is subordinate, and the derivation has been better explained above.

Rem. 6. The simple relatives are sometimes employed as demonstratives. Thus ὅς, 2 Cor. 2 : 16.

The VIII. column, which is complete, contains what are called *compound relatives*. They are formed, I apprehend, by prefixing ὁ or ὅς to interrogatives or indefinites of the later formations; as ὅστις or ὅτις from τίς, ὁπότερος from πότερος; sometimes to those of the earliest formation; as ὅκως from κῶς. In use they appear not to differ from the simple relatives; except ὅστις, which often has the force of an universal.

Rem. 7. The π, and τ, of this column, are sometimes doubled for the sake of increasing the quantity of the preceding syllable.

The IX. column contains *universals*, which are formed from the simple and compound relatives by certain syllabic adjections; as (1.) ἄν or ἐάν, *perhaps*, *by chance*; (2.) γέ, *indeed*, *at least*; (3.) δή, *now*, *then*; (4.) δήποτε, *now at any time*; (5.) δηποτοῦν, *now at any time indeed*; (6.) κέ or κέν, i. q. ἄν; (7.) οὖν, *then*; (8.) οὖν δή, *then indeed*; (9.) πέρ, *ever*: (10.) ποτέ, *ever*, *at any time*; (11.) τισοῦν, *any one then*.

Thus ὅς is strengthened or rendered an universal, by ἄν or ἐάν, δήποτε, κέ, πέρ.—ὅστις by ἄν or ἐάν, γέ, δή, δήποτε, δηποτοῦν, οὖν, πέρ, ποτέ.—ὁπότερος by οὖν, δήποτε; (comp. Lat. *uter*, strengthened by *vis*, *libet*, *cunque*, or by repeating *uter*.)—ὅσος is strengthened by ἄν, δή, δήποτε, πέρ.—ὁπόσος by δήποτε, οὖν, τισοῦν.—οἷος by δήποτε, οὖν.—ὁποῖος by δή, δήποτε, δηποτοῦν, οὖν, οὖν δή.—ὁπηλίκος by οὖν.—ὅτι by οὖν.—ὁπόθεν by οὖν.—ὅπου by οὖν.—ὅπῃ by οὖν.—ὁπότε by οὖν.—ὅπως by οὖν.—ὁποσάκις by οὖν.

The 1st series or row contains *pure pronouns*, as distinguished from the other series, in which the pronominal idea is mixed with something foreign. They are formed from the pronominal root by the simple addition of the sign of case. For the sake of completeness, we distinguish in the table the three genders of the nominative.

The 2d series contains *adjectives of preference*, which combine the pronominal idea with that of number. They are a sort of comparative degree made from the pure pronoun, by adding τερος, (comp. Sansc. *taras*, Zend. *tara*, Pers. *ter*, Lat. *terus*, Slav. *toryi*, Lithuan. *tras*.) Such formations are found in other Indo-European languages; as Sansc. *kataras*, Lat. *uter*, *neuter*, *alter*, *ceterus;* Slav. *kotoryi;* Lithuan. *katras*, Goth. *hwathar*, Old Germ. *huedar*, Eng. *whether*. Comp. also other similar forms in Greek; as ἀμφότερος, *both;* ἑκάτερος, *each of two, either*.

Rem. 8. It ought here to be observed, that just as the first series gives rise to the other series by immediate derivation, so this series in like manner has a variety of derivatives, which are analogous to those of the first series, and form a kind of triple compounds. Thus are derived I. from ἕτερος, ἑτεροῖος, *of another kind;* ἑτέρωθεν, *from the other side;* ἑτέρωθε, *on the other side;* ἑτέρωσε, *to the other side;* ἑτέρᾳ and ἑτέρηφι, *in another way;* ἑτέρως, *otherwise*, (whence ἑτεροίως, *in another manner;*) ἑτεράκις, *at another time;* III. from πότερος, πότερον, *whether?* ποτέρωθι, *on which of the two sides?* ποτέρωσε, *to which of the two sides?* ποτέρως, *in which of two manners?* V. from οὐδέτερος, οὐδετέρωθεν, *from neither side;* οὐδετέρωσε, *to neither side;* οὐδετέρως, *in neither manner;* VI. from μηδέτερος, μηδετέρωθεν, *from neither side;* μηδετέρωσε, *on neither side;* μηδέτερως, *in neither manner;* VIII. from ὁπότερος, ὁποτέρωθεν or ὁποτέρωθε, *from which side;* ὁποτέρωθι, *on which side;* ὁποτέρωσε, *to which side;* ὁποτέρως, *in which of two ways;* IX. from ὁποτεροσοῦν, ὁποτερωθενοῦν, *from whichever side*. The number of forms is in this way greatly augmented.

The 3d series contains *adjectives of quantity*. They appear to be formed by a reduplication of the pure pronoun; thus ὅσος from ὅς. Comp. Lat. *quisquis*, where the repetition denotes universality; and some cases in Hebrew, where the repetition denotes distribution.—ἴσος in the I. column has nearly lost its original import, and denotes *equal, like*.—The other columns have the following shades of meaning; (1.) concrete quantity, or magnitude; (2.) discrete quantity, or number; (3.) time; (4.) intensity; (5.) more metaphorical significations.

Rem. 9. From πόσος of the III. column are derived πόστος, *of what number?* ποσταῖος, *of what day?* from ὁπόσος of the VIII. column, ὁπόστος, *of what number;* ὁποσταῖος, *of what day;* from ὁποσοσοῦν of the IX. column, ὁποστοσοῦν, *of whatsoever number;* thus helping, as it were, to form new series of triple compounds.

Rem. 10. The σ of this series is sometimes repeated for the sake of increasing the quantity of the preceding syllable.

The 4th series contains *adjectives of quality.* They are formed from the Ionic genitive of the pure pronoun; thus *τοῖος* from *τοῖο*, *οἷος* from *οἷο*. Comp. *ἐμός* from *ἐμοῦ*, *δημόσιος* from *δήμου*, anciently *δημοσιο;* Lat. *meus* from *mei; cujus, cuja, cujum,* from *cujus*, genitive of *qui.*—*ἴος* in the I. column has nearly lost its original import, and signifies *one.*—I insert *οὐδείς* in V. column and *μηδείς* in VI. column, on account of their relation to *ἴος* in the I. column, but I do it with hesitation.—The other columns have two shades of meaning, (1.) simple quality; (2.) quality with distinction.

Rem. 11. From *τοῖος* of the I. column is derived *τοίως*, *in such a manner;* from *τοιοῦτος* of the I. column, *τοιούτως*, *in such a manner;* from *κοῖος* of the III. column, *κοίῃ*, *in what kind of way?* a sort of triple compounds.

Rem. 12. This series might be extended by adding *ἀλλοῖος*, *of another kind.*

The 5th series, which is incomplete, contains *adjectives of country.* They are formed from the pure pronoun, perhaps in the genitive, by postfixing the preposition *ἀπό*, and inserting *δ* to prevent the hiatus; thus *ποδαπός* for *που(δ)απο(ς)*; *ὁποδαπός* for *ὁπου(δ)απο(ς)*; comp. *ἀλλοδαπός*, *from another country; ἡμεδαπός*, *from our country; παντοδαπός*, *from every country; τηλεδαπός*, *from a far country*, *ὑμεδαπός*, *from your country;* also *ἐχθοδοπός*, *from a hostile conntry.*

The 6th series contains *adjectives of size* or *age.* They are formed from the pure pronoun by means of *λικ*, (=Goth. *leiks*, Eng. *like.*)

The 7th series is a regular formation, which is deserving of attention. The technical distinctions of grammarians have separated the different members of this series in such a way, that their analogy has not always been perceived. I have called them *conjunctions;* but they are in fact *a sort of article* prefixed to sentences, as the common article is prefixed to nouns. They are the neuters singular or plural of the corresponding pure pronoun in the first series. The following are examples of their use; I. *ἵνα*, as, *συμφέρει ὑμῖν, ἵνα ἐγὼ ἀπέλθω*, *it is expedient for you, that I go away,* John 16: 7. (2.) *τό;* as, *εἰσῆλθε δὲ διαλογισμὸς ἐν αὐτοῖς, τὸ, τίς ἂν εἴη μείζων αὐτῶν*, *now there arose a contention among them, (to wit,) this, which of them should be greatest,* Luke 9: 46. VIII. *ὅτι;* as, *αὕτη δέ ἐστιν ἡ κρίσις, ὅτι τὸ φῶς ἐλήλυθεν εἰς τὸν κόσμον*, *and this is the condemnation, that light has come into the world,* John 3: 19.

The 8th series contains *adverbs of the place whence.* They terminate in *θεν*, (=Sansc. *tas*, Lat. *tus*, Slav. *du;*) comp. *ἄλλοθεν, ἄνωθεν, κάτωθεν, οὐρανόθεν.*

Rem. 13. The form *ἔνθεν* is used also of time and causality or condition.

The 9th series contains *adverbs of the place where.* It has two formations; one that of the genitive case, as ποῦ; the other that in θι, (=Sansc. *d'i*,) as πόθι; comp. ἄλλοθι, οὐρανόθι.

Rem. 14. The form ἔνθα is used also of time.

The 10th series contains *adverbs of the place whither.* It has two formations; one an ancient dative, as ποῖ; the other in δε or σε, as ἐνθάδε, πόσε; comp. ἄλλοσε, οὐρανόνδε.

The 11th series contains *adverbs of the place by* or *through which.* They are all datives feminine singular from the pure pronoun, used as the instrumental, ὁδῷ being understood. They should be written with subscript Iota, wherever the primitive is in use. This same case may denote the place *where* or *whither*. Comp. Lat. *eâ*, scil. *viâ*; *quâ*, scil. *viâ*.

The 12th series contains *adverbs of the time when.* All of them (excepting column I.) are accusatives neuter singular, with the syllabic adjection τε. Comp. τόφρα, (compounded of τό and φρα;) ὄφρα, (for ὅφρα, compounded of ὅ and φρα;) Lat. *tum*, (=Gr. τόν;) *tunc*, (analogous to *hunc*;) *quum*, (as if accus. from *quis*;) *dum*; *nunc*, (analogous to *tunc*;) *num*, (in *etiamnum*;) Goth. *than*, (whence Eng. *then*,) accus. sing. masc. for *thana*.

Rem. 15. τότε and ὅτε, with μέν and δέ, are accented thus, τοτέ and ὁτέ, and have the same signification as ποτέ indefinite.

Rem. 16. τόκα, πόκα, ποκά, οὔποκα, ὅκα, are Doric forms.

Rem. 17. The τ or κ is sometimes doubled; as, ὅττε, ὅκκα.

Rem. 18. This series easily slides into the sense of condition, circumstances, or cause.

The 13th series contains *adverbs of the time* or *hour of the day.* They are probably derived from lengthened forms, as τῆνος, πῆνος, etc. by adding the termination ίκα, comp. αὐτίκα, πρόκα. They appear to denote, (1.) the time *when* generally; (2.) the time or hour of the day specifically.

Rem. 19. From τῆνος are also derived τηνεί, and τηνόθι, *there*; τηνόθεν, τηνῶθεν, and τηνῶθε, *thence*.

The 14th series contains *adverbs of manner* or *likeness.* They are ancient ablatives, used as modals, all ending in ως, (Sansc. *ât*, Zend. *t*, Old Lat. *d*;) comp. καλῶς, κακῶς, etc.

Rem. 20. Columns II. IV. V. VI. VIII. IX. easily slide into the sense of time.

Rem. 21. Columns VII. VIII. IX. easily slide into the sense *how that, so that, that, because that, in order that*, etc.

Rem. 22. The indefinite form πως is enclitic and to be written without an accent. See Passow. Buttmann, however, adds an accent.

Rem. 23. πως and πω appear to me to have the same meaning, and to have been originally the same word, the latter being derived from the former by apocope. I see no reason either for making the termination ως an old accusative form, as Passow supposes, or πω an old Doric genitive, as the same lexicographer has done.

The 15th series contains *adverbs of number.* They are formed immediately from the 3d series or adjectives of quantity, by adding the termination κις, (=Sansc. *s'as*, Lithuan. *gis;*) comp. τετράκις, πεντάκις, πολλάκις, etc.—ἰσάκις has various meanings; (1.) *as often;* (2.) *as many;* (3.) *equally;* (4.) *in as many ways.*

Rem. 24. The medial σ of this series is sometimes doubled for the sake of the measure; as τοσσάκις, τοσσάκι, ὁσσάκι. Comp. Rem. 10. supra.

Rem. 25. The final ς is sometimes dropped before a consonant for the sake of the measure; as, τοσσάκι, ποσάκι, ὁσάκι.

The appearance of these correlatives in the cognate Indo-European languages will be reserved for a future number.

ART. X.—*First Annual Report on the Geological Survey of the State of Ohio;* by W. W. MATHER, principal Geologist, and the several Assistants. pp. 134. Columbus, Ohio.

(Communicated.)

THIS document reflects credit not only on the board, by which it was prepared, but the state by whose munificence they were enabled to prosecute their researches. It embodies a mass of valuable and well digested facts, collected during the geological investigations of the past season. These facts are of a practical character, and directly applicable to the arts. Technical terms, and theoretical speculations, as a general thing, seem to have been sedulously avoided. We propose to lay before our readers an abstract of this valuable document, as well as to notice some statements, which conflict with our own observations.

The corps was organized last June. Prof. W. W. Mather of New York, was appointed chief or superintending Geologist. Subordinate to him were four assistants proper, one acting assistant, and one topographical engineer. For the better attainment of the objects of the survey, several distinct departments were created. To Dr. S. P. Hildreth, of Marietta, was assigned the department of palæontology. To Dr. J. P. Kirtland of the Cincinnati Medical College, that of botany and zoology. Dr. John Locke of Cincinnati, was in Europe at the time of his appointment, and did not return in season to enter upon the duties of the survey.

Prof. C. Briggs, Jr., of New York was appointed fourth assistant. J. W. Foster, Esq., of Zanesville was appointed acting assistant, and associated with Mr. Briggs in the survey of the district between the Scioto and Hockhocking rivers. To Col. Charles Whittlesey of Cleveland, was assigned the topographical department of the survey.

Such is the present organization of the board; and from the reputation of the several gentlemen employed, we doubt not that their labors will be instrumental in stimulating the industry, and developing the resources of a great and growing state. With these prefatory remarks, we proceed to notice the several reports, embraced in this document.

The report of Prof. Mather, comprises a description of the principal formations in the State—the value, range and extent of the coal and iron deposits—the best method of fluxing ores,—the chemical composition, and mechanical texture of soils—the application of marls as a manure, and a variety of interesting details, which our limits will not permit us to particularize. Coal is one of the most valuable and widely diffused minerals in the eastern section in the State. In reference to this, he says:—

"From the reconnaissance of the past season, it is estimated that about 12,000 square miles of the state, are undoubtedly underlain by coal, and 5,000, by workable beds of this valuable mineral. In many places, several successive beds of the coal are superposed one over the other, with sandstone, iron ore, shale and limestone intervening. The coal beds are favorably situated for working, as they are found in the hills and ravines, where they can be drained with little expense, and without deep shafts and expensive machinery, like those of Europe, or some parts of our own country. It is impossible, with the data as yet ascertained, to estimate the amount of workable beds; but probably a mean thickness of six feet of coal capable of exploration over 5,000 square miles, is a moderate estimate of our resources in this combustible. Our citizens are not yet aware of the prospective value of coal lands; and it is, perhaps, only by setting their practical utility before them, that they will appreciate the importance of this mineral on their estates."

"Every square mile, containing two yards in thickness of workable coal, will yield about 6,000,000 tons, which is an abundant annual supply of fuel for all the people of this state, both for domestic and manufacturing purposes; and, if we allow double this amount for prospective consumption, in consequence of increased population and manufactures, we have coal within a moderate depth, sufficient for consumption during 2,500 years. If we consider the value of coal as a means of *motive power* in propelling machinery, each acre, of the 5,000 square miles of coal, contains stored and ready for use, a power equal to that of one hundred and ninety two men for one hundred years, working ten hours per day. Allowing a profit of only twenty five cents on each cubic yard of coal, an acre would yield a profit of more than $2,000 where a depth of six feet is worked.

"These facts will, it is hoped, lead our citizens to appreciate the vast mineral resources in this valuable combustible, with which our territory through Infinite Wisdom, is so bounteously supplied." pp. 5, 6, 7.

The estimate is very far too low, not only as to the area, traversed by the coal, but its mean thickness. As many as six distinct beds or seams of workable coal crop out successively, as you travel from east to west. These beds vary in thickness from 2½ to 8 feet. Thus, we think that 20 feet of workable coal, over an area of 8,000 square miles, would be a nearer approximation to the truth.

But perhaps the most interesting fact in this report, in a geological point of view, is the degradation of the land, bordering on Lake Erie. In many places, the encroachment of the lake has been so rapid, within a few years, as to become a formidable evil. From the difficulty of opposing a barrier to these encroachments, many towns are threatened with demolition.

"The shore at Cleveland is washing away rapidly in front of the town. The cliffs, undermined by the surf and land springs, crack off at the top and slide partly down, so as to come within the action of the surf, while other slides from above, continue to push it farther and farther into the lake, until all is carried away by the waves and shore currents. Slides occur every year. Several rods, in width, have slidden down and been washed away within a few years.

"Attempts have been made to arrest this degradation, which threatens to remove the site of the city in the course of a century or two, unless it be checked. If piers be erected at intervals, extending out for one hundred to one hundred and fifty yards from the shore, and well filled in, alluvial deposits from the sand swept coastwise by the surf and shore currents, will necessarily be deposited in the eddies formed by these obstructions. An example of the application of this principle may be seen on the west side of the pier which protects the harbor, where several acres of alluvial land have been formed within four years. As the coast west of Cleveland is rock-bound, very little detrital matter is swept eastward, while the coast to the east of Cleveland, to Fairport, composed of earthy materials, is mostly in a state of rapid degradation. The northeast winds sweep this detrital matter along to the westward, and deposit it behind the obstacles which create eddy currents. The long pier at Cleveland has caused such currents, and the deposit of the alluvial sands just mentioned.

"One evidence that the lake has been making encroachments on this part of the coast for a long time, is an isolated hillock, a part of the original shore, which was also the boundary of a bluff on the Cuyahoga river. This bluff turned the river westward, so that its mouth was a mile or more west of Cleveland, and remaining without degradation on the river side, (as is evident by its moderate slope,) was washed away on the lake shore, until it was cut through at the bend, and gave the river a shorter course to the lake through a new mouth. The old mouth is closed by a sand beach, and the alluvial ground mentioned as having been formed west of Cleveland, is partly in front of the hillock, which presents a nearly vertical escarpment towards the lake.

"The evidence of the degradation of land by the surf on the shore, may be seen at any time by standing on the cliff at Cleveland (and at many other points on the coast) and looking off upon the lake. At the the distance of one-half to one mile from the shore, a distinct line may be seen to mark the division between the muddy water, produced by the washing away of clay and the grinding up of pebbles on the coast, and the clear blue water of the lake. All the water between that line and the shore is tinged with finely divided matter in a state of suspension. This matter settles in still water, and probably forms clay on the bottom of the lake, imbedding shells and other organic remains." pp. 16, 17.

We should be pleased to multiply extracts from this report, but our limits forbid. In it, we find the same accuracy of observation and the same scrupulous regard to facts, unbiassed by theory, which characterize the productions of that gentleman.

The next report is that of Dr. Hildreth. This gentleman, we regret to say, has resigned his situation in the survey, in consequence of ill health. He has long been an assiduous and successful cultivator of the natural sciences, and his several contributions to this Journal, have introduced us to a rich geological field, which has been hitherto, but partially explored. While we accord to him as a general thing, the character of a judicious and accurate observer, from some of his conclusions, we must be allowed to dissent. Thus, page 26, referring to the rocks which overlie the coal, he says :—"They are the new red sandstone, lias, oolite, &c. The *two* latter are rocks which have been very partially, or more probably not deposited at all, over the coal measures of Ohio." Thus asserting, by *implication* at least, that the new red-sandstone exists in Ohio. In the 29th Vol. of this Journal, if we recollect right, the writer suggests that we may have an equivalent of the sandstone of the Connecticut valley, in the valley of the Ohio. This, he founds on the coincidence of the two rocks in lithological character. We have seen no formation in Ohio, which we have thought equivalent to the new red sandstone, and we have had an opportunity of studying both formations attentively. While the sandstone of the Connecticut valley agrees in many important particulars,* with that containing the zechstein of Germany, and the new red sandstone of England, it differs, so far as our observations extend, from any formation in Ohio, in its lithological characters, in its associated minerals and in its organic remains. The prevailing color† of the former is a deep red, sometimes variegated—that of the latter, white—but occasionally tinged. The same difference is observable in the respective shales of the two formations. Copper is a common mineral in the new red sandstone of the Connecticut valley. In Ohio, we have detected it but in a single instance, and that in a small quantity. In the former, bituminous marlite is common—in the latter, we find nothing which approaches it. In the former, satin spar often forms a thin lamina with the shale;—in the latter, never. The same diversity exists with regard to the organic remains. The rocks, which crop out on the eastern part of Ohio, we regard as the most modern, with the exception of the recent and tertiary formations. Here the dip is E. S. E., nor is there an anticlinal axis between this and the western border of the State. Yet in these rocks occur the Producta and the Spirifer—fossils characteristic of an older formation than the new red sandstone. The new red sandstone is characterized by a scarcity of organic remains. In Ohio, they are profusely scattered throughout all the rocks. In Ohio, no mammifers, and indeed, no vertebrata have been found.‡

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* Hitchcock's Geol. Mass. p. 212.

† Color is a character of little value among rocks, especially in the sandstones.—Eds.

‡ Ichthyolites are said to have been found in the buhr of Ohio, but this needs confirmation. They are the only vertebrata as yet found below the new red sandstone. There can be no doubt, from the imbedded fossils, that the buhr of Ohio, is a member of the coal series.

In the sandstone of the Connecticut valley, ichthyolites (*Palæothrissa macrocephala*) occur abundantly. Besides, according to Professor Hitchcock, the bones of a vertebrated animal, several feet in length, and not at all fossilized, have been found. In addition to this, ornithichnites* are found, the occurrence of which, while it draws line of demarkation between that formation, and the old red sandstone, must separate it from any formation in Ohio. For these reasons, we think that the new red sandstone of the Connecticut valley, cannot have an equivalent in Ohio—that the two formations were produced at distinct geological epochs, and under circumstances widely different.†

One of the principal topics embraced in Dr. Hildreth's report, is the range and extent, as well as the economical value of the buhr, or, as he terms it, the calcareo-silicious deposit. "It is," he justly remarks, "one of the most interesting features in the geology of the coal measures of Ohio, and like the meridian line in geography, will afford a valuable guide in developing the rock strata which lie beneath, or are superimposed on this deposit." This is a protean rock, at one time assuming a cellular aspect, with little or no admixture of calcareous matter, and again passing into a compact cherty limestone. Yet we are assured, (p. 29,) that under every aspect it may be known by the imbedded fossils which accompany this rock in its whole course. The fossils, he afterwards informs us, *peculiar to* this deposit, are Encrini, Producti, Spiriferi, Terebratulæ, &c. Here we remark, that particular fossils are characteristic of particular formations; but we have not sufficient evidence to believe that the particular members of a group have their peculiar fossils. We have noticed all the fossils enumerated, in the mountain or carboniferous limestone, which underlies the coal measures of Ohio, in many of the iron ores interstratified with them, in the blue limestone below the buhr, in the limestone in contact with it, and some of the fossiliferous

* Some few individuals have attempted to throw discredit on these discoveries of Professor Hitchcock; but, for ourselves, we regard the existence of ornithichnites as clearly settled as that of the orthoceratite or productus. An inspection of the Professor's specimens we think, must convince the most incredulous. While we regard it as one of the most interesting discoveries which has recently been made in geology, we deprecate every attempt captiously, and without the examination of the evidence, to detract from the well earned reputation of the author.

† The writer has not informed us to what place he would refer this sandstone.—Eds.

limestone imposed upon it. As an article of traffic, Dr. Hildreth says:

"The importance of this article in a commercial and domestic point of view, may in some measure be estimated, when it is stated by intelligent persons, who have been long engaged in the manufacture of mill-stones, that the annual amount of the manufactured article is not less than $20,000; and that it may be safely calculated at this sum, for twenty years past. When to this, is added the money saved to mill-owners, from the use of the native instead of the foreign buhr-stone, that amount will be nearly doubled. It came into use about the year 1807. The early manufactured mill-stones were made of a single piece; but these often proving to be of unequal density, and not making good flour, were abandoned, and staves constructed of separate blocks, cemented with plaster, and confined togther with iron bands. Where these blocks are selected with care, by an experienced workman, the flour is said to be equal in quality to that made by the French stones.

"From the year 1814 to 1820, the price of a pair of four and a half feet stones was $350, and a pair of seven feet, sold for $500; while the foreign article sold for a still higher sum. The four feet stones now sell for $150. In the townships of Richland, Elk and Clinton, a large number of the inhabitants are engaged in the dressing of blocks, and in the construction of mill-stones. The buhr-rock is a mine of wealth to the inhabitants, and has contributed largely to the prosperity and independence of this whole region of country. The manufacture of mill-stones is not confined to the waters of Raccoon, but is also carried on to considerable extent in Hopewell township, Muskingum county. The quantity is apparently inexhaustible, and new quarries will be opened, at points where it is not at present looked for, and probably of a more even and compact texture than that now obtained. Few or no quarries have been yet worked by drifting under the sides of the hills, but the rock is generally procured by what is technically called "stripping," or excavating the superincumbent earth, near the top of some ridge or hill, where it is easy of access." p. 33.

His remarks on the salt springs are copious and interesting; but we must pass them without comment. In taking leave of this report, we express our pleasure in its perusal, and our conviction that it will enhance the well-founded reputation of Doctor Hildreth, as a scientific observer.

The report of Dr. Kirtland, from the nature of his department, does not admit of much detail. He has briefly and succinctly set forth some of the advantages which may be expected to arise from an investigation of the zoology and botany of Ohio. From it we make but a single extract.

"By knowing the habits of insects, we can often obviate their attacks. The farmer may find it advantageous, in those sections of the state where the Hessian fly is common, either to postpone sowing his seed until the time for depositing the egg of the insect has passed, or to substitute spring for winter wheat; and it is also probable that some of the winter varieties of this grain may yet be found with stalks so solid that they will resist the attacks of this enemy. Many years since, the timber in the navy yards of Sweden was rendered unfit for use by the perforations of a small worm. The government applied to Linnæus for a preventive of its attacks. He recommended to have the timber sunk in water during the few days that were occupied by the insect in depositing its eggs. The remedy was perfectly effectual; and, simple as it was, saved more than a million of dollars annually to his country." pp. 68, 69.

The report of Mr. Briggs embraces all the economical facts collected by him and Mr. Foster, on the detailed survey of the southern portion of the State. There is an accompanying section to illustrate the superposition of the rocks between the great limestone deposit and the upper part of the coal series.

With respect to geological sections, says De La Beche, too much stress cannot be laid on the importance of rendering them as conformable to nature as circumstances will admit: that is, the perpendicular elevations and base lines should be, as much as possible, in proportion to each other. Without this necessary precaution, such sections are little better than caricatures of nature, and are frequently much more mischievous than useful, even leading those who make them to false conclusions, from the distortions and false proportions of the various parts. * * * It is clearly in the interest of science that they should be what they pretend to be, miniature representations of nature.* To this section we have three objections. 1. The strata are indicated without reference to relative thickness. 2. They are represented as nearly horizontal with a uniform dip of 30 feet per mile, whereas they are more or less undulating. We think that these physical features of the country could have been indicated on the section. Our third objection is of a more serious character. The conglomerate is erroneously represented as extending nearly to Bainbridge; whereas the outcrop of the con-

* Geol. Manual, Phila. ed. 1832, p. 519.

glomerate is a few miles west of Jackson, a distance of more than twenty miles east of its termination on the section. Not a vestige of it is to be seen *in situ,* even on the highest hills in the vicinity of Chilicothe.

We propose to lay before our readers a description of the principal formations in Ohio, beginning with the oldest rocks and ascending in the series.

I. *Great Limestone Deposit.*—This is the equivalent of the mountain or carboniferous limestone of Europe. It is first struck in Adams county, and extends thence to the western borders of the State. It is of a grayish color, with a tinge of blue, and subcrystalline in its texture. It generally occurs in layers, varying from a few inches to two feet in thickness, with thin seams of shale intervening. From its toughness, it forms a valuable building material. Organic remains are profusely scattered throughout this deposit. Of *Zoophytes,* the principal are the *Caryophylla, Turbinolia, Cyathophyllum, Favosites,* and *Astrea.* Of the *Crustacea, Trilobites* and *Calymene.* Of *Mollusca,* the *Spirifer, Producta,* and *Terebratula.* Of *Conchifera,* the *Melaina, Delphinula, Planorbis, Orthoceratites, Ammonites,* and *Turritella.* On some of this limestone we have noticed ripple marks, which were probably contemporaneous with its induration.

From the appearance of this limestone, it is not unreasonable to suppose that the particles composing it were once held in aqueous solution, and subsequently deposited in tranquil water along the bottom of the ocean. This *may* have been consolidated by subterranean heat, acting on the mass. This is rendered *probable,* by the ingenious experiments of Sir James Hall. From them we derive the following conclusions: that a compressing force equal to the weight of 52 atmospheres, or 1700 feet of sea, is sufficient for the formation of limestone, if a due degree of heat be applied; that under 86 atmospheres, or about 3000 feet of water, a complete marble may be formed; and lastly, that, with a pressure of 173 atmospheres, or 5700 feet, a little more than a mile of sea, the carbonate of lime is made to undergo complete fusion, and to act powerfully on other earths. These compressions are, comparatively, by no means great. The force of gunpowder, at the least estimate, is equal to the weight of 1000 atmospheres.*

* Edinburgh Rev. vol. 9, p. 27, Art. Sir James Hall on the Effects of Heat and Compression.

On this limestone is imposed a yellowish siliceous limestone. It is generally destitute of organic remains. It is quarried extensively for building, and is burned for quick-lime.

II. This consists of a bed of shale, two or three hundred feet in thickness. It is generally black, very fissile, and frequently, when breathed upon, exhales a fetid odor. Towards the lower part of this deposit, occur masses of carbonate of lime, of a spheroidal structure. Some of them are globes, and on being broken, exhibit no peculiar structure. Others appear to have been originally amorphous masses, traversed by calc spar and sulphate of baryta, and constitute the nuclei around which concentric layers have subsequently formed. Others, again, are lamellar in their structure. Sulphate of alumine and potash and sulphate of iron are abundant throughout this deposit. From these materials copperas might be manufactured in large quantities.

III. *Waverly Sandstone Series.*—This name has been applied to a fine-grained sandstone which is extensively quarried at Rockville, Portsmouth, Piketon, and Waverly. It constitutes the best building material in the State. This group consists of alternating layers of shale and sandstone, varying in thickness from a few inches to two or three feet. Some of this sandstone contains a large portion of aluminous matter, so that it readily exfoliates on exposure to the air. The most common organic remains in this deposit are *Encrini*, (a species of *Helix?*) besides some bivalve shells. The moulds of these remains are often filled by sulphuret of zinc and sulphate of strontian, but more frequently by sandstone. We have also noticed one or two species of *Fucoides*, probably nondescripts. Throughout the whole extent of this formation, from the Ohio river to the lake, ripple marks are found. Some of them are so surprisingly regular as to resemble the flutings of a Corinthian pillar. We have seen a surface of a hundred feet in length by fifty broad, marked in this way.

IV. *Conglomerate.*—This rock sometimes consists of an aggregation of quartzose pebbles, and again passes into a granular sandstone. It crops out on the western border of the coal measures in bold escarpments, varying from 80 to 100 feet in thickness. In a rock composed of such materials, we should not look for homogeniety of character or uniformity of thickness: for in the detritus, brought down from the primitive mountains,—of which the secondary rocks appear to have been formed,—the pebbles would have been deposited first, while the finer particles would be borne far out into the ocean. In some instances, the pebbles are deposited in layers, as though in a turbid state of the water, nothing but pebbles were deposited, while, in a more tranquil state, nothing but comminuted sand.

V. *Lower Coal Series.*—These consist of alternations of sandstones, shales, limestones, iron ores, and coals, to the thickness of 300 feet. In this belt, which extends through the State in an E. N. E. direction, are embraced the most valuable deposits. The sandstones are quarried for building, gravestones, and grindstones. The limestones are used as fluxes at the furnaces. Many of them are burned for quick-lime. One stratum, from the fineness of its texture and compactness, takes a very high polish. It can be used to advantage as a marble. Many of the shales, on disintegration form good fire-clay. But the most valuable members of this group are the coal and iron ores. There are two distinct beds of coal. The lower one is of a superior quality, and at no remote day, will be extensively mined for fuel. In reference to the extent of this deposit in Jackson and Lawrence, Mr. Briggs says:

"The whole amount of coal between these points, from the Ohio river, north, to the Hocking valley, may be safely estimated as sufficient to form an entire stratum of fifty miles in length, five miles in width, and nine feet in thickness. This amount of coal will yield about 9,000,000 of tons per square mile. This estimate includes but a very small part of the coal, which can be obtained from the beds heretofore described; for, after disappearing beneath the water courses, they doubtless continue eastward, toward the Ohio river, sinking deeper and deeper beneath the surface, so that they can be reached only by shafts near the Ohio, at the depth of some hundred feet." p. 87.

Equal in importance are the iron ore deposits. They are rich, —some of them yielding 60 per cent.,—and easily wrought. From their juxtaposition with the coal and limestone, it requires little foresight to predict that this branch of manufacture will become a great and inexhaustible source of revenue to the State. On page 93 we have an estimate of their extent.

"At a very low calculation of the amount of good iron ore in the region which has this season been explored, it is equal to a solid, unbroken stratum, sixty miles in length, six miles in width, and three feet in thickness. A square mile of this layer—being equivalent, in round numbers, to 3,000,000 cubic yards—when smelted, will yield as many tons of pig iron. This number, multiplied by the number of square miles contained in the stratum, will give 1,080,000,000 tons; which, from these counties alone, will yield annually, for 2,700 years, 400,000 tons of iron—more than equal to the greatest amount in England previous to the year 1829.

"From this estimate, which it is believed is much too low, it appears that the iron ores of this portion of the state are not only sufficient to supply all domestic demands for ages, but to form an important article of commerce with other states." p. 93.

With such mineral deposits in the bosom of a State, with a soil of unsurpassed fertility, with natural and artificial channels of communication with the south and the north, with the east and the west, under the blessings of a free government, where industry is protected and labor rewarded, who can limit the prosperity of the State, or prescribe the number of her inhabitants?

Among the most interesting details of this report, are those respecting the fossil elephant discovered during the past season. As there is some doubt as to the geological position of the deposits in which these bones are found, we will extract the description.

"About two years ago, some bones, so large as to attract the attention of the inhabitants, became exposed in the bank of one of the branches of Salt creek, in the northwest part of Jackson county. They were dug out by individuals in the vicinity, from whom we obtained a tooth, a part of the lower jaw, and some ribs.

"In the examinations at this place, during the past season, it was concluded to make further explorations, not only with the hope of finding other bones, but with a view of ascertaining the situation, and the nature of the materials, in which they were found. The explorations were successful. There were found some mutilated and decayed fragments of the skull, two grinders, two patellæ, seven or eight ribs, as many vertebræ, and a tusk. Most of these are nearly perfect, except the bones of the head. The tusk, though it retained its natural shape as it lay in the ground, yet, being very frail, it was necessary to saw it into four pieces in order to remove it.

"The following are the dimensions of the tusk, taken before it was removed from the place in which it was found:—

Length on the outer curve, - - -	10 feet 9 inches.
" " inner curve, - - -	8 " 9 "
Circumference at base, - - -	1 foot 9 "
" 2 feet from base, - -	1 " 10 "
" 4 " " - -	1 " 11 "
" 7½ " " - -	1 " 7½ "

"This tusk weighed, when taken from the earth, 180 lbs. The weight of the largest tooth is $8\frac{1}{4}$ lbs.

"These bones were dug from the bank of a creek, near the water, where they were found under a superincumbent mass of stratified materials, fifteen to eighteen feet in thickness." pp. 96, 97.

The place where these bones occur is evidently a lacustrine deposit, consisting of horizontal layers of sand, loam and marly clay. The layer in which the bones occurred is dark blue, colored by phosphate of iron. The tusk in many places was tinged with this substance. This may serve as a general section of the deposits, in which these bones are found at the west, and corresponds, except in the absence of the peat, with a section given by Phillips of the lacustrine deposits of Yorkshire, in which the great Irish Elk (*Cervus giganteus*) is found. Whether these deposits belong to the newer pliocene of Lyell we are not prepared to say. We have not yet facts enough upon the subject. In Europe, the age of these deposits, can, in general, be readily recognized by the accompanying marine shells. Here so far as we have observed, there is an absence of marine as well as fresh water shells. That the bones above described, were floated to the place where they were found, is probable from their horizontal position, and the stratified deposits, with which they were covered; but not previously subjected to a considerable degree of violence, as intimated by Briggs. The jaw bone was fractured. As that was found on the surface, after a freshet, it is not unreasonable to suppose that its fracture was recent. The bones of the cranium also, were broken; this we might expect would be the case from the very frailty of their structure, without supposing that they had been subjected to violence. We see nothing in this region, which would indicate a cataclysm of sufficient power to excavate valleys, pile up deep beds of gravel, &c.; while the deposits, in which these bones were entombed, appear to have been formed in still waters. This, we infer from the horizontality of the layers, and the comminuted slate of the materials composing them. Besides, we find these bones in such a position as to induce us to believe that the carcass *might have been* drifted entire, into this lake or estuary.

The gases generated by putrefaction would cause it to rise to the surface; and as the process advanced, the bones would fall piecemeal from the floating carcass, and in that case, be scattered at random over the bottom of the lake, estuary or sea; so that a jaw would be found in one place, a rib in another, a humerus in a third—all included, perhaps in a matrix of fine materials, where there may be evidence of very slight transporting power in the current, or even of none, but simply of some chemical precipitate.*

With these remarks we take leave of the report of Mr. Briggs; we have r d it with pleasure and profit.

We have described the different groups embraced in the report of Mr. Briggs. We now proceed to describe those above.

VI. *Buhr.*—This rock forms the dividing line between the upper and lower coal series. In our remarks upon Dr. Hildreth's report, we gave the principal characteristics of this rock.

VII. *Upper coal series.*—These, like the lower coal series, are composed of sandstones, shales, coal, iron ores, and limestones. The coal is the most valuable mineral in this group. There are at least, four distinct beds, capable of being wrought, and of a good quality. In this group, is included the cannel coal of Cambridge, described in a former number of this Journal. The limestones in this series, are more abundant than in the lower, and exert a beneficial influence on the soil. The Belmont Hills are noted for their productiveness. The iron ores included in this group, are not as abundant as in the lower series—nor are they wrought for manufacturing purposes. The organic remains of the two groups, do not differ essentially. In the limestones, we meet with the *Encrinite*, *Delphinula*, *Spirifer*, *Productus*, *Terebratula*, &c. We have detected no terrestrial plants. The sandstones often contain the stems of coal plants. The most common are *Stigmaria ficoides*, *Lepidodendron Sternbergi?* and several varieties of *Sigillaria.* From the shales, beautiful impressions are obtained. The principal are *Equiseta*, *Calamites*, several species of *Filices*, and *Lycopodiaceæ*, and perhaps, one or two species of *Palmæ.* Two or three species of *Astorophyllites* have been found. *Fucoides* are not uncommon.

VIII. *Tertiary deposits.*—Under this head, we place the prairies or barrens, in the western portions of the State, the pebble beds and boulders of primitive rocks, so abundant in some parts of the Scioto valley, as well as those deposits, in which the

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* 3. Lyell, Lond. Ed. 232.

bones of extinct mammalia occur. These formations occupy an extensive area in the middle and western portion of the State.

IX. *Recent deposits.*—The most extensive deposits of this kind, are such as are now forming along the banks of the rivers. None of them are of sufficient interest to deserve being mentioned.

We have thus given a brief description of the principal rocks of Ohio. It is as extended as our limits would permit.

The report of Col. Whittlesey, of the topographical department, remains to be noticed. We perceive that the survey and description of the ancient works of Ohio are included in his duties. In reference to these he says:—

"I have inspected the ancient remains within the district embraced in this season's operations, and have sketches and notes of nine separate works. Further exploration and measurements are necessary, however, to render complete the plan, specification and detailed description of most of them. These plans will exhibit the figure of each ruin, as far as it can be traced upon the ground; the elevation and depression of its embankments and excavations, by means of vertical sections or profiles, and a topographical sketch of the vicinity. A plan of the remains at Marietta is nearly finished, and may serve as a specimen of the general method, according to which it is proposed to execute the whole set.

"Many of these ruins of a lost race, are to this day without a description, while their forms and dimensions are fast disappearing under the operation of the plough and the spade. For it is in the rich valleys of the Miami, the Scioto, and the Muskingum, where the modern agriculturalist now cultivates the soil, that an ancient people, more numerous than the present occupants, pursued the same peaceful avocation, at least ten centuries ago; and upon the sites of modern towns within these valleys, as at Cincinnati, Chilicothe, Circleville, Piketon, Portsmouth, and Marietta, the ancients located *their* cities, of which distinct traces exist. They also occupied many other points upon the rivers named, of which evidences remain too plain to be misunderstood. The interest manifested by the learned abroad, relative to these works, and the hasty and imperfect sketches taken of them by travellers, in addition to a local curiosity respecting our predecessors upon this soil, and the other considerations above named, seem to demand of us a thorough record of what remains to our observation. A general description will accompany the plans when complete, for which it is proper to reserve observations. But the popular name of 'fortifications,' bestowed upon these ruins, leads me to state, that I have *seen* none to which the term is applicable. I have examined the extensive works at Marietta, and those more extensive ones at, and in the vicinity of Portsmouth—at Vulgamore's, in Pike county

—at Piketon—at Kilgore's, in Ross county, and at Alderson's—with other lesser and detached works, and can discover in none of them elements of military strength, or evidences of a warlike intention. The principal enclosures are rectangles, or circles, weak figures, without ditches, made weaker by numerous openings, not only in the sides, but at the corners. The subordinate parts of large works, and the small isolated ones, *sometimes have ditches,* but always, as far as I have seen, on the *inside,* though cases of extensive fossa are said to exist. The main figure always occupies ground accessible on all sides, and no spring, or receptacle of water, is found *within the walls.* Other equally good reasons might be advanced, why these structures are not adapted, and were not designed, either for attack or defence, under any supposable mode of human warfare.

"No portion of Ohio appears to be destitute of ancient tumuli and embankments; the object and origin of which are still, in a great measure, mysterious and unknown." pp. 104, 105, 106.

We are glad that we are about to have an accurate survey, and description of these memorials of a former race. The work of Mr. Atwater, published under the auspices of the Massachusetts Antiquarian Society, is incorrect.

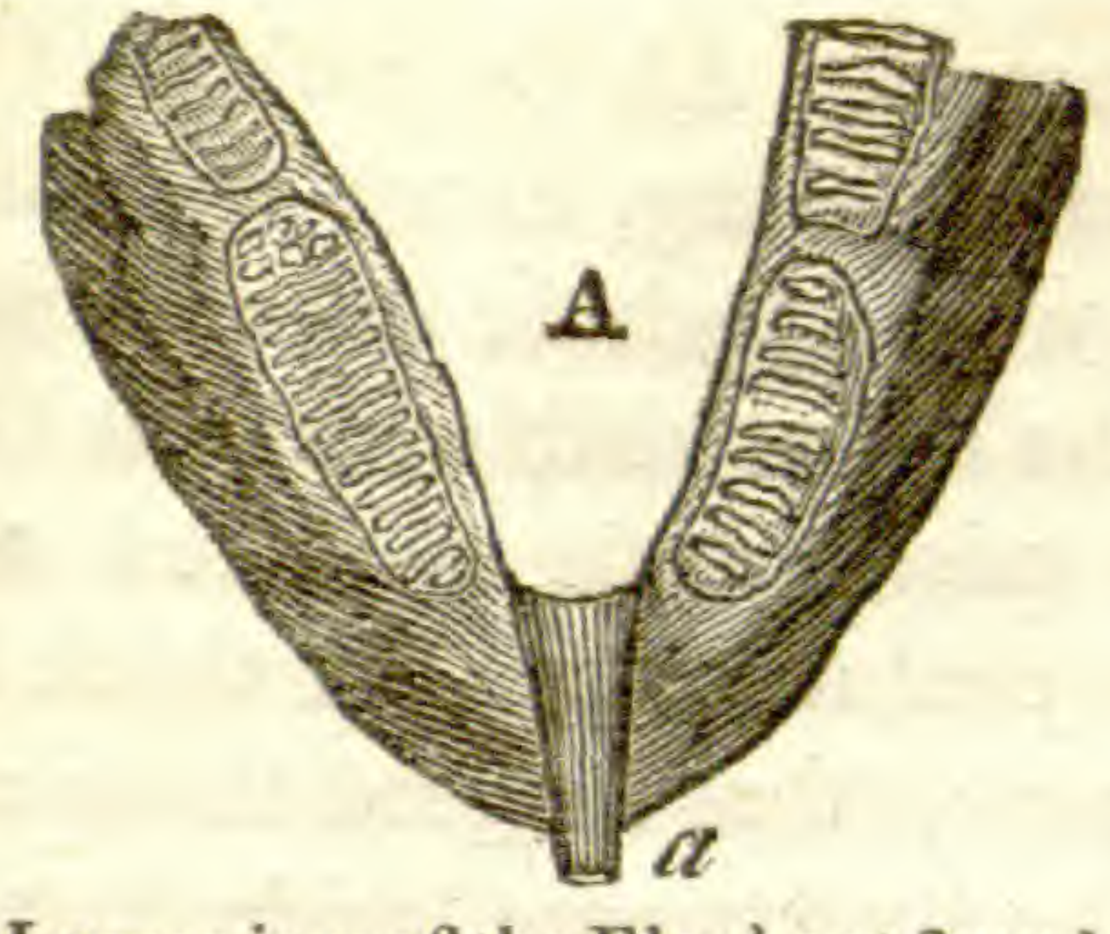
Appended to this report, is a list of geological queries, as well as a glossary of the principal geological terms, for the benefit of the general reader.

Remarks in addition to and explanation of the Review of the Report of the Geological Survey of Ohio—in a letter to the Editor.

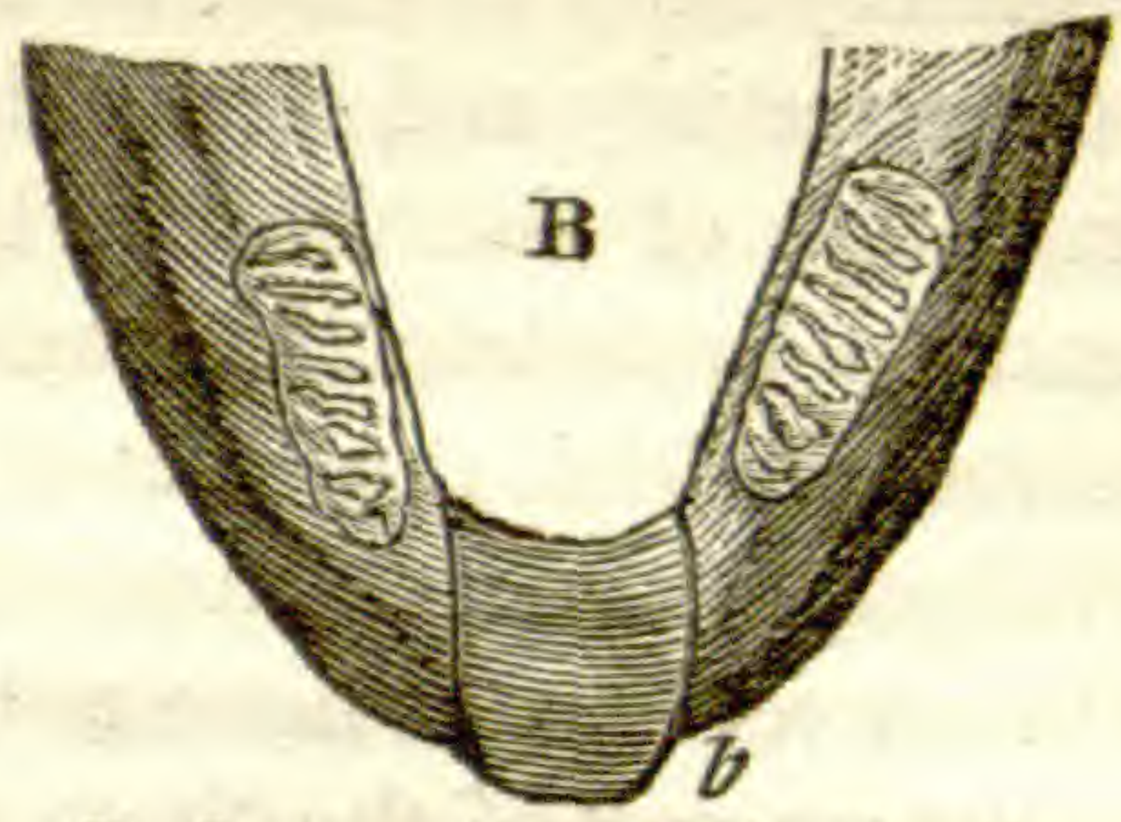
Columbus, March 23, 1838.

Dear Sir—You inquire whether the bones found at Jackson belonged to the mastodon or elephant? They do not belong to the mastodon, and yet they differ in some respects from the fossil elephant,) *E. primogeneus.*) These differences I will proceed to particularize. 1st. The jaws differ, as will be seen by the figures, which are not remarkably accurate, but sufficiently so for illustration.

You will perceive by the following sketch, that the jaw A converges more than B. In this respect, it approaches the existing species. There is also a remarkable difference in the construction of the canals, *a* and *b.* The tusk of the Jackson elephant is cornuform, more so than those of the existing elephant, but less so than in the fossil elephant. The *E. primogeneus* found near the Arctic ocean, had tusks, which formed nearly a circle.



A. Lower jaw of the Elephant found at Jackson.



B. Lower jaw of the fossil Elephant.

I have not had an opportunity of comparing the teeth of this elephant with those of the *E. primogeneus.* They resemble some of those figured by Parkinson. I will give you a drawing of one of the plates of the *E. Jacksoni.* (I will so call it for the sake of brevity.) This drawing is rather too wide, in proportion to the length. Thus you will see that there are seven lines running obliquely, seven distinct

ribands, and five which do not extend across the tooth. The other teeth differ from this, having more ribands which extend across the tooth, and only two which are broken. From these differences, we think that it cannot belong to the *E. primogeneus* of Cuvier, and yet we are not prepared to say that it is identical with the *E. recens.*

I agree with you, that some other designation besides Waverly ought to be applied to the fine-grained sandstone. We ought to exclude all local names. And yet the term "upper secondary" is objectionable, since this rock underlies all the coal, and is separated from the carboniferous limestone only by a bed of shale, three hundred feet thick. The term Waverly is used to designate a peculiar member of the secondary rocks, a particular stratum which I have never seen elsewhere. It is composed of comminuted sand, and yet it adheres so closely as to form the best building material we have in the State. It is a rock *sui generis.*

Dr. Hildreth, I suspect, must have arrived at the conclusion that the new red sandstone was found in Ohio, merely from the lithological characters of some of the rocks. The sandstones are occasionally tinged red, but this is local. For example, the conglomerate, beneath *all* the coal, sometimes assumes this appearance, and the Doctor was disposed to call it the new red sandstone, merely from its external characters. All the rocks in Ohio, except the tertiary and recent deposits, belong, in my opinion, to the transition of Buckland, which would include the coal measures and the mountain limestone, the oldest visible rock in Ohio. Those rocks which the Doctor has mistaken for new red sandstone belong to the sandstone of the coal measures. I think I remark in my review, (I have not a copy,) that I regard those rocks in the eastern part of the State, as the most recent, aside from the superficial deposits, since the dip is E. S. E., and unbroken. At Wheeling, two beds of coal crop out, which extend into Ohio. For these reasons, I think that neither the new red sandstone, nor the lias, nor the oolite, is to be found in Ohio. I was desirous to discuss this point, as the impression has gone abroad, that the new red sandstone is found here.

ART. XI.—*Researches in Magnetic Electricity and new Magnetic Electrical Instruments;* by CHARLES G. PAGE, M. D.

1. *Compound Electro-Magnets for the Magnetic Electrical spark, shock and decomposition.*—In the last number of this Journal, I announced this new form of magnet, as decidedly superior to the common solid electro-magnet, for exhibiting magnetic electrical phenomena. I have since performed a variety of experiments, with reference to the best mode of constructing these magnets, and arrived at some beautiful results and important conclusions. I find that the magnet made of flat plates of thin hoop iron, answers best for lifting power and sparks; but those made of fine annealed iron wire, answer nearly as well, and (for reasons, by and by to be mentioned) will in some cases be found preferable to the flat bars. Sixteen magnets were made of soft iron wire, in bundles of various lengths and diameters. Thirteen were made of No. 26 wire, two of No. 16, and one of No. 8. For lengths within ten inches and diameters within one inch, the very fine wires answer best. But for longer and larger magnets than these, the larger iron wires answer equally well. Each of these magnets were tried with one, two, and three coils of No. 16, copper wire, (wound each the whole length of the bars and superposed by a single

pair of lead* and zinc plates, eight inches single surface of zinc,) kept constantly in good action by the sulphate of copper. One of these magnets weighing two ounces, with four coils of fine wire exterior to three of large, gave a shock which could not be endured. The two best magnets of the sixteen, were, one made of one hundred fine wires six inches long, and one of five hundred wires, ten inches long. This last, furnished the most splendid deflagrations, and by far the strongest shocks. Its decomposing power was very great, for the means used. One was prepared of one thousand wires, and a foot long, but its power was inferior to that of five hundred wires. This large compound bar was ultimately sawed in halves, and each half indicated as much power as the whole. This fact seems to prove, that the length of the coils of copper wire, was too great for the size. I apprehend that a copper wire of a larger size,† would have made it superior to the other magnets. The advantage before alluded to, possessed by the magnets prepared from bundles of fine wire, is, the facility of making a curved or U magnet,‡ wound accurately throughout its length. There is little or no advantage in winding common magnets on the curved portion, owing to the difficulty of laying the wire on that part, at right angles to the axis of the bar. A very perfect U magnet covered accurately throughout its length, is readily made, by winding a straight bundle of fine iron wire, with as many coils of copper wire as desired, and bending them afterward, They are bent with ease, and the wire disposes itself on the bent portion in a beautiful and regular manner. All the magnets that were made of this description, were tried before and after they were bent, and no change in their properties could be observed. The best of the magnets, above alluded to, was covered with two hundred feet of fine wire, exterior to four coils of large wire. Combining the secondary currents of the large and small wire,

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* If properly prepared, lead for the negative plate, is much superior to copper, where the sulphate of copper is used.

† I have universally found that large wire answers best for large magnets, and small wire for small magnets. The larger the wire, the more freely it conducts, but large wire cannot be used with advantage on small magnets, as the coils or turns will not be sufficient in number, and the axis of the wire will lie more oblique to the axis of the magnet, than that of a smaller wire, or than upon a larger magnet.

‡ The term, horse shoe, applied to magnets, is inappropriate, and has led many into the error of constructing magnets of this awkward and disadvantageous form. The letter U would briefly designate this species of magnet.

the shock was so great as to render it difficult to keep even the tips of the fingers upon the wires. A single thermo-electric pair, heated and cooled, connected with the large wire, gave a bright spark and a shock, which could be felt as far as the wrist. The use of three pairs in sequence, enhanced the results. It must here be observed, that the shocks and sparks, are not thermo-electric, but magneto-electric. The pure thermo-electric spark, I apprehend, has never yet been seen. I obtained, a long time since, sparks and shocks from a thermo-electric pair, in connexion with Henry's flat spiral. But in that case also, the results were purely secondary, or magneto-electric, the copper spiral while transmitting a current, in fact, representing a magnet with axial poles. I have always maintained the position, that a shock direct, cannot be obtained from a single pair of plates, or any elementary current, under any arrangement whatever. Although recently, we have the high authority of Faraday, that iodide of potassium, and some other compounds may be decomposed, by a single galvanic pair, yet even admitting this to be fully established, I see no reason for retracting, and may continue safely to assert, that an elementary battery however large, cannot afford a direct appreciable shock. In Faraday's experiment, the decomposition was the result of uninterrupted action, but in all experiments hitherto, where shocks have been obtained by the aid of a single pair, they have been obtained as single impulses, immediately consequent to the completion of the circuit, as with the large magnet of Prof. Callan, or as in all other cases, to the interruption of the circuit. In a new instrument, shortly to be described, I have a singular instance of an electro-magnet, affording shocks, not only on the completion and breaking of the circuit, but even while the battery current is passing without interruption. It appears irrational to suppose for a moment, that the shock obtained by breaking the circuit with coiled conductors, can receive any augmentation from the conjunction of the primitive and secondary currents, for the presumption is, and the fact itself seems sufficiently obvious, that the sparks and shocks indicating a new and secondary current are directly consequences of the dissolution of the primitive current. In other words, the effects produced by the breaking of a primitive elementary current, are due solely to magnetic excitation, and have no connexion with that primitive, except that of cause and effect. In fact, strictly speaking, the results thus observed are not secondary, but tertiary phenomena; the secondary production, being the development or neutralization of magnetic forces. And, as Mr. Sturgeon has very ably set forth in his beautiful theory of electro-magnetic lines, in the present state of our knowledge, it is indispensable to the explication of the reciprocal action of magnetism and electricity, to *suppose* the existence of a secondary intervening medium, whether the coiled conductors act with or without the co-operation of ferruginous bodies. One singular fact which I noticed, nearly two years since, remains to be reconciled with the postulates, that a direct shock cannot be appreciated from an elementary current, and that secondaries are strictly consequences remote from primitives. When two, three or four pairs of plates, or any number below twelve, arranged as a compound series, are connected with coiled conductors, with or without soft iron enclosed, the sparks and deflagrations, are far more brilliant on breaking the circuit, than with the same plates used as a simple or elementary battery. This fact is readily accounted for. The battery current itself is capable of passing through perceptible space, with appreciable duration, and as the secondary current, (which is the natural electricity of the wire, set in motion by magnetic forces,) returns to its equibrium through the medium of the battery plates and its liquid, the two currents must here move in conjunction, and enhance the combustion of the metals used. I have strictly examined the power of the pure secondary developed in this way, and find it never to exceed the secondary from the same pairs arranged as an elementary series. In fact, the secondary begins to diminish, just when the magnetizing power of the compound battery begins to diminish, which is well known to occur, as the series extends. The properties of small and large compound batteries, have moreover been examined while the currents have been passing through circuits from twenty feet to half a mile, without any observable characteristic changes. But to return to the action of the compound electro-magnet. The superior value of these magnets, whether made of flat plates, or fine wire, may be traced to several causes. First, the homogeneous texture of the iron from which wires or flat plates are made, is favorable to the extensive development of magnetism. Secondly, the same quality favors its neutralization, when the exciting cause is withdrawn. Thirdly, the sum of the actions of so many highly charged magnets, and lastly, the mutual neutralizing influence of the individual magnets of a similar polar arrangement. This last, is by far the most important consideration. The following experiments, throwing light on this point, will be regarded as novel, and have an important bearing on the subject of magnetism itself.

Take a piece of fine iron wire, carefully annealed, three or four inches in length, and touch it once with a common steel magnet. Being very soft, it yields readily to the inductive influence, and as its length is very great, compared with its breadth, if carefully handled, it will be found to retain sufficient power to hold more than its own weight. Hold it now by one end and snap the other with thumb and finger, and its magnetism will be instantly lost. The same quality of the iron which favored the extensive development of magnetism, favored also its neutralization on the disturbance of molecular forces. The transition here was so sudden and decided, that I was led to try the influence of a magnet thus operated upon, in developing electricity. A long piece of iron wire, retaining considerable magnetic power, was suspended so as to vibrate freely in a spiral of copper wire. A smart rap upon the suspended iron wire, determined a strong galvanic current through the copper spiral, as indicated by the galvanometer. The result, though readily anticipated, was nevertheless very striking. Again, take a number of pieces of fine iron wire, and magnetize them separately, so that each by itself will hold its own weight; combine them now in a bundle, and instead of the aggregate lifting power of the elements, you scarcely realize the power of one of those elements, owing to the neutralizing influence of the similar poles. It is the co-operating, neutralizing effort of similar poles, that chiefly determines the superior value of the compound electro-magnet for magnetic electrical experiments. The fact that very fine steel wires answer almost as well for these magnets as wires of soft iron, strongly corroborates this last position. For the knowledge of this curious fact I am indebted to Mr. Daniel Davis, philosophical instrument maker, of Boston. A bundle of fine steel wires when wound, give a bright spark and strong shock, whereas the same amount of steel in a solid bar, produces a hardly perceptible augmentation.

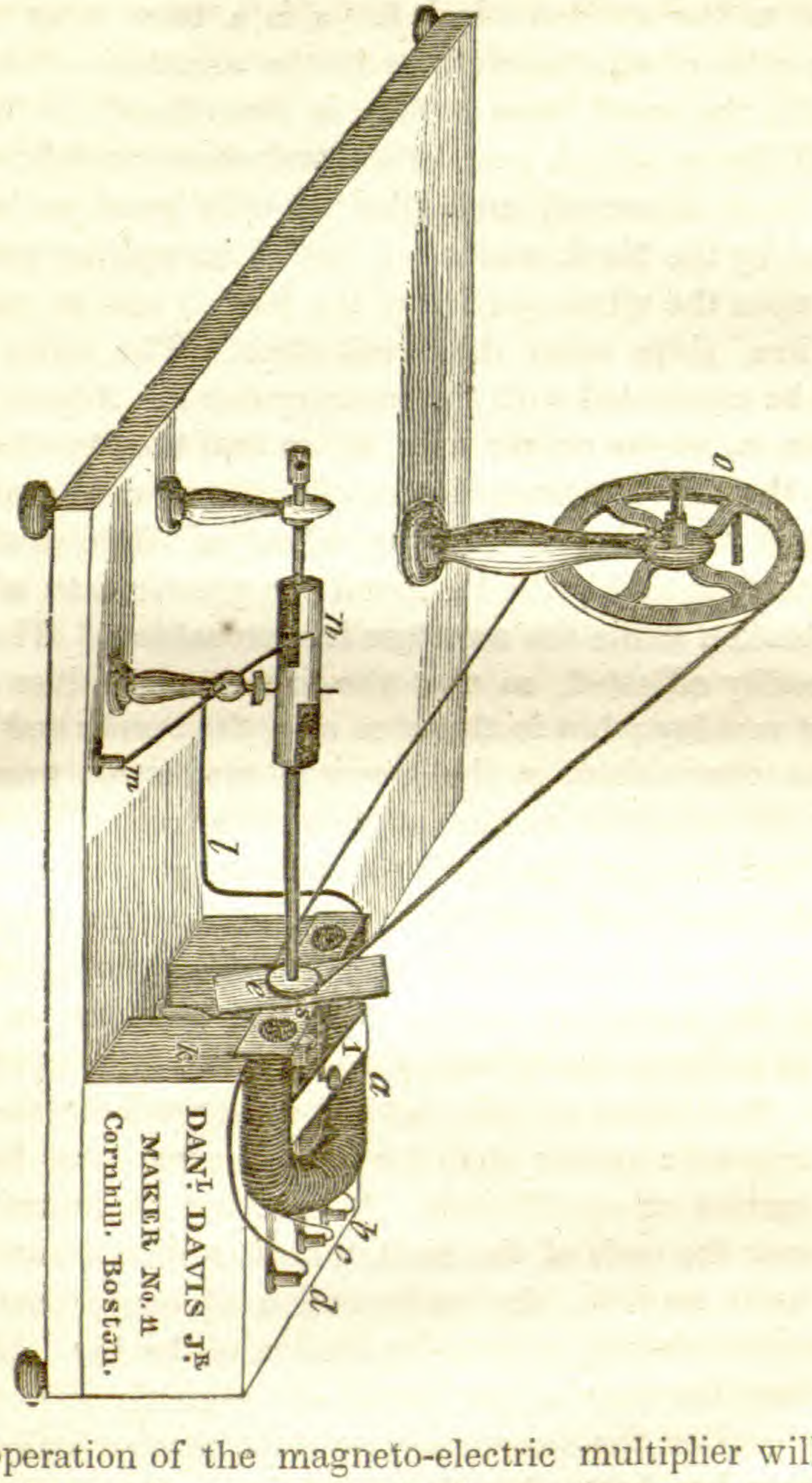
2. *New Magnetic Electrical Machine, or Magneto-Electric Multiplier, convertible into an Electro-Magnetic Engine.*—In order that this machine may be readily comprehended, it will be

necessary to make a few brief preliminary observations, and to advert to the discoveries which led to its invention. When a piece of soft iron enclosed in a helix of wire, is rendered a magnet, by the approach of a magnetized bar, a current of electricity flows through the helix (during the *development* of magnetism) in a direction contrary to that of a galvanic current, which would render the piece of soft iron a magnet of the same character. Withdraw the inducing magnet, and during its withdrawal, or the neutralizing process in the piece of soft iron, the direction of the electric current in the helix will be the *same* as that of a galvanic current which would render the soft iron a magnet of similar polar arrangement. Similar momentary currents are excited when the exciting cause is a galvanic current. *Completing* the galvanic circuit with the helix, determines a current flowing against the battery current. *Breaking the circuit*, determines a current flowing in the same direction with the battery current, which produces the bright spark. Any disturbance of magnetic forces is accompanied with a disturbance of electric equilibrium. It is well known, that an electro-magnet possessing an immense lifting power when its poles are joined by an armature, exerts a comparatively feeble action at a distance. The reason is this: the two magnetic forces or poles are tending constantly to neutralize or disguise each other, the softness of the iron favors this mutual action, and the whole amount of magnetism developed cannot be perceived, until the magnetic forces are insulated or determined towards the poles by the application of an armature. The application then of the armature must occasion a considerable disturbance or movement of magnetic forces, and give rise to an electrical current in the wires. The direction of this current can easily be predicted, from what has been before said. The application of the armature is equivalent to the further development or separation of magnetic forces: hence the new current will flow against the battery current. When the armature is pulled off, the new current is in the same direction as that of the battery. And if the magnet-wires be so arranged that the galvanic circuit may be broken at the instant of pulling off the armature, it will be found that the magneto-electric spark and shock will be far greater, than can be obtained by simply breaking the circuit, without the aid of this operation. Thus we have a new method of augmenting to a great degree the magneto-electric currents from an electro-magnet. The application of the armature contributes to the development of magnetism, and on the simultaneous withdrawal of the armature, and the galvanic current, the whole amount is suddenly neutralized.* The current developed by the *application* of the armature, I have appreciated by the following experiments, and I find its consideration to be of very great importance in the application of electro-magnetism as a moving power. This subject will be considered at some future time, and at present I shall be content with giving briefly the reasons why we cannot increase the power with economy, where a great number of magnets are charged by the same battery. 1. The motion of attracting poles towards each other, actually diminishes the power of each magnet, by determining a current against the current of the battery. 2. The succession of similar or repelling poles, determines a current also against that of the battery. 3. The withdrawal of attracting poles (which must be effected by mechanical power, and is of course directly against an independent movement,) maintains the power of the magnets, as the new current is then in favor of the battery current.

Exp.—To test the value of these secondary currents, I included a galvanoscope in the circuit with an electro-magnet, and placed the needle beyond the direct influence of the magnet. On bringing up the armature, the needle returned four degrees, and on suddenly applying it, the needle swung nearly back, but immediately returned to nearly its original deflection of 40°. Suddenly pulling off the armature, the needle swung over 90°. The following experiment is still more striking. Connect two electro-magnets, so that they shall be charged in sequence, but at the same time, and with the same battery. Load one of them with about as much as it will hold. Apply the armature to the other magnet, and the weight of the first magnet will immediately drop. The same may be repeated with either magnet. The power of this reacting current, as it may be called, is in proportion to the number of magnets in use, charged by the same battery, the num-

* A steel magnet gains power slowly when its poles are armed and loaded simply by determination, or insulation of its poles. Pulling off the armature again weakens its power. Jerking it suddenly off, weakens it still further. In this case the magnetic forces seem to acquire momentum, and go beyond their original statical development.

ber of coils of wire covering the magnets, and lastly in proportion to the rapidity of motion.



The operation of the magneto-electric multiplier will now be understood at a glance. It is simply an electro-magnet, with a revolving armature and break-piece. The revolution of the armature is of course equivalent in its effect, or nearly so, to its rectilinear approach and abduction. *a* is a small compound electro-magnet, 12 inches in length before bent, composed of 500 fine iron wires, covered with 5 superposed coils of large copper wire, No. 16, and 7 layers of fine copper wire, No. 26. *b*, *c*, are the terminations of the small wire, *d*, *l*, the terminations of the large wires. 1, is a wooden strap, which, with a binding-screw, secures the magnet to the wooden block *k*. *s* is a brass strap, to hold firmly the poles of the magnet. *e* is the armature of soft iron, which, with the small brass pulley, is fitted firmly to the shaft. *o*, the multiplying wheel. *n*, is the break-piece, which is merely a copper ferule dissected, and filled up with wood or ivory, as represented by the black spaces. *l*, one of the magnet wires bent up, plays upon the whole portion of the ferule; and *m*, one of the battery wires, plays upon the break-piece. The other battery wire is to be connected with the mercury cup *d*. Adjust now the break-piece, *n*, or the copper wire, *m*, so that the circuit shall be broken at the time or immediately after the armature leaves the magnet, and turn the multiplying wheel *o*. The sparks and shocks thus produced, will be found far greater than when the circuit is broken while the armature is approaching. The break-piece is readily adjusted, so that the armature revolves of itself with great rapidity; but in this case also, the sparks and shocks* are at once diminished, as the source of magnetism must be cut off before the armature arrives at its equilibrium. With things thus arranged, connect the two ends of the small wire *b*, *c*. (This wire is insulated, and entirely independent of the large wire.) The revolution of the armature is now suddenly stopped. The flowing of the secondary current after the galvanic is broken, keeps up or prolongs the power of the magnet so as to retain the armature. As a proof of this, set the spring and break-piece so that the magnetic power shall be cut off, some time before the armature arrives at equilibrium. It revolves of course slowly. Connect now the ends of the small wire *b*, *c*, and it immediately revolves with rapidity, the prolongation of magnetism by the secondary, contributing now to the motion of the bar. Here then the secondary becomes a new source of magnetic power. This instrument, when the armature is revolved mechanically, affords a shock from *b*, *c*, both when the circuit is completed and broken. The sparks are exceedingly brilliant, and the shocks so powerful that they are sometimes felt by the bystanders through the floor. The light from charcoal points is intense. It decomposes pure water, and charges the Leyden jar. But its most remarkable and novel property is that of giving a slight shock without breaking

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* The shocks are taken from the cups *b*, *c*.

the circuit, and while the galvanic current is flowing without obstruction. To effect this, place the spring-wire *m*, with *l*, on the whole portion of the ferule and turn the wheel. A slight shock will be felt at *b*, *c*, being simply the consequence of magnetic disturbance by the motion of the armature. A single thermo-electric pair of bismuth and antimony plates heated and cooled, affords a shock which is felt as far as the wrist.

Washington, D. C. June 2, 1838.

MISCELLANIES.

1. *Synopsis of a Meteorological Journal kept in the city of New York for the year* 1837, *including the average results of the last five years;* by W. C. Redfield.—The observations which I have made on the direction of the wind near the earth's surface, and also on the direction of the highest observed clouds, at periods of four hours' duration, commencing at 6 A. M. and ending at 10 P. M., are comprised in the following table.*

Monthly results for the year 1837.	Direction of the wind at the surface, in periods of four hours each.				Direction of the highest observed current in the region of clouds.			
	Observations of wind from N. E. quarter, including N.	From S. E. quarter, including E.	From S. W. quarter, including S.	From N. W. quarter, including W.	Observations of clouds from N. E. quarter, including N.	From S. E. quarter, including E.	From S. W. quarter, including S.	From N. W. quarter, including W.
January, - - -	21½	1	35½	85	3	0	51	78
February, - -	14	7½	56	53	7	0	66	27
March, - - -	48½	32½	38	32	8	1	62	43
April, - - -	35	22	49	43	5½	1	49½	49
May, - - -	21½	58	33	34	5	11½	77	34½
June, - - -	24	34	73½	13½	13	0½	44	23½
July, - - -	10½	20	79½	29½	3½	6	51	55½
August, - - -	18½	36	48½	44	0	0	48	20
September, - -	33	28	43	35	11	5	67	27
October, - - -	45½	15½	43½	41½	4	8	72½	32½
November, - -	6	13	72½	51½	0	0	40	54
December, - -	32½	1½	58½	61	0	0	51	62
Number of observations,	310½	269	630½	523	60	33	679	506
Proportion in 1000,	179	155	364	302	47	26	531	396
Average proportion in 1000 for 5 yrs.,	219	127	388	266	55	21	593	331

* For a summary of observations from 1833 to 1836 inclusive, see Reports of the Regents of the University of the State of New York for the years 1835 and 1837; also, American Journal of Science, Vol. xxviii, pp. 154—159.

Average proportion of easterly winds in 1000 for five years, 346
Do. of westerly winds " for same period, 654
The westerly surface winds being to the easterly *nearly as two to one.*
Proportion of E. winds in the region of clouds, for five years, 76
Do. of W. winds, " " for same period, 924
The westerly winds being to the easterly, in the region of clouds, during this period, in the proportion of *nearly twelve to one.*

From the foregoing synopsis of observations it appears that the main current of atmosphere prevailing in this region is from the southwestern or western quarter. This may account for the general uniformity of the course pursued by our storms, of almost every description.

Table of the monthly mean height of the barometer in English inches, for each of the five daily observations recorded during the year 1837; *with the average results of the last five years,* 1837 *included.*

1837.	Mean of barometer at 6 A. M.	At 10 A. M.	At 2 P. M.	At 6 P. M.	At 10 P. M.	Monthly mean.
January,	29.855	29.908	29.854	29.874	29.890	29.876
February,	30.022	30.039	30.014	30.021	30.035	30.026
March,	30.210	30.245	30.210	30.199	30.225	30.218
April,	29.924	29.949	29.895	29.907	29.960	29.927
May,	30.035	30.075	30.041	30.032	30.058	30.048
June,	29.950	29.960	29.950	29.931	29.951	29.948
July,	30.011	30.027	30.002	29.985	30.005	30.006
August,	30.086	30.094	30.075	30.068	30.087	30.082
September,	30.262	30.282	30.243	30.234	30.256	30.255
October,	30.259	30.272	30.239	30.281	30.273	30.265
November,	30.160	30.193	30.156	30.168	30.189	30.173
December,	30.167	30.193	30.144	30.181	30.214	30.180
Average results,	30.087	30.103	30.069	30.073	30.095	30.085
" " for five years,	30.097	30.118	30.086	30.083	30.105	30.098

In the foregoing table no correction is made for temperature or for variation in the surface level of the cistern. The annual mean of the attached thermometer is near 68° Fahr., and the capacity of the tube to that of the cistern as one to forty. The capillarity of the tube is provided for in the zero adjustment of the instrument, and its position is about ten feet above the ordinary sea level.

A Table showing the Monthly Maximum and Minimum of the Barometer at New York for the year 1837.

1837.	Monthly maximum and date.	Monthly minimum and date.	Monthly range.
January, . .	30.37 on the 13th, wind N. N. W. fair.	28.83 on the 21st, gale N. E. by E.	1.54
February, . .	30.57 on the 13th, close of gale at N. W.	29.27 on the 23d, change of easterly storm.	1.30
March, . .	30.57 on the 2d and 11th, fair N. N. E.	29.63 on the 18th, change of southerly storm.	.94
April, . .	30.40 on the 28th, wind S. S. W. clear.	29.12 on the 8th, change of easterly storm.	1.28
May, . .	30.40 on the 2d, wind S. W. fair.	29.63 on the 6th, change of S. E. storm.	.77
June, . .	30.20 on the 29th, wind S. W. fair.	29.60 on the 7th and 20th, do. do.	.60
July, . .	30.35 on the 17th, wind S. W. fair.	29.74 on the 24th, change of southerly storm.	.61
August, . .	30.49 on the 6th, wind W. fair.	29.70 on the 30th, do. do.	.79
September, .	30.67 on the 24th, wind N. clear.	29.83 on the 11th, do. do.	.84
October, . .	30.73 on the 9th, w'd N. E. fair: gale off the coast.	29.87 on the 20th, do. do.	.86
November, .	30.70 on the 28th, wind N. E. fair.	29.18 on the 22d, change of S. E. storm.	1.52
December, .	30.63 on the 23d, wind W. S. W.	28.98 on the 18th, do. do.	1.65
Annual results,	30.73 October 9th.	28.83 January 21st.	1.90
Do. corrected for var. in level of cistern $\frac{1}{40}$.	30.75	28.81	1.94

The irregular fluctuations of the barometer during the year 1837, have been somewhat remarkable. For the first ten days in January, which included alternations of stormy weather, the mean height of the barometer was only 29.68 inches. The mean of the first ten days in March was 30.47 inches, this too being a period of variable weather, with heavy gales on the Atlantic, passing near our coast. From the 18th of September to the 18th of October, an entire month, the mean of the barometer was 30.32 inches, the mercurial column having but once in this period fallen to 30 inches for a single observation, although several violent storms traversed the southern coasts of the United States, and over the north Atlantic during this time, on routes not greatly distant from this part of our coast. Other periods during the summer and autumn were distinguished by similar results. This may show that, while the barometer is known to fall when under the action of these storms, a contrary effect is produced upon the exterior border of the storm, a fact which might be inferred from the known rotative character of these gales.

New York, February, 1838.

2. *Notice of a Bramah Press attached to the eyes of certain fishes;* by Dr. W. C. Wallace, Oculist, New York.—When tracing the nerve which supplies the muscle of the crystalline lens in the halibut, I noticed at the bottom of the socket, an aperture communicating with a passage of some extent, and intersected by numerous bands. As I had often before observed an effusion of water when cutting out the eyes of this animal, I procured another head and injected water into the socket: the eyes were immediately elevated, and the field of vision enlarged. This provision for projecting the eyes according to the wants of the animal, and for withdrawing them in case of danger, explains the necessity for a thick coat of jelly, or of fat behind the retina, to keep the fine filaments of the nerve at a proper temperature.

The socket of the turtle contains cavities, into which air may be forced, and the eye blown out. The air cavities are intersected by numerous tendons and fleshy columns, to keep the eye from being pushed out too far. By this contrivance, the eye may be sunk so far in the socket, that there is no danger of striking the organ against the shell, as the head advances or recedes.

3. *Maynard's Catalogue of Mathematical and Philosophical books.*—A very extensive catalogue of mathematical and philosophical books, has been lately published by Mr. Samuel Maynard, of London. The books are offered at reasonable prices, and among them are many that are rare and valuable. Mr. Maynard confines himself to the sale

of works on the mathematical sciences, and accordingly, endeavors to have, as nearly as may be, a complete collection of such works. Those who have occasion to purchase mathematical and philosophical books, might, we think, apply to him with much advantage. His address is, Mr. Samuel Maynard, No. 8, Earl's Court, Leicester Square, London.

4. *New Trilobites.*

(1.) Ceratocephala goniata.*

Communicated to the Western Academy of Natural Science at Cincinnati, May 25th, 1838; by John A. Warder.

Genus, Ceratocephala.

So named because the head is ornamented with appendages which so nearly resemble the antennæ of recent crustaceans, that this genus which we have ventured to propose, seems to form the link that was

* Prof. Silliman—*Dear Sir*—I am desirous to make use of your valuable Journal to publish an account of a new trilobite which has been recently discovered. It differs so entirely from the genera that we find described, and is yet so clearly a member of the race, that the erection of a new genus appears necessary, although the proposition is made with diffidence, by one who objects to the confusion which is apt to grow out of needless distinctions, and too great subdivisions of natural families. Although it is generally admitted that they are evidently analogous to the crab, it has been often and strenuously denied that trilobites possessed any organs corresponding to their *antennæ*. We are now prepared to offer conclusive testimony to the contrary. The specimen, of which we send you a drawing, was found at Springfield, Clark county, Ohio, in the same locality with the Calymene Blumenbachii, bufo? phlyctanoides, and other rare fossils—(all the remains found in that rock are casts of the inner or under side of the crustaceous covering)—the one under consideration I procured last week from the cabinet of Mary A. Warder.

Two specimens of another species have been found near this city by J. G. Anthony, on the first of April, presented to the Academy for examination on the fourteenth, and reported on at our meeting of the thirtieth, at which time it was admitted to belong to some unknown genus of trilobites, bearing horns or feelers; but the committee to whom it was referred hesitated in describing it, because they were in hopes that some further elucidation would be furnished by new and more perfect specimens. In the mean time, J. G. Anthony wrote letters and sent casts to Prof. Jacob Green, and to the Academy of Sciences in Philadelphia, to Dr. De Kay of the New York Lyceum, and to Dr. Storer of Boston—so as to disseminate the information as much as possible, and by this means to secure the priority—so that if any of these gentlemen have ventured to erect a new genus from the fragment, I shall be willing to have my species merged in their genus, provided, the characters will embrace it, as my generic characters do his; but as I can hardly imagine they have taken any steps in the matter, and as my specimen was first found and had excited the attention of its possessor, the following paper was prepared and read before our Academy on the evening of the 24th instant, at nine o'clock, P. M. Yours, respectfully, J. A. W.

deficient between extinct and existing forms, and to confirm the generally entertained belief, that the trilobite race were true analogues of the crustacea. This genus embraces two species already found, one at Springfield last summer, the other near this city, by J. G. Anthony, on the first of April.

Generic characters.

Body, contractile?

Head, full, lobate, irregular, tuberculated, and furnished with two antennæ or horns, projecting forward beyond the buckler, based between the termination of the front and the margin of the lip; between them there is a central eminence on the mesial line.

Front, prominent.

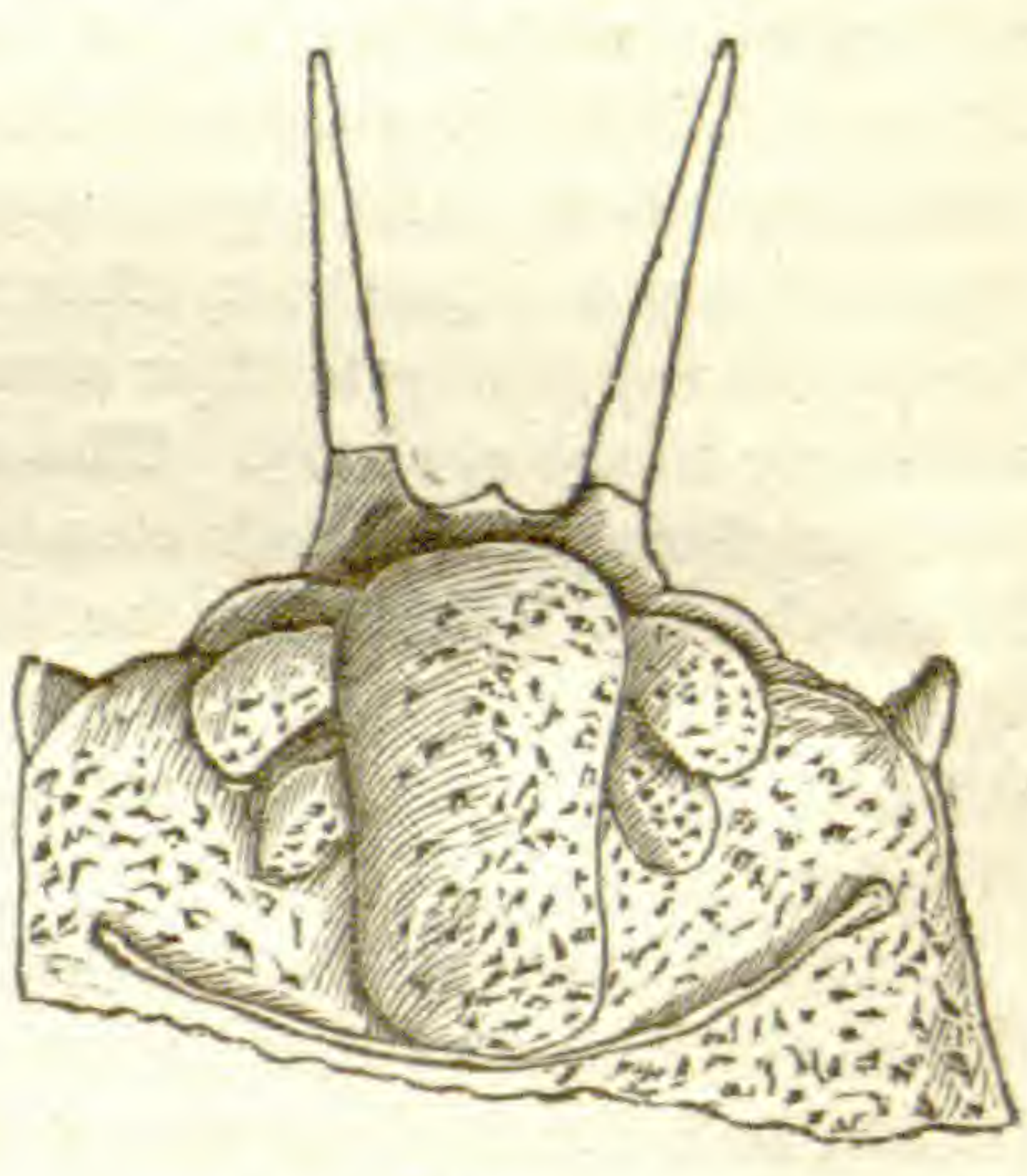
Cheeks, extending on each side so as to form large spherical triangles, separated from the front by deep sulci, in which are placed oculiform processes, (three in number?)

Abdomen and tail, deficient in our specimens.

Species, CERATOCEPHALA GONIATA.

Clypeo antice angulare, convexo, punctato; tuberculis oculiformibus eminentissimis et triplicibus; cornibus prorsum expansibus.

The head of this species presents the outward figure of half an irregular decagon, full, nearly semi-cylindrical in its transverse diameter, furnished with two antennæ projecting forward; they originate between the front and lip, nearly opposite the sulcus, between the front and cheeks; they are broad at the base, and extend two lines to the place where they are broken off: between these and the front there is a raised point half a line high, on the mesial line, covered with tubercles precisely like those of the *Calymene Phlyctanoides.* Lip raised, and semi-circular anteriorly, but extended laterally by angular projections from the cheek. Three oculiform processes occupy the spaces between the front and cheeks; the upper and lower pairs most prominent, and have deep pits beside them. Front, prominent. Cheeks, extending on each side so as to form large irregular triangles, are ornamented laterally by a projection, supporting the angles of the lip, giving the whole buckler its very irregular form. Near the centre of each cheek there is a prominence half a line high, apparently broken off; these are connected by a raised line sweeping back around the posterior extremity of the *front.*



Abdomen and tail wanting in our specimen, believed to be tubercular throughout—(as a fragment presents that appearance.)

Breadth of the head one inch and a quarter; length three quarters of an inch.

(2.) Ceratocephala ceralepta.

Communicated to the Western Academy of Natural Science at Cincinnati, April 14th, 1838, by John G. Anthony.

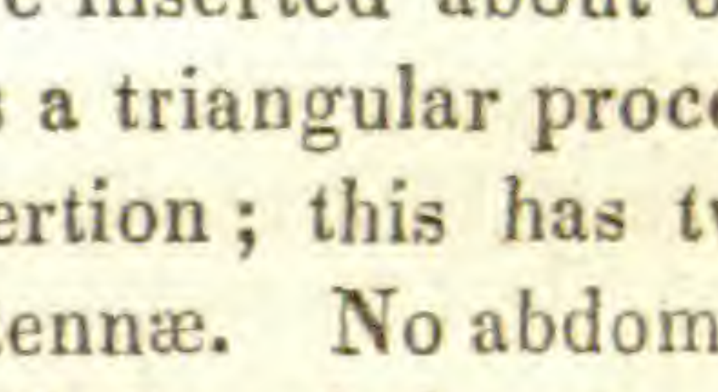
Ceratocephala ceralepta.—Clypeo antice rotundato, subplano, granulato.

Margine crenulata.

Cornibus prorsum expansibus et gracilibus.*

The buckler is semi-lunate, surface covered with fine granulations resembling shagreen; its margin is raised, presenting a rounded rim, over which pass two antennæ, distant from each other where they pass over, about one fourth of an inch. These antennæ extend one third of an inch beyond the rim, and are only one third of a line in diameter, forming a character from which we derive our specific name, "ceralepta" (slender horned); their extremities are broken off, and it would appear that they have been several lines longer; they diverge a little at their extremity, being about one line more distant there than at the margin of the buckler; they are inserted about one line within the rim. Between the horns there is a triangular process extending from the rim back as far as their insertion; this has two deep sulci on each side, separating it from the antennæ. No abdomen or tail has yet been found, which could be identified as belonging to this species.

1.† 2.



Only two specimens are known to have been found, both by myself. They were discovered among the rubbish thrown down from a quarry, half a mile from this place. Millions of fragments may be found there of Calymenes, Isoteli, &c., and we may hope a more perfect specimen of our own species.

When first shown to some scientific friends, it was pronounced a part of Ceraurus pleurexanthemus, and Dr. J. Green so judged it from an imperfect cast shown him. Those who have since had an opportunity of comparing my specimen with a Ceraurus pleurexanthemus

* Cabinet of John G. Anthony.

† 1. Under side of the head of Ceratocephala ceralepta.—2. Upper view of another specimen. The color of the fossil is a dark brown, nearly black

found in this vicinity this spring, have discovered that it cannot be confounded with it. Among those who thus doubted at first, and afterwards became convinced, I may mention Dr. J. A. Warder of this place, who, on a recent visit to Springfield, Ohio, found among some fossils belonging to his sister, a specimen of what he deems another species belonging to the same genus with the present. On consultation, we have concluded to form a new genus, to be called Ceratocephala, (*horned head.*)

(3.) ASAPHUS POLYPLEURUS. *Green.**

Clypeo? costis abdominis duplicibus; cauda rotunda; corpore convexo.

This Asaph, at first sight, seems to differ especially from all the other American species hitherto noticed, in the number and thinness of the ribs, or costal arches of the abdominal lobes. When carefully examined, however, it becomes obvious that the apparent number of the ribs is produced by a straight longitudinal furrow on the upper surface, which divides each rib into two nearly equal portions, thus seemingly doubling their number. These furrows or grooves do not terminate in the costal arches, but extend, in several instances at least, beyond, into the *membranaceous expansion* by which they are surrounded. The ribs therefore do not end in free angular points, as those of the A. Wetherilli, the A. Limulurus, and some others. The membranaceous expansion forms a narrow semicircular border round the lateral and caudal edges of the body. The middle lobe of the back is very prominent. The animal is decapitated, and the fragment described measures in length and breadth three fourths of an inch.

The above trilobite occurs in a coarse grained greyish limestone, which contains other fossils. It was found by that distinguished geologist, Richard C. Taylor, Esq., in the state of Missouri, on the bank of the Mississippi, near the mouth of the Des Moins river. It is to be regretted that our fossil is so much mutilated and worn; but enough yet remains to identify from it the species, when perfect specimens shall be discovered. The prominence of the middle lobe of the abdomen indicates that it may ultimately be referred to some other genus than the Asaph.

(4.) *Additional notices of Trilobites.*

From Mr. J. Walter, of Louisville, Ky., we have received a drawing of a trilobite seven and a quarter inches long, by four inches broad.

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* Communicated for this Journal, by JACOB GREEN, M. D. Professor of Chemistry in the Jefferson Medical College, Philadelphia.

Specimens we have not seen, but the drawing has been inspected by a gentleman, than whom there is no better authority; and although he wisely declines to give a decided opinion upon a drawing merely, it appears probable, that this is a new species; but we decline inserting either the drawing or descriptive notices, until a specimen can be examined. This fossil is found in Bourbon county, Ky.; and about thirty miles from that place, in Mason county, there is found a very perfect trilobite, two and three quarter inches by one and a quarter. Mr. Walter will confer a favor by sending specimens to Prof. Jacob Green, Philadelphia, and to the Editor.

A letter from Mr. Willis Gaylord, dated Otisco, Onondago county, N. Y., June, 1838, contains drawings of very perfect orthoceratites and trilobites, which are known to prevail very extensively in that region. We believe the species not to be new; and if they are new, they have probably not escaped the attention of the gentlemen engaged in the geological survey of the state of New York.

5. *Substitute for Emery.*—Topaz, the discovery of which in this country was first announced in this Journal* many years since, has continued to occur in such abundance, (although not *in general* beautiful,) that the owner of the locality has been induced to crush it to powder as a substitute for emery. The hardness of the topaz is such (8) as to place it next to corundum, (9) with the exception of spinelle, automolite and chrysoberyl, which approach nearer to corundum than topaz; but they have never been found in the quantity that the latter occurs at Monroe. And we understand that those who have made use of this substitute find, that for all common purposes, it answers very well.

6. *Temperature of the Saco River.*—I send for publication in the Journal of Science, a table of observations made during the past year upon the temperature of the Saco river. The experiments were made in running water, above the falls, and may be relied upon as correct.

This river has its source in the 'Notch' of the White mountains of New Hampshire; is about ninety miles in length, and falls into the ocean three miles below the place where the observations were made.

It will be noticed, that during the time that the river was covered with ice, the water remained stationary at the freezing point. On the 9th of December, at six o'clock, A. M., about three fourths of the water was stopped by anchor ice. The day was clear, and the warmth of the sun having removed the ice, the water flowed in the usual quantity at about ten o'clock.

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* Vol. x. p. 352. Vol. xi. p. 192, &c.

The river was clear of ice on the 10th day of April, and closed on the 9th of December, being the day on which the anchor ice referred to was formed, the temperature changing at the same time from thirty-three to thirty-two degrees.

I have observed that in extreme cold weather, the vapor from the falls has a very sensible effect upon the temperature of the atmosphere, the mercury commonly standing four or five degrees higher within a few rods of the river, than it does at the distance of one fourth of a mile.

JOHN M. BATCHELDER.

Saco, May, 1838.

Days of the month.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	32°	45°	60°	70°	72°	64°	57°	42°	34°
2	32	45	61	70	71	63	57	42	34
3	32	45	62	70	71	63	57	41	34
4	32	45	63	70	71	63	56	40	34
5	32	45	63	70	71	64	55	40	33
6	32	46	63	70	70	64	53	40	33
7	32	46	63	70	70	65	52	39	33
8	32	46	64	70	70	67	51	37	33
9	32	47	65	70	70	69	50	37	32
10	33	48	64	70	69	70	50	37	32
11	34	48	64	70	69	68	50	37	32
12	35	50	64	70	69	67	50	37	32
13	36	50	63	71	68	67	49	37	32
14	36	50	64	71	68	66	48	35	32
15	37	50	64	72	68	65	48	34	32
16	37	50	65	72	68	65	47	34	32
17	37	50	64	72	68	65	46	34	32
18	38	50	62	72	69	66	47	35	32
19	38	50	63	73	70	65	49	35	32
20	39	50	62	73	71	64	49	36	32
21	39	50	62	73	70	63	49	36	32
22	39	51	63	73	69	61	49	36	32
23	39	52	64	73	68	60	49	36	32
24	39	52	63	73	68	60	49	36	32
25	40	53	64	73	68	60	49	35	32
26	40	54	66	72	68	59	49	35	32
27	42	55	66	72	68	59	49	34	32
28	43	56	66	72	68	58	48	34	32
29	45	58	67	72	67	58	47	33	32
30	45	59	68	72	66	58	44	33	32
31		60		72	65		43		32
Mean Temp.	36.63	50.19	63.77	71.39	68.97	63.53	49.87	36.57	32.39

7. *Asphaltic Mastic, or Cement of Seyssel.*—A pamphlet before us, has been published in London, by F. W. Simms, Civil Engineer, (8vo. pp. 27, 1837,) explaining at some length the great importance of the above cement, in the construction of pavements, roofs, floors, hydraulic structures, and other works of a similar nature. This cement is prepared from a bituminous limestone, found at Pyrimont, one league north of Seyssel, in the department of L'Ain, on the eastern chain of the Jura mountains. This limestone is inpregnated pretty uniformly by about nine per cent. of bitumen, and for the purposes of the arts is broken down to a fine powder, being previously roasted to drive off any water that might be present. It loses by the roasting about one fortieth of its weight, and becomes so loosely coherent as to be easily forced through a sieve, with meshes one fourth of an inch square. To the calcareous asphalte thus prepared, seven centimes in the hundred are added of bitumen, extracted at the same place from the *molasse* (silicious gravel and bitumen) which extends from the banks of the river Rhone, to the foot of the Jura, covering the last stratum of the superior calcareous oolite, of which these mountains are composed. This bituminous gravel is broken into egg-shaped pieces, and thrown into boiling water, by which means the bitumen is completely separated, with a yield of about fifteen to eighteen per cent. The bitumen and calcareous asphaltum are thrown together in the above proportions into iron cauldrons, carefully heated, and when liquid, a quantity of clean gravel also heated quite hot, is projected into the mass, and thoroughly incorporated by stirring. When it is rather more fluid than treacle, and begins to simmer, it is fit for use, and may be carried in buckets to the moulds, if the blocks of a pavement are desired; or if intended for lining walls of stone or brick, forming of roofs, and the like, the small gravel spoken of above, is omitted.

Its application to all the purposes of architecture where cements are required, in the construction of permanent floors, water tanks, &c., seems to promise the most substantial advantages. Several experiments have been made to test its strength as a cement, one or two of which we will cite. Thirty bricks were cemented together with the Asphaltic Mastic* of Seyssel: the whole length was 5 feet 7¼ inches, each brick being two inches thick.

* The following are the retail prices of this material, both in its native and manufactured states, as charged by the company in Paris.

	£	s.	d.
"Asphalte in its native state, per 100 kilograms (about 219 pounds English) - - - - - - - - - - -	1	0	10
Foot pavements, &c. &c. per metre superficial (1,196 square yards English) - - - - - - - - - - -	0	5	10
Covering of roofs, per metre superficial - - - - - -	0	7	6

"*Experiment* 1.—The length of thirty bricks was placed upon a fulcrum, or prop, as nearly in its centre as would admit of the projecting ends being in equilibrium: fifteen bricks were overhanging each side of the prop, and after being left in that situation for a length of time, it was ascertained that no sensible change had taken place in any of its parts.

"*Experiment* 2.—We next placed one end of the connected bricks upon a firm support, and then placed heavy weights to keep that end down, leaving twenty-two bricks projecting horizontally, quite unsupported except by the tenacity of the cement; this projection measured four feet one inch; the average weight of the bricks was five pounds each. After fifteen minutes thus suspended, the extreme end appeared to have descended near half an inch, but of this we were not quite certain: no further change was at all perceptible.

"*Experiment* 3.—This experiment was both unintentional and unsatisfactory; the workmen in removing the bricks to rest each end upon a prop, that we might place weights upon its unsupported middle, let one of the ends fall with its full force upon the ground, while the other end remained supported: a fracture was the consequence, but it was a brick that broke and not the cement.

Experiment 4.—Ten bricks in length were supported at each end, and the weight of 150 kilograms, upwards of 300 pounds, was placed upon the middle, and was allowed to remain fifteen minutes without undergoing the least change; additional weights were then added till they amounted to 303 kilograms, or upwards of 606 pounds, and after being exposed to this weight for ten minutes it broke at the middle brick; but, as in the third experiment, it was the brick, and not the cement, that had given way." pp. 9, 10.

After quoting an instance or two of the use of this material as a pavement, we must close our notice, and refer those who wish further

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The following are the prices at which Yorkshire stone-paving can now be obtained in the metropolis.

	Tooled.	Rubbed.
	s. d.	s. d.
Three inch paving, per foot superficial - - -	0 9	0 11½
Four inch - - ditto - - - - -	1 0	1 2½

The above are the prices of the small sized flag-stones; but where larger stones are required, such as are now employed for paving the bettermost streets, the Yorkshire landings must be used, the prices of which are as follows:

	Tooled.	Rubbed.
	s. d.	s. d.
Four inch, per foot superficial - - - - - -	1 8	2 0
Five inch ditto - - - - - - - -	2 0	2 4
Six inch ditto - - - - - - - -	2 10	3 2"

information, to the pamphlet itself, or to Mr. F. W. Simms, Upper George Street, Greenwich, or 136 Fleet Street.

"The foot-path of the eastern side of Pont Royal, was laid down as an experiment two years and a half ago; and although it is stated, that as many as 30,000 persons pass and repass daily, yet it appears to be almost as perfect as when first put down; whereas the curb and other stones with which it is bounded have worn to a great extent. Our observations here confirm Chevalier de Pambour's statements.

"The whole of the foot-paths on Pont de Carrousal, have been down two years, and do not indicate the least wear whatever; this specimen is also submitted to a severe test from the vibrations of the bridge, which is of iron, but of so light a construction, that the vibration from passing carriages, is at least as great as that of the suspension-bridge at Hammersmith; yet it has withstood this, and also the action of two winters, without the least symptoms of cracking or decay."

"We cannot omit to mention the magnificent piece of pavement now nearly completed in the Place de la Concorde: in the centre of which the Egyptian obelisk is erected: 24,000 square yards are here being laid down in elegant Mosaic work, with the asphalte of Seyssel. The ease, rapidity, and simplicity with which this is formed, calls forth the admiration of all passers-by. The fluid mastic is spread to fill a mould, formed of bar-iron of the pattern desired, (at the Place de la Concorde, the design consists of large squares alternately black and white, each square having a circular disk in its centre of the contrary color to itself,) while the mastic is still fluid, a fine gravel is sifted over it, either white or black gravel according to the color required, and then as the mastic sets, the whole is beaten flat with wooden stampers of about fifteen inches long and nine broad; the pavement so done, and after a little wear, can scarcely be distinguished from granite."

"We will here place on record our observations of the method followed in the manipulations of the material, and the formation of the foundation to receive it, as adopted at the Place de la Concorde.

"First, the ground is made nearly level, or of the requisite slope, then the curb stones are laid by the mason, the surface of which is left about four inches above the ground; this space is filled within an inch of the top with beton, which is a substitute for the concerte of England. The beton here employed is thus constituted. A mortar is first made, consisting of one third of hydraulic lime, and two thirds of river sand, then one of mortar, with three of cleaned gravel well mixed, which form the beton: this must be well pressed on its bed, and the surface subsequently smoothed with a thin coat of mortar, similarly composed to that above described; the use of hydraulic lime is, that the beton and mortar may set more rapidly. When the whole is quite dry, and not till then, the Mosaic pattern may be set out in the mortar, and by means of flat iron bars, rings, &c. of the proper thickness (about half an inch) the moulds are formed, into which the fluid mastic is poured, and spread as before described." pp. 11, 12, 13.

8. *Rafinesque's Botanical Works.*—(Communicated.)—Professor Rafinesque of Philadelphia, began to print and publish in 1836, two great botanical works, which he states to be the result of his botanical researches for forty years, since 1796, in the two hemispheres.

The first is FLORA TELLURIANA, or Synoptical Mantissa of two thousand new or corrected families, genera and species of plants, from all parts of the earth, and thus the first work ever published in America, upon the general botany of both hemispheres. Three parts of three hundred and six pages, large 8vo. have been published already. One of one hundred and four pages, containing the introduction, natural classification, and generic rules; the second of one hundred and twelve pages, and the third of one hundred pages, include eight hundred new or revised and corrected genera and species with some new natural orders. He has particularly revised the families of Saxifrages, Gentianea, Polygones, Asphodelides, Helonides, Orchides, Astorides, Atriplexides, Labiatæ, Resedines, &c. This work is supplemental to De Candolle and Lindley, and contains many American genera.

The second work is NEW FLORA AND BOTANY OF NORTH AMERICA, supplemental to all other American floras, containing the genera and species omitted or mistaken by Pursh, Michaux, Torrey, Hooker, Beck, Elliot, &c. Three parts have also been published, forming a half volume of three hundred pages, 8vo. The first contains the introduction, geography, lexicon and monographs; the second, a historical sketch, and Neophyton of three hundred new or revised species of herbaceous plants, whereof eighty six are monocotyledons; the third, sylvan sketch and new Sylva of two hundred and thirty four new or corrected trees and shrubs. There are several complete Monographs of the genera Celtis, Morus, Spirea, Hydrangea, Hamamelis, Fagus, Forestiera, Ceanothus, and some new genera, Nestronia, Cladastis, Nudilus, Zanthyosis. Also, monographs of Lechea, Amphicarpa, Kuhnia, Peltandra, Eclipta, Crotalaria, Capsella, Baptisia, Gerardia, Iris, Tradescantia, &c.

Both are sold by the author, for one dollar each part, or five dollars for the six parts already published. We understand that he accommodates the botanists, by receiving their works in exchange, or else specimens of rare plants: and he receives subscriptions for the remainder of his botanical and zoological publications.

9. *Wonders of Geology, in two Vols. 12mo., with numerous plates and wood cuts;* by GIDEON MANTELL, LL. D., F. R. S., M. G. S., &c., &c.—This new work we have, within a few days, received from the respected author, and as the present No. of the Journal is near finishing, we hasten to give it a passing notice. Dr. Mantell's earlier works, among which were, Illustrations of the Geology of Sussex, 4to., with 42 plates, that on Tilgate Forest, 4to., with plates, The Geology of the South East of England, 8vo., with numerous plates and cuts, and many memoirs and tracts, were published when the author resided in his native town of Lewes, seven miles from Brighton. By his great industry and zeal, he redeemed, from the cares of an extensive and laborious practice in surgery, time enough to produce these fine works, which rank with the very first on the science of geology, and have raised the reputation of their author to a high standard, giving him both an European and a transatlantic fame. Dr. Mantell, during his residence at Lewes, collected a splendid, and in a great measure an unique museum, the most remarkable ornaments of which were the astonishing fossil bones and other reliquiæ of his own region, discovered chiefly by himself and his family. Of this museum we gave an account at page 162, Vol. 23, of this Journal.

A few years since, Dr. Mantell removed to Brighton, and there established his museum in appropriate apartments. It soon became a nucleus, around which clustered the Sussex Scientific and Literary Institution, and in its rooms were held instructive and entertaining conversaziones. On these occasions and in connexion with the museum, many interesting objects of nature and art were exhibited and described by Dr. Mantell and his friends, and thus a hope was conceived and cherished (we wish we could say, it has been *fully sustained*) that a permanent elevation might be given to the fashionable crowd which revolve around the court and the throne, during its temporary pilgrimages to this favorite point on the chalky shores of Albion.* In these efforts Dr. Mantell was, primus inter pares, (if indeed a compeer he had,) among many associates in science and literature, most of them his personal friends, who adorned those coteries, so novel, in a city devoted to the splendors of the court and the fashionable amusements of the high and noble gentry who revolve in its orbit.

* Fifty-five miles south of London on the Channel coast.

For the sake of forwarding the great object in view, Dr. Mantell yielded to the wishes of his friends and the public, by giving occasional lectures on topics relating to the sciences which he has so successfully cultivated. Those who had read his various works, in which science, genius, and taste were warmed by a noble but disciplined and sustained enthusiasm, waited only to learn whether his powers as a public speaker (at that time, as we have been credibly informed, little inured to actual practice) were commensurate with his high attainments as an original investigator, and as a man of science and of intellectual vigor; nor were they disappointed. We are assured by numerous public statements in the Brighton papers, as well as from independent sources, that his success in this character was fully commensurate with his previous reputation. In consequence, he was called upon to give a regular course of lectures on geology and the connected sciences, aided by his magnificent museum and by ample illustrations from drawings.

We have already mentioned this course of lectures, and we copied an abstract of one lecture, as given in a Brighton paper. (See Vol. 33, p. 328 of this Journal.) It was numbered 1, and we intended, as then announced, to make other extracts from time to time; although extraordinary absences and engagements have suspended the selection, we still cherished the design, when the arrival of the work announced at the head of this notice, superseded our purpose, in a way which we could not well explain, without this introductory statement.

The Wonders of Geology of Dr. Mantell contain the substance of the lectures given by him at Brighton, and thus the public are put in possession, in a concise and perfected form, of the whole of the stores of knowledge from which we intended to cull the most instructive and inviting parts. We shall not, however, feel precluded from proceeding again with our original purpose, especially, should the work not appear in the bookstores of this country.

It contains, indeed, the principal wonders of geology; but it would be great injustice to consider it as a mere collection of *mirabilia*. It embraces a regular system of geology, exhibiting its leading facts, and clearly elucidating its philosophy, the latter being the great object of the work, to which the facts, as a basis, are only auxiliary.

The arrangement is, from the alluvial and diluvial down through the tertiary, secondary and transition to the primary rocks, and all the igneous formations; ending with the actual ignivomous mouths, as they appear in the existing volcanos. The form of lectures (of which there are eight) is preserved, with the appropriate style and address, and with the references to the objects presented by way of illustration.

Although the lectures are necessarily long, (since the whole story of the actual structure of the crust of the globe and of its basis is told, as far as we know it,) they are conveniently divided under numerous heads, printed in small capitals, and thus the eye easily catches and reviews the various topics.

The plates are of the size of the volumes, so that there is no inconvenience from folded paper; and many appropriate wood cuts in connexion with the subjects, chequer the pages, and thus speak, through the eye, effectively to the mind.

Many things might be said as to the best arrangement for a course of lectures, or for a work on geology.

1. We may begin as Dr. Mantell has done, at the actual surface, and proceed from what we know and are familiar with, down through formations less and less known, until we arrive at the deep profound of the earth, the bathos of our ignorance; this is in the reverse order, both of the chronology and deposition of the strata. On the whole, this arrangement presents many important advantages, but leaves the igneous phenomena unexplained until a late period.

2. We may begin with the granite, the deepest rock of which we have any knowledge, and then in the ascending order, we meet only with materials with which we have been made acquainted, and of which the derivative rocks are constructed. We proceed also from animals and plants, the least known, or entirely unknown, through successive families, more and more assimilated to those of our own times, and end with those that are identical with the existing races.

3. We may begin with the granite and ascend through the ignigenous rocks to the surface-fires of the actual volcanos, and then, descending through them, to their deep foci, ascend again, through the schistose-primary, and fossiliferous rocks to the actual surface; or we may descend in the reverse order.

4. We may begin with the cones of active and extinct volcanos—descend through the igneous rocks to the granite, and then up as before, through the primary, transition, secondary and tertiary, to the actual surface, ending with the diluvial and alluvial.

Having ourselves tried all these methods in instruction, we have preferred the 1st and 4th; and of these two, the latter, as putting us in early possession of igneous agency, the most potent, and the most concealed of the causes connected with geological dynamics, and leading us naturally through the sequel of aqueous agencies with which we are better acquainted. Still, our preference for this course is so slight, that for the sake of leading on a class by the aid of so instructive and delightful a guide as these volumes afford, we should not hesitate to adopt that course which Dr. Mantell has chosen.

Thus much of the order; now of the execution of the WONDERS OF GEOLOGY. After the ample proofs of talent, science, skill, taste and enthusiasm, regulated by a severe induction, which Dr. Mantell had before given us, it would indeed have been surprising if his last work had not been worthy of its predecessors and of its author; with pleasure we add, that it fully sustains its claims to the lineage whence it has sprung.

In point of science it is precise, accurate, condensed and cumulative in proof, conducting the pupil forward by a series of steps, grateful in the progress and conclusive in the result; no important facts are omitted and none are unduly expanded.* The style is lucid and flowing, but simple and elevated, while the figures render every thing intelligible, even to the unprofessional reader.

The introduction which precedes, and the retrospect which closes the account of each formation, afford an admirable summary both of facts and doctrine, and are distinguished for graphic power, eloquent diction, and comprehensive views.

The greatest excellence of Dr. Mantell's work is, that it affords an excellent pioneer and conductor for the pupil attending a course of lectures, and even for the private student, who has to work his own way without a guide. In both these respects, it is superior to any book with which we are acquainted, and we shall be gratified should it be in our power to introduce it to the American public under a form in which it can reach the colleges† and academies and schools—not to mention the studies of literary men, and the parlors of families. It is a work of delightful entertainment as well as of instruction, and although less elaborate than the original works of investigation of the same author, it will find its way to many more readers, and will, therefore, be even more extensively useful than they have been.

The author modestly disclaims the merit of originality, having, as he says, only strung together the beautiful pearls collected by others, while he has merely furnished the string. But his friends will not

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* If there be any part which some persons might regard in this light, it would probably be what relates to the local geology of the English and French secondary and tertiary; for ourselves, however, we should decidedly prefer this fullness, especially, aided as we have been by our English friends, (and by none so much as by Dr. Mantell himself,) with the specimens necessary to the elucidation of these formations. In this country, geologists might wish a more ample account of the granitic and primary family which on this continent, and especially in the Eastern States, makes a great figure.

† We hope soon to be able to take similar ground with respect to a new work of Mr. Lyell—Elements of Geology, in one volume, now in the press in London. Mr. Bakewell's new edition, of which a reprint was promised in our last number, has not yet, to our knowledge, arrived in this country.

permi this merits to rest here. They will not forget, that his own original investigations have been among the most successful of the age, and their results among the most brilliant obtained by geologists.

"Commencing with the human epoch, he proceeds through the various systems which preceded the creation of man, and the several eras of the gigantic elephant; of the tertiary; the chalk; the weald; the oolite and lias; the corals; the carboniferous strata, and the primary rocks, are by turns the subject of instructive and delightful comment. The work is illustrated with much taste; a frontispiece from the *burin* of Martin gives a representation of the country of the Iguanodon, representing these monsters of the ancient world attacking and devouring each other; two drawings of corals, tastefully designed, and splendidly colored by the pencil of Miss Mantell, form embellishments of first-rate beauty and interest, and nearly a hundred wood engravings with colored sections of strata, maps, &c., bestow at once pictorial grace and scientific illustration on the volumes. A work commencing as does this with the most recent periods, and advancing to those incalculably remote,—in a word, proceeding from the human epoch and the connection of man and his works with the mutations of the earth, through periods in which no traces of mankind are discoverable, but animal and vegetable remains alone occur, down to the primary rocks themselves, in which no organic remains have hitherto been supposed to exist,—comprises a vast, an almost unlimited, field of inquiry, and requires in the writer who should justly describe them, qualifications and powers of no common character.

"Dr. Mantell has acquitted himself admirably of the arduous task which he has chosen; and, as a valuable collection of scientific data—as an able generalization of facts—as a clear and lucid statement of the chief principles and most important deductions of geology—in short, as a highly valuable and useful epitome of the Encyclopædia of geological science, we should unhesitatingly recommend this work as superior, in many essential particulars, to any yet published. Its plan displays that lucid arrangement and order which eminently characterize the lectures of the author, and by which he is enabled to render objects, apparently uninviting or repulsive, in the highest degree attractive and pleasing: to attract and interest even the gentler sex with studies which philosophers themselves consider abstruse and severe, and thus to show that philosophy is—

> "Not harsh or crabbed, as dull fools suppose,
> But musical as is Apollo's lute."

"Each lecture is arranged under important and attractive heads; these are referred to in a copious index; while the most difficult scientific terms are explained in a glossary; so that he who runs may read."—*Brighton Herald, (Eng.) paper, March* 31, 1838.

The present work, like others of the same author, is distinguished by a reverent spirit towards the Author of nature, who appears to be sometimes forgotten by those who investigate his works. Dr. Mantell's volumes will leave a happy moral and religious impression upon the minds of young persons; and thus science, in this department, as well as in others, will be seen to be the handmaid and ally of revealed religion.

It is an interesting fact, that among the fine writers of the present day, several of the geologists hold a very high rank, and their works, although devoted to science, are also an ornament to literature. Who can write better than Sedgwick, Buckland, Lyell, Greenough, Daubeny, Murchison, De La Beche, and Mantell, and many more geologists who might be named!

There is but one painful impression left on the mind, in closing Dr. Mantell's delightful volumes. He informs us that this is his farewell to science,* as he must henceforth be devoted to the practice of an arduous profession, and for this purpose he has already left the classical fields of his own geological domain—Tilgate forest and Brighton cliffs and the Chalky Downs of Sussex—to plant himself in a suburban village,† as a practising surgeon.

We were thus plaintively reminded of Blackstone's touching farewell to the Muses, when he was about to enter the gloomy halls of the courts of law; and still more forcibly, of the struggle of Garrick between Comedy and Tragedy, as portrayed by the magic pencil of Reynolds—each rival sister wooing him with admitted and almost prevailing claims and attractions. In the present contest between surgery and geology, each striving to appropriate to itself an honored votary, we dare avow, that our loyalty is, at all hazards, engaged in favor of geology; and if a transatlantic republican might dare to waft in the western breeze a whisper that, perchance, may cross the ocean and reach the ear of the youthful, lovely, and excellent British Queen, it would be, *that a man who has honored the British nation, and delighted the scientific world by his beautiful researches, might be made easy* to pursue the bent of his own glowing and gifted mind, and thus *to work onward in science, until the work of life is done!*

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* At least, as a lecturer.

† Clapham Common, near London, distinguished as the former residence of many great and good men, among whom were the Thorntons, father and sons, Lord Teignmouth, and Wilberforce.

10. *Report accompanying the Map of the extremity of Cape Cod, Mass., executed during portions of the years* 1833, 1834, *and* 1835; by James D. Graham, Major U. S. Topographical Engineers. Doc. No. 121. Jan. 1838. 8vo. pp. 101.—This valuable document is chiefly occupied with tables showing the flow of the tides at Provincetown Harbor, and at Race Point, Cape Cod, Mass., in 1833, 1834, and 1835, and with quarter-hourly tide tables kept at Provincetown Harbor, in June and July, 1835. The observations were made and the tables prepared under the direction of Major Graham. They have evidently cost much persevering labor, and are very creditable to all concerned. Observations on the phenomena of the tides are at the present day receiving much attention from men of science in various parts of the world, and we have no doubt this contribution will be gladly welcomed by all those engaged in the elucidation of this interesting subject.

11. *Prodromus of a Practical Treatise on the Mathematical Arts: containing directions for Surveying and Engineering;* by Amos Eaton, A. B. and A. M., Senior Professor in Rensselaer Institute. 8vo. pp. 191. Troy, N. Y. 1838.—The author in his preface states, that this volume is made up of selections from a mass of heterogeneous materials which he has been depositing in his common journal for more than thirty years. It is a large collection of miscellaneous hints, principles, rules and processes in practical science. The following list of the titles will furnish a partial idea of the topics treated of:—Arithmetic, Trigonometry, Mensuration, Land-Surveying, Statics and Dynamics, Mechanical Powers, Architecture, Rail Roads, Excavations and Embankments, Canals, Roads in general, Water works, water power applied to milling, &c., Topography, Materials for construction, Useful Rocks and Cements, Timber materials, Iron materials. It is not easy to give an abstract of a work of this nature. A brief inspection has satisfied us that it contains much valuable matter, and that it cannot fail to be of great service to all engaged in the business of engineering.

12. *Hydrogen gas in a lead pipe, used as an aqueduct,* in a letter to the Editor from Nelson Walkly.—I was at the house of a friend during the last summer, and while there, he was engaged in laying lead pipe from a spring to his house for conducting the water, a distance of three quarters of a mile.

Between the spring and his house was a hill several feet higher than the spring, and several whose summits were not as high. His house was fifteen feet lower than the spring. He informed me that he had laid down his pipe several times and set the water running, but it never had continued to run over ten days at a time. He had repeatedly taken it up and tried it, supposing it contained a leak. He called on the man whom he had originally employed to lay his pipe, for a cause, and found that he knew nothing, except that the stoppage was occasioned by air, and that air could not get in, unless there was a leak in the pipe. My friend, when I arrived, was taking up his pipe for the last time, to try whether there was a leak. After trying it with a pressure of 50 lbs. to the inch, he found no leak and laid down his pipe, and by means of a forcing pump set the water running again. As formerly, after running less and less for about ten days, it entirely ceased. I then took it in hand, determined to find out, if possible, the cause of the obstruction. I made a puncture in the pipe at one of the high places lower than the spring, and found that the pipe contained not air, but hydrogen gas. I was now more embarrassed than before, as I could not imagine what was the source of the hydrogen. I happened about that time to take a tin cup of water, and noticed a row of minute bubbles along the seam; the thought struck me, that it was the combination of metals in the pipe that occasioned galvanic action sufficiently powerful gradually to decompose the water.

To try it, I put a small piece of the same pipe into a tumbler of water, and after standing two days, I found the pipe covered with a coat of white oxide, with the exception of the seam where it was soldered together, and there the tin which composed the solder was perfectly bright. From this I inferred, that the galvanic action of the pipe on the water produced decomposition, the oxygen combining with the lead, and the hydrogen carried along by the water until it came to the high places in the pipe, and there accumulated until it filled the pipe and entirely obstructed the water.

To remedy this difficulty, I made holes into the pipe at every high place, and soldered over them a vertical tube, open at the top, excepting the hill that was higher than the spring, and to that part of the pipe I soldered a tube similar to the others, with this exception, that I soldered it up at the top. The first mentioned tubes let the gas escape as it came along, and the one on the highest elevation suffered the gas to accumulate in it until a small bubble protruded below the end of the vertical tube, and was detached from the body of the gas in the tube and carried on by the water. After the above arrangement was effected, the water was set running, and has continued to run without any sensible diminution ever since, upwards of eight months. Query. Is not the action of water upon lead, mentioned in Vol. XXXIV, p. 25, of this Journal, occasioned by a combination of some other metal with the lead?

Tuscaloosa, Ala. May 25th, 1838.

13. *Bituminization of peat and conversion into coal.*—At page 73 of the present volume this fact is mentioned; the following more full notice of it is contained in Dr. Charles T. Jackson's Report on the Geology of Maine, pp. 80, 81.

"In Limerick we examined the peat bogs on the estate of Mr. Ebenezer Adams, where a very remarkable substance is found resembling exactly the cannel coal. It is found at the depth of three feet from the surface of the peat bog, amid the remains of rotten logs and beaver sticks, showing that it belongs to the recent epoch. The peat is twenty feet deep, and rests upon white siliceous sand. This recent coal was found while digging a ditch to drain a portion of the bog, for the sake of obtaining peat as a manure; about a peck of it was saved, and served to supply us with specimens. On examination, I found that it was formed from the bark of some tree allied to the American fir, the structure of which may be readily discovered by polishing sections of the coal, so that they may be examined by the microscope.

"It contains in 100 grains,

Bitumen, - - - -	72
Carbon, - - - -	21
Ox. Iron, - - - -	4
Silica, - - - - -	1
Ox. Manganese, - - -	2
	100

"This substance is a true bituminous coal, containing more bitumen than is found in any other coal known. I suppose it to have been formed by the chemical changes supervening upon fir balsam, during its long immersion in the humid peat.

"The discovery of the recent formation of bituminous coal, cuts the gordian knot which geologists and chemists are endeavoring to unravel, and shows that the process is still going on. The difference between bitumen and resin is not very great, and the absorption of a small quantity of oxygen is all that is required to effect the change. Other localities of this curious substance, may be found by searching the numerous peat bogs in other parts of the state."

The coal measures of Mansfield, Mass., are in the conglomerate or graywacke; a fact that would not be readily admitted in England. It is evident that our conglomerate rests on sienite, and alternates with the argillaceous slate rocks: also, that its mineralogical composition and structure, as well as its position, stamp it as a graywacke formation; and yet it is full of coal plants! I have collected fourteen or fifteen species there during three visits to the mines.*

* Extract of a letter to the Editor from Dr. Jackson.

14. *Denial of a charge of plagiarism;* by Dr. W. C. WALLACE, Surgeon to the Institution for the Blind.—In the London Magazine of Natural History, for March, 1838, there is the following statement, by John Dalrymple, Esq., Lecturer on Surgery at Sydenham College.

"Some few years back, in examining the organ of vision in a pike, (*Esox lucius*,) I observed a small roundish grey colored body, about the size of a hemp-seed, attached to the circumference of the lens; and at the same time, certainly without due consideration, I designated it a muscle, principally from the fact, that I traced a nerve running from the posterior part of the eye, to this peculiar body. The preparations then made I exhibited to some young American gentlemen, attending the practice of the Moorfields Ophthalmic Hospital."

"That the existence of this body is yet unknown in England, at least, is I think borne out by the fact, that the learned Professor of Comparative Anatomy at the Royal College of Surgeons, Mr. Owen; and Mr. Yarrel, so well known by his beautiful work on the ichthyology of Great Britain, were both unacquainted with the circumstance when I mentioned it to them."

"In a number of the American Journal of Science and Arts, will be found a somewhat similar account of a muscle, discovered in the eye of the streaked bass, (*Perca nobilis vel Mitchilli*,) by Mr. W. Clay Wallace, surgeon to the New York Institution for the Blind. This gentleman did me the favor to send me over about twelve months since, his paper published in that Journal. From the circumstance of my not being aware of being personally acquainted with Mr. Wallace, *I cannot help suspecting that he is one of the Americans to whom the observations made by me were imparted at the Ophthalmic Hospital some years ago*."

In justice to the young American gentlemen attending the practice of the Moorfields Ophthalmic Hospital, I deny, says Dr. Wallace,* that I ever saw or heard of Mr. Dalrymple, previous to the publication of my discovery in 1835, or that I ever had, directly or indirectly, any communication with any person who had seen, or even heard of him or his imparted observations. Mr. Dalrymple published an elaborate work on the eye, a copy of which was presented to me by a highly valued friend in the year 1835. As there was nothing definite stated in his work about the means by which the focus of the eye is regulated to different distances, nor of the body attached to the crystalline lens, I immediately forwarded him a copy of my paper. From this statement it is obvious, that if I were disposed to deviate as far from candor and courtesy as Mr. Dalrymple has done, I might with far greater

* In a letter to the Editors of this Journal.

plausibility, turn the tables upon him and say; *I cannot help suspecting that he is one of those to whom the observations made by me were imparted through the medium of Silliman's Journal in* 1834, *and now published as his own in the Magazine of Natural History, in* 1838.

15. *Gold in Georgia.*—A correspondent in Georgia, intimately acquainted with the gold mines there, informs us recently that, although the gold is of a very superior quality, averaging 940 to 1000, the deposit mines are nearly exhausted, and until labor in this country becomes redundant, it is doubtful whether the vein mines will pay the expense of working them.

16. *Yale Natural History Society.*—This Society has been already mentioned in our pages. The progress of institutions of this nature must always be slow, especially during the first years of their existence, and before a considerable library and museum, and important transactions have called public attention to them. Already, several valuable original papers have been published, by the Society, in this Journal, evincing originality and accuracy of scientific investigation, and illustrated by ample and finished engravings, by no means unworthy of older and more celebrated associations. We learn that it is the intention of the Society, as soon as practicable, to collect these papers, and to publish them as transactions. It has doubtless been an advantage to the Society, that they have been able to place their memoirs before the public so soon after their being ready, and it is to be hoped that they will always be able to do so.

The museum of the Society has advanced faster than was expected. A valuable collection of several hundred species of birds was received two years since from a member in China, (Dr. Parker,) and the liberality of the public has enabled the Society to display them to great advantage. Their collections in the other departments of zoology, and in botany, are small, but a nucleus is formed in each. The specimens collected by Prof. C. U. Shepard, illustrative of the geology of this State, were, by the permission of his Excellency Gov. Edwards, deposited in the Society's rooms, and constitute a cabinet of more than ordinary interest.

The library is yet small, but the means exist to a certain extent, of increasing it as soon as is deemed expedient. Some additions have been made to it during the past year, of which none are more important than the Transactions of the Zoological Society of London. An effort was just commencing by the Society to raise a fund of $20,000 for the increase and support of the library; but before much could be done, the pecuniary embarrassment of the country came on; and it was deemed expedient to withhold all solicitation after about $1,700 had been pledged. William Maclure, Esq. of Mexico, (to whose patronage the Academy of Natural Sciences in Philadelphia chiefly owe their present prosperity,) with his usual liberality, gave the sum of five hundred dollars to the library, free of all conditions.

17. *Meteoric Shower in April.*—The fact that a meteoric shower occurred about the last of April, 1803, seemed to furnish reason for the expectation that an unusual display of meteors might, by proper efforts, be detected at this season of the present year. According to the best information obtainable, that shower occurred on the morning of the 20th of April, 1803. Arrangements were consequently made for observations on the morning of April 20, 1838, at Porto Rico, W. I.; Tuscaloosa, Ala.; Knoxville, Tenn.; Hudson, Ohio; Buffalo, N. Y.; New York City, and New Haven. From Porto Rico no returns have been received. At Tuscaloosa, observations were accidentally omitted. From Hudson, Ohio, Prof. Loomis reports that the weather was unfavorable, but that between $3\frac{1}{2}h.$ and $4h.$ A. M. it was clear in the east, and nothing unusual was seen. At Buffalo, N. Y. observations were made on the morning of the 21st, by Mr. R. W. Haskins and Dr. C. H. Raymond. The sky was partially cloudy, but clear enough to permit them to decide that nothing uncommon was visible. The previous morning was overcast. At New York City, Mr. G. C. Schaeffer saw nothing unusual; but the view was much interrupted by clouds. At this place, observations on the mornings of the 20th and 21st detected nothing more than common. On the night of the 20th, at Knoxville, Tenn., Prof. Wright, with an assistant, saw 154 meteors between 10 P. M. and 4 A. M. of the 21st. This number is probably somewhat above the average, but how much above, additional observations are needed to determine.

The facts here recorded do not decide whether a meteoric shower did or did not visit the earth on or about the 20th of April, 1838. In a case of this nature, a negative cannot be established without a clear sky and numerous observers encircling the whole globe. E. C. H.

New Haven, Conn.

18. *Improvements in Magnetical Apparatus.*—At the meeting of the British Association, held in Bristol, in 1836, the Rev. W. Scoresby made a communication to the Physical Section, on an improved mode of construction in magnetic needles for compasses, &c. by the combination in a parallel series, *not* in contact, of several thin plates of tempered steel. A variation instrument, which he at that time exhibited,

constructed on this principle, was stated to have a far greater directive energy than any instrument, of the nature of a compass, previously constructed. Since that period Mr. Scoresby has been pursuing, as opportunity offered, an extensive series of investigations on the subject; both as to the law of combination in steel plates and bars, and as to the effect of temper, thickness, &c. on the aggregate power; with the view of producing more powerful instruments for determining the delicate variations in, and the actual condition of, the earth's magnetism; a subject now engaging attention in some of the principal observatories in Europe. The results, which have been successful beyond the objects originally contemplated, have been recently communicated to the Institute of France. One of these results likely to be of much importance in magnetical science, to which it is extensively applicable, is that of producing permanent artificial magnets of almost unlimited power. On the principle of construction of compound magnets hitherto adopted, only a very limited number of bars could be combined with advantage, in consequence of the great deterioration of power occasioned by the condition of violence. Mr. Scoresby found, on combining very superior plates of tempered steel of two feet in length and about $\frac{1}{24}$th of an inch in thickness, that the first six plates received so much power that no additions, however great the number, were capable of producing more, in the aggregate, than about double that power. Aiming, however, to counteract the tendency to such rapid deterioration, Mr. Scoresby made some magnetical combinations of *perfectly hard* steel plates, (which he has a ready method of magnetizing and testing,) by means of which an almost unlimited power can be obtained. Already this combination has been carried, with no inconsiderable augmentation of the aggregate energy, to the very last, to the extent of several dozens of hard plates, 15 inches in length, so as to produce, by such combination, a compound magnet of very extraordinary power for its mass. The application of this principle to apparatus for magnetic electricity will obviously be of much advantage for compactness and power; whilst the application of the discovery to variation needles, dipping needles, and, probably, to sea compasses also, promises to be of much importance in experimental science, as well as for practical and economical purposes. Mr. Scoresby's investigations have also led to other practical results, such as the means of testing most rigidly the quality and temper of steel plates, and of bars intended for compound magnets on the ordinary construction, by which the best plates can be selected and the most powerful combinations may be obtained.—*Lond. and Edin. Phil. Mag., April,* 1838.

19. *Meteorological Society,*

[Established in 1823,—revived in 1836.—47, Hatton Garden, London.]

Officers for the Sessions 1838 *and* 1839.

President—George Birkbeck, M. D., F. G. S., &c.

Vice Presidents—Æneas Mc. Intyre, LL. D., F. L S., M. B. S., &c. Richard Taylor, Esq., F. R. S., F. R. A. S, &c.

Treasurer—Charles Shearman, Esq., F. R. A. S., &c.

Secretary—W. H. White, M. B. S., &c.

Other members of the Council—Charles Henry Adams, Esq. W. R. Birt, Esq. The Right Honorable Lord Robert Grosvenor, M. P. Sir J. F. W. Herschel, K. H., F. R. S., F. A. S., &c. Samuel Luck Kent, Esq., F. G. S., &c. John Lee, LL. D., F. R. S., F. A. S., P. N. S., &c. Jonathan Pereira, Esq., F. L. S., &c. Captain Sir John Ross, R. N., F. R. S., &c. John Reynolds, Esq., M. B. S. James George Tatem, Esq. Robert Carr Woods, Esq.

The number of members amounts to sixty-two, of which ten are *honorary* and twelve *associate members.*

The Council refers with pleasure to the very interesting and valuable communications, amounting to upwards of sixty, received during the last fifteen months, from the following gentlemen :—C. H. Adams, Esq., Edmonton,—Wm. Addison, Esq., Great Malvern,—W. R. Birt, Esq.—H. W. Bailey, Esq., Thetford,—Rev. W. T. Bree, Allesley Rectory,—Rev. W. B. Clarke, A. M., F. G. S., &c., Poole,—Dr. Clutterbuck, London,—Charles Conway, Esq., M. B. S., Near Monmouth, —Professor Cerquero, Astro. Royal San Fernando,—Wm. Gardiner, Jun., Esq., Dundee,—Lieut. Grey, Associate, Australian Expedition, —J. W. G. Gutch, Esq., Swansea,—Sir J. F. W. Herschel, K. H., F. R. S., F. A. S., &c., Feldhausen, South Africa.—Graham Hutchison, Esq., Glasgow,—Samuel Luck Kent, Esq., F. G. S., High Wycombe,—Lieut. Morrison, R. N., M. B. S., Galway,—S. Moss, Esq., Cheltenham,—Henry Ommanney, Esq., Australian Survey,—Professor Olmsted, Yale College, United States,—John Prideaux, Esq., Plymouth,—Professor Quetelet, Royal Academy, Brussels,—Capt. Sir John Ross, R. N., F. R. S.,—John Ruskin, Esq., Oxford,—Capt. Smyth, R. N., F. R. S., Observatory, Bedford,—J. G. Tatem, Esq., High Wycombe, Bucks,—J. Templeman, Esq., St. John's, Newfoundland,—R. C. Woods, Esq., London,—and others, who are not members of the society.

The thanks of the society, are due to the following contributors to the society's library,—The Albany Institute,—The South African Institution,—Prof. Quetelet,—Prof. Olmsted,—M. D'Avezac,—Graham Hutchison, Esq.—Patrick Murphy, Esq.—Lieut. Morrison, R. N. —Prof. Whewell,—Capt. Smyth, R. N.—Dr. Lee, F. R. S.—&c. &c.

As soon as the funds of the society will permit, the Council will publish several interesting papers, illustrative of meteorological phenomena; in which important proceeding they will be greatly assisted, by the valuable observations made by Sir J. F. W. Herschel, at the Cape, in the period during which he has been stationed in that interesting portion of the globe.

The Council requests that all communications or donations of books, instruments, &c. may be forwarded to the secretary, No. 47, Hatton Garden, London.

We have learned with pleasure by a letter from the secretary, Mr. White, dated April 2d, 1838, that this important society is proceeding with fair prospects of success. We invite the attention of American meteorologists to the great importance of coincident observations in this country, upon the plan recommended by Sir. J. F. W. Herschel, of which we have received an example from the society for 37 hours, commencing at 6 A. M. of the 21st of March, and ending at 6 P. M. of the 22d. The plan has, we are aware, been carried into effect in several places in the United States, and the results made public by the Albany Institute; but it is very desirable that observations of this nature should be multiplied, and that scientific individuals in every part of our land should lend their aid to an object so important.

We have also received a copy of the laws and regulations of the society, which appear judiciously devised, and it will give us pleasure to aid its efforts in any way in our power. We give the result of its observations for the 37 hours named above.

MAXIMUM OF THE 21st.		MAXIMUM OF THE 22d.	
On the Earth, -	- 48° 2	On the Earth, -	- 42° 5
4 feet above do.	- 50 0	4 feet above do. -	- 49 0
30 feet above do.	- 53 0	30 feet above do.	- 46 0

MINIMUM OF THE 21st.		MINIMUM OF THE 22d.	
On the Earth, -	- 34° 5	On the Earth, -	- 32° 5
4 feet above do.	- 35 0	4 feet above do. -	- 35 0
30 feet above do.	- 33 0	30 feet above do.	- 34 0

20. *London Electrical Society, and Annals of Electricity, Magnetism and Chemistry, &c.*—To this important branch of knowledge a distinct journal is now devoted, and a society has been formed for its more assiduous cultivation.

The journal, which at first appeared quarterly, is now published monthly, under the able supervision of Mr. William Sturgeon, lecturer on Experimental Philosophy at the Honorable East India Company's Mil. Sem. Addiscombe, &c. &c.

In the journal are contained, not only original British papers, but reprints or abstracts of the principal things published on these subjects in other European countries and in the United States. Figures are liberally supplied in handsome lithographed plates, and we cannot doubt, that a periodical work on these very important subjects, conducted with so much spirit and ability, will be fully sustained and prove eminently beneficial. We heartily wish it success, and hope it will be extensively *patronized* in this country. The price of each No. is 2*s*. 6*d*. sterling. Mr. Sturgeon is assisted by gentlemen eminent in the departments of philosophy to which the journal is devoted.

The Electrical Society have commenced their publications in a quarto* form; the first No. contains the rules and regulations of the society, and a manly, sensible, introductory discourse, by Mr. Sturgeon, setting forth the objects in view. The second No. contains two papers on important subjects.

1. The action of the Voltaic battery shown to be two-fold, and the distinction between the terms quantity and intensity determined by the theory of vibration; with a reply to the various objections made to the theory, by Mr. Thomas Pollock, read Oct. 21st, and Nov. 4th, 1837.

2. Description of some experiments made with the Voltaic battery, by Andrew Crosse, Esq., of Broomfield, near Taunton, for the purpose of producing crystals, in the process of which, certain insects constantly appeared. Communicated in a letter, dated Dec. 27th, 1837, addressed to the secretary of the London Electrical Society.

21. *Columbite and tin-ore at Beverly, Mass.*—Prof. SHEPARD finds small 12-sided prisms of columbite and hemitropic crystals of tin-ore, in the green feldspar-rock, discovered by the late Dr. CORNELIUS.

22. GEOLOGICAL AND OTHER REPORTS.

We have before us,

1. Dr. Charles T. Jackson's Second Report on the Geology of Maine. Augusta, Maine. 1838. pp. 168.

2. His Second Annual Report on the Geology of the public lands belonging to the States of Massachusetts and Maine. pp. 93.

3. Professor Hitchcock's Report on the Re-examination of the economical Geology of Massachusetts, in relation to its soils, agriculture, fuel, ores, &c. &c.

4. Second Report on the Geology of New York, being State document No. 200. pp. 384.

* A very inconvenient form for *an active society*, whose publications ought to be easily portable without injury, even about the person, and as cheap as is consistent with efficiency and respectability.—*Eds*.

5. Annual Report of the Regents of the University. No. 52. March 1, 1838. pp. 220.

6. First Report on the Agriculture of Massachusetts, by Henry Colman, commissioner for the Agricultural Survey of the State. pp. 139.

7. First Annual Report of the Board of Education, &c. Boston. 1838. pp. 75.

8. Report of the Secretary of the Board of Education on the subject of School Houses, supplementary to the above. pp. 64.

9. The statistical tables of Massachusetts. Except the last, which was mentioned at p. 213 of this volume, these reports, important as they are, must, for the present, stand with only a titular enrollment. We have fully the will, but at present, have not the power to do more. We trust that some of them, and especially those on geology, will be mentioned hereafter.

Journal of an Exploring Tour beyond the Rocky Mountains, in 1835–6, and 7; by Rev. Samuel Parker, A. M. With a map and an engraving. Ithaca, N. Y. 1838. pp. 378, large 12mo.

Mr. Parker's tour was made under the American Board of Commissioners for Foreign Missions, with particular reference to the Indians.

This main object is kept steadily in view, and there is much valuable information in the work in relation to the aborigines, whose interesting condition and ultimate prospects are deservedly exciting the sympathies, exertions, and contributions of the christian people of the United States.

The work contains also numerous facts of deep scientific interest, especially in relation to the ample and decisive proofs of igneous action and of earthquakes in the Rocky mountains, and the country between them and the Pacific. It would give us pleasure to make an abstract in relation to trap, basalt and undoubted modern volcanic products, but as we have neither room nor time, we can only recommend the perusal of the work both to the lovers of nature and of man.*

British Annual and Epitome of the progress of Science, for 1838, edited by Robt. D. Thomson, M. D. Lond. 1838. 18mo. cloth, lettered. pp. 387. This valuable work was preceded last year by a similar volume, containing Recent progress of Optical Science, by Prof. Powell; Experiments and Observations on visible Vibration and Nodal division, by C. Tomlinson, Esq.; Recent Progress of Astronomy, by W. S. B. Woolhouse, Esq., &c.; the History of Magnetical Dis-

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* We cannot, however, entirely recommend the cosmogony of the 16th chapter, and a few words, which we could wish had been omitted, especially as the style is in general, simple, lucid, and graphic.

covery, by Thomas Davies, F. R. S., &c.; Recent Progress of Vegetable Chemistry, by Robt. D. Thomson, M. D.

The present volume contains a calendar with ample astronomical information, by W. S. B. Woolhouse, Esq., &c.

Contributions to a table of the Chronology of Science.

Weights and measures, English and Foreign.

Tables of the coins of different countries.

English and Foreign Universities, and Scientific and Literary Institutions and Libraries.

A new and beautiful numismatic process.

Sketch of the History and Present State of Geology, by Professor Thomas Thomson, M. D., &c.

On the Principles of Classification, as applied to the primary divisions of the Animal Kingdom, by Prof. Robt. E. Grant, M. D., &c., with numerous figures.

Notices of new chemical substances discovered during the past year, by Robt. D. Thomson, M. D.

Notice of the life of James Watt.

Queries respecting universities and seminaries of education.

These volumes are replete with valuable and interesting information, conveyed in a perspicuous and attractive form, and we trust will command the patronage which shall insure their continuance, year by year.

Various Journals.—We can only name,

1. The Indian Review of works of Science, and Journal of Foreign Science and the Arts, embracing Mineralogy, Geology, Natural History, Physics, &c. Edited by Frederick Corbyn, Esq. The three first numbers are missing—also the 13th, and the last received is No. 18, September, 1837, with an extra copy of 15.

2. The Hawaiian Spectator. Honolulu, Oahu, Sandwich Islands, No. 1. By an association of gentlemen. pp. 112.

3. The Gardeners' Magazine, and Register of Rural and Domestic Improvement. Nos. 36, 37, 38, and 39,—the latter for April, 1838. By J. C. Loudon, F. L. S., &c. Lond.

4. The Continental and British Medical Review, or Monthly Therapeutical Journal, by A. M. Bureaud Riofrey, M. D. Nos. 10, 11, and 12—the latter for February, 1838.

The Indian Review and Hawaiian Spectator, are memorable in the history of periodical literature, on account of the countries from which they come, and we cannot doubt, that they are an acceptable acquisition to the intellectual and moral world.

We hope hereafter to draw upon their pages to enrich our own.

Pl. 6


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GULF OF MEXICO
72 W. from Greenwich
MAGNETIC CHART
of the
United States,
BY ELIAS LOOMIS.
1838.

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