THE

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SCIENCE AND ARTS.

CONDUCTED BY

PROFESSORS B. SILLIMAN AND B. SILLIMAN, JR.,

AND

JAMES D. DANA.

SECOND SERIES.

VOL. VIII.—NOVEMBER, 1849.

NEW HAVEN:

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ERRATA.

Page 254, line 10th from top, for $\frac{(a^2c^2)x}{a^2y}$ read $\frac{(a^2-c^2)x}{a^2y}$

Page 419, line 6th from top, for Geographical, read Geological.

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

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April, 1849.

THE AMERICAN ASSOCIATION FOR THE PROMOTION OF SCIENCE.

Agreeable to an invitation from the Corporation of Harvard University, the next meeting of this Association will be holden at Cambridge, commencing on Tuesday, August the 14th. For other particulars see page 145 of this volume.

July 1, 1849.

Instruction in Practical Chemistry, Mineralogy and Geology.

THE

AMERICAN

JOURNAL OF SCIENCE AND ARTS.

[SECOND SERIES.]

Art. I.—*A Monograph of the Ancient Monuments of the State of Kentucky;* by E. G. Squier.

Kentucky abounds in ancient earthworks, which partake very much of the character of those bordering on the Gulf of Mexico. Many of the enclosures are manifestly defensive, but the larger proportion, like those of Ohio, were probably dedicated to sacred purposes. The latter, however, are seldom of large dimensions; and none, so far as we are informed, assumed the remarkable combinations which are to be observed in the Scioto and Miami valleys. They are, for the most part, small circles and squares,—the former greatly predominating in point of numbers. The mounds, on the other hand, are usually more regular and perhaps of larger average dimensions than those to the northward of the Ohio. The rectangular and terraced mounds, in particular, are comparatively numerous, and are often of great size. Those which are low, and cover large areas, are known as "*platforms.*"

Few of the Kentucky works have ever been surveyed, although many have been noticed and described with greater or less fullness, at various times. Prof. Rafinesque, in his notes, has indicated the localities of a great number, but has failed to give us any very clear conception of their character. In his fanciful introduction to Imlay's History of Kentucky, he estimates the number of groups of works within the state at six hundred.*

* For "Ancient Monuments of the Mississippi Valley," I have in the following pages substituted the abbreviation "A. M. of M. V." For the name of Rafinesque, from whose confused notes most of the facts were obtained, simply the initial "R."

Fayette County.—1. An irregular enclosure or fortification occupying a peninsula formed by the Elkhorn river, at its junction with the Town fork, seven miles from Lexington. The river passed through one portion of the enclosure,—a feature unknown in any other work with which we are acquainted. Near this work are several small enclosures and a number of large mounds.

A plan from a survey found among the Rafinesque papers, purporting to have been made in the year 1790, is engraved in A. M. of M. V., Plate IX, No. 3. Another plan, corresponding with this in every essential particular, is published in Collins' History of Kentucky. It is possible that in the subdivisions which have been made, this work now falls in Woodford county.

2. An irregular enclosure of eighteen acres area, on the South Elkhorn river, six miles distant from Lexington. The Cally Ford road passes through it. The walls are low; ditch exterior. A plan, from what appears to be a minute survey by Rafinesque, is published in A. M. of M. V., Plate XIV, No. 4.

3. Another irregular work, of similar character but larger size, is situated not far from that last described, on the South Elkhorn river. It has an area of twenty-five acres. A plan, from a survey by Rafinesque, is published in A. M. of M. V., Plate XIV, No. 3.

5. Rafinesque mentions a polygon, of seven unequal sides, and 4800 feet in circumference, in the vicinity of Lexington, but does not indicate its exact locality. According to this authority the embankment, at the time of his writing, was from eight to sixteen feet in height.

6. Rafinesque also notices an enclosure near the mouth of the Elkhorn river, six hundred feet in circumference; parapet two feet high; ditch interior to the embankment. Within this enclosure is a "platform," seventy feet square; also a mound four feet high and one hundred and seventy-five in circumference. Various other works, "causeways, platforms, and mounds," are mentioned as occurring in this vicinity.

Woodford County.—1. At Cynthiana, on the south bank of Licking river, a small circular work, 570 feet in circumference. A similar work is found on the lands of Mr. H. Miller, on the Licking river.—(R.)

2. On the farm of Mr. W. Anderson, also on the banks of Licking river, is a group of six mounds; two of which have embankments around their bases. The circumference of the largest is six hundred feet, height thirty feet.—(R.)

3. An octagon terrace or "platform" occurs near Lovedale.—(*Figured and described, A. M. of M. V., p.* 176.)

Jessamine County.—1. A large mound one mile southeast of Nicholasville. It is elliptical. Several graves lined with stones have been found in mounds, in this vicinity.—(R.)

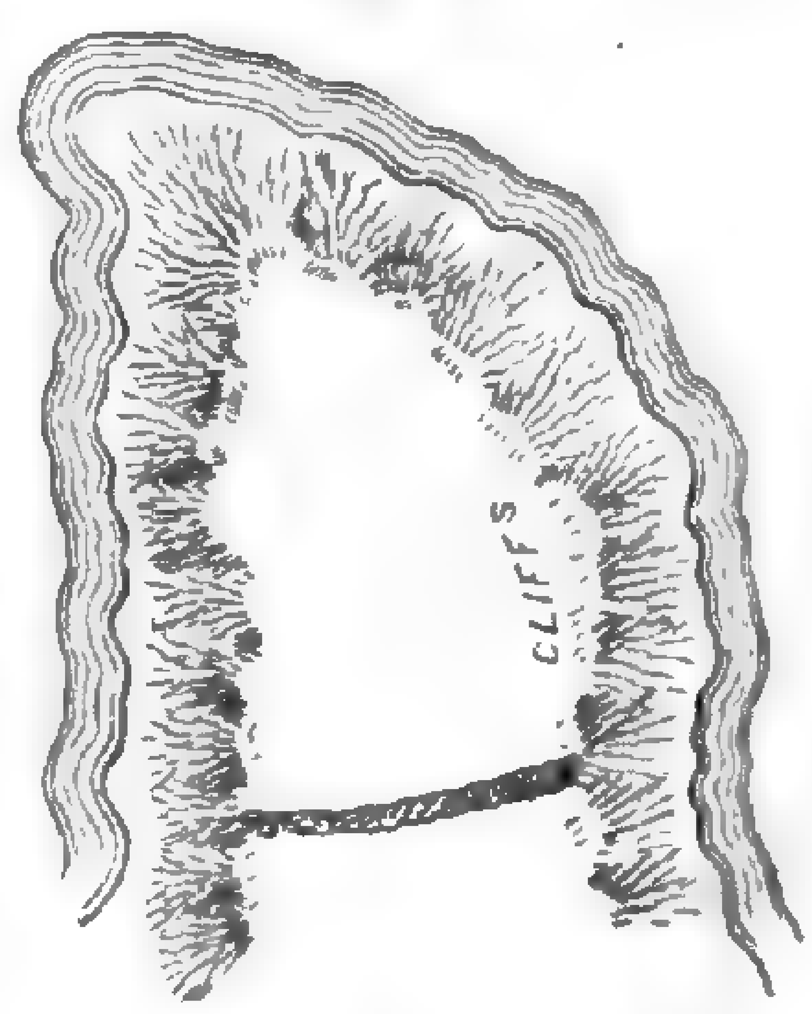
2. A large collection of Indian graves, four miles from Buck's Tavern, and also on a bluff, to the right of the road, near Grimes' Mills.—(R.)

Clay County.—1. A square stone work, about ten miles northeast of Manchester, on the road to "Red Bird river" salt works. Sides each measure about one hundred feet in length.—(R.)

2. At the salt works on Goose creek, in this county, are abundant evidences that the salines were once worked by the Indians, —broken pottery, pestles, etc., being found here in abundance.

Larue County.—An interesting work occurs in this county. "It is situated upon a level bottom of twenty or more acres, near its extreme point, where the creek makes a sudden bend. The creek is here about fifteen yards wide, with abrupt banks, six feet high. The walls have fallen or may have been thrown down, and are now about three feet high, covering a space twenty feet wide. They may originally have been seven feet wide by six feet high. The distance from gateway to gateway is a little upwards of one hundred feet, and the area enclosed is not far from twenty square rods. The ground is somewhat lower within than exterior to the walls. These walls seem to have been faced inside and out with dry masonry, filled in with smaller stones. There are still two pieces of the inside wall standing, one at the southwest angle of the work, the other at the north side of the eastern gateway. The stones have evidently been fractured by percussion, and now lie edges up,—clearly the fallen faces of the original walls. It may be well to remark that the bottom land here presents no stones of any sort, and is an alluvial black loam. In respect to its antiquity, it can only be said that it is covered with a primitive forest, and that a pine tree nearly seven feet in circumference is growing on the wall."—*Collins's Kentucky*, p. 398.

Fig. 1.



Trigg County.—1. At Canton near Boyd's landing on the Cumberland river, an enclosure nearly square, 7500 feet or about a mile and a half in circumference. The wall is from three to five feet high; ditch exterior. It encloses nine mounds of large size. One is rectangular, truncated, twenty-two feet high, one hundred and fifty long and ninety broad.—(R.)

2. There are many mounds of various shapes and sizes in this county. Two miles south of Canton, on the top of a high rocky bank of the Cumberland river, are three mounds, each about ten feet high. An oblong square "teocalli," or truncated mound, also occurs upon the bank of the Cumberland, not far from the above named mounds. There are two conical tumuli, one at each end of this structure. Several broad flat mounds or "platforms," are found near the junction of Little river with the

Cumberland. They contain bones, covered with stones. There is a conical mound here, twelve feet high. Near the line of Christian county, are many others.—(R.)

Logan County.—1. On Muddy Creek, ten miles northwest from Russleville, a quadrangular enclosure, with an exterior ditch, and a gateway opening towards the creek, on the north. It encloses two mounds, each about twelve feet high and truncated. —(R.)

2. On Muddy Creek, six miles from Russleville, a circumvallation on the east side of a bluff of freestone, one hundred feet in height. It encloses one acre and a half; ditch exterior; parapet three feet high; with gateway opening toward the river. Below this work is a long row of mounds, on the bank of the creek.—(R.)

3. Near "Clay's Lick," on the west bank of Whippoorwill creek, is a raised "platform," 400 feet in circumference and four feet high. There are several broad excavations near by.—(R.)

4. Ten miles northeast of Russleville, on Gasper river, is a square enclosure with a mound in the center.—(R.)

5. A few miles southeast of Russleville, in what is called the "barrens," are a great number of small mounds, covering several hundred acres. Many have been excavated and numerous relics recovered. Some very interesting ones formerly occupied the present site of Russleville. The Masonic Hall was built upon one of them.—(R.)

Harrison County.—1. Near Cynthiana, on the Licking river, an enclosure 800 feet in circumference; embankment ten feet high; ditch interior. In the center is a mound 342 feet in circuit. A gateway opens to the southwest. In this direction, seven hundred feet distant, is a mound, now the site of a dwelling house. —(R.)

Bath County.—Near Bloomfield, on the road from Mount Sterling to Upper Blue Lick, is a large square enclosure of many acres.—(R.)

Clarke County.—Near Boonsborough, several enclosures and a number of mounds. At Indian town, an irregular work supposed to be defensive.—(R.)

Adair County.—On the "Long Bottom" of Cumberland river, several flat square mounds or platforms.—(R.)

Hart County.—Near Williams' Mill, an enclosure of considerable size, circular in shape. In a spring near by, have been found a number of large conch shells—(*Pyrula perversa ?*)—(R.)

Mason County.—Three miles from Washington, a singular platform, figured and described, A. M. of M. V., p. 176.

Union County.—Several caves containing human bones are found in this county. Eight miles from Morgansfield is a flat rock covered with carvings of human feet of all sizes, wolf tracks, etc.—*Collins's Kentucky*, p. 540.

Hopkins County.—Within four or five miles of Madisonville, a hill work, enclosing ten acres.—*Collins's Ky.*, p. 250.

Carroll County.—An ancient enclosure ten miles from the mouth of the Kentucky river, square, containing one acre, with heavy walls.—*Collins's Kentucky.*

Garrard County.—There are a number of enclosures in this county, mostly circular, and an abundance of mounds. Some large ones occur near Lancaster, and there are others on Paint creek.—(R.)

Davies County.—An enclosure at the mouth of Green river, on the Ohio. Another on an island in the Ohio, somewhat lower down.—(R.)

Greenup County.—Two groups of works on the Ohio, opposite the mouth of the Scioto river. One consists of a series of concentric circles, with a truncated terraced mound in the center, and with an avenue leading to a point on the bank of the river, opposite which it is resumed, connecting with the Portsmouth works five miles distant. The other group is eight miles lower down the river, and consists of a large square of fifteen acres, with avenues leading off from the sides, each 2,100 feet long.—*See account, plans, &c., in A. M. of M. V.*, p. 77, Plates XXVII, XXVIII.

Lewis County.—An ancient enclosure on the banks of the Ohio river.—(R.)

Rock Castle County.—About three miles northwest of Mount Vernon, a row of Indian graves, forming a straight wall or ridge of limestone piled up. It is two hundred feet long, and between three and four high. Abundance of human bones are mixed with the stones.—(R.)

Knox County.—An enclosure on the Cumberland river, three miles above Barbersville, containing three acres. Numerous mounds in the vicinity.—(R., *and also Collins's Ky.*, p. 250.)

Whitley County.—An enclosure on a bottom of the Cumberland river between Meadow and Flat creeks. Here are numerous remains, and among them a square mound or "teocalli," three hundred and fifty feet long, one hundred and fifty broad, and twelve feet high. Similar remains are found on Blake's fork of Watts's creek, on Lime Camp creek, and at other points within the county.—(R.)

Shelby County.—On the road from Frankfort to Bardstown, about twenty-five miles from each place, a square enclosure of one acre, now occupied by an orchard. At Shelbyville is a large mound.—(R.)

Mercer County.—1. An ancient work, four miles above Harrodsburgh, on Salt river; another a mile and a half above: each quadrangular.—*Collins's Ky.*, 452.

2. An ancient enclosure in the "horse shoe" bend of Dick's river, with two square bastions and a gateway on the narrow ridge of the isthmus. The wall twenty feet high from the bottom of the ditch. Several large mounds near the Shawnee Spring.—(R.)

Lincoln County.—On Dick river, three miles from Wilmington, a square mound, six hundred feet in circumference, five feet high and truncated. Many relics found in the vicinity.

Caldwell County.—On Donaldson fork of Treadenwater river, is a work constructed by building a strong stone wall across the isthmus of a peninsula formed by a bend in the stream. The bluff is about one hundred feet high. The wall is about one hundred and fifty feet long, four high and very broad. The enclosed area is something less than an acre.—(R.)

Scott County.—1. A square enclosure on Mr. Wither's land, near the mouth of Dry run, a tributary of the Elkhorn.—(R.)

2. A ditch across the neck of a peninsula formed by a bend in the Elkhorn river, north bank, between Thompson's and Payne's mills.

3. Some works on the banks of Frankfort river, four miles from Georgetown, near Craig's Mills.

Bracken County.—1. Large ancient cemetery on a "bottom" of the Ohio river near Augusta. Said to be two miles long.—(R., *also Collins's Ky.*, p. 180.)

2. A quarry of flint, anciently worked by the Indians.—(R.)

Gallatin County.—On a hill, at the mouth of the Kentucky river, a large enclosure.—(R.)

Boone County.—1. A large square work, on the bank of the Ohio, near Bellevue, below the mouth of the Great Miami river. Also some large mounds between Burlington and North Bend.

2. An enclosure a little above the town of Petersburgh. The wall extends from the abrupt bank of the Ohio, to the precipitous bank of Taylor's creek. It is four feet high. The area of the enclosed ground is twenty-five acres.—*Collins's Kentucky*, p. 180.

Campbell County.—Near Covington, between Licking river and Willis creek, an elliptical platform, eight feet high and seven hundred and fifty feet long, commencing in a large conical mound, twenty-five feet high. A large mound is situated on the top of "Big hill," north of Big-bone Lick. It is elliptical in shape, one hundred and fifty feet long, depressed in the center.—(R.)

Livingston County.—1. A large enclosure and other monuments at the mouth of the Cumberland river.

2. Near the mouth of Hurricane creek, three-fourths of a mile from the Ohio river, an octagon enclosure, 2852 feet in circumference, containing four mounds. There are several other monuments of small size, in the vicinity.

3. A circumvallation on the farm of Mr. Jones, two miles from Lancaster. Just outside the gateway is a spring, in which were found eighteen large and twelve small shells, resembling the conch. Another enclosure occurs on the farm of Mr. Kenneday near by, where fifteen similar shells were found.—(R.)

Jefferson County.—A polygon enclosure at Locust Grove.—(R.)

Harlan County, (formerly Knox.)—A large mound at Mount Pleasant, upon which the Court house is built. It gave name to the place. It is circular, truncated, and was originally twenty feet high. A large mound occurs at a place called Cumberland Gap, with many smaller ones around.

Christian County.—There are numerous traces of an ancient population in this county. At Licking creek, six miles southeast of Hopkinsville, are many embankments, mounds, etc. A great number of round holes, with raised edges occur here. A number of large mounds formerly existed in Hopkinsville, upon the largest of which the Court house was erected. There are yet many mounds in the vicinity.—(R.)

McCracken County.—Mounds are especially abundant in this county. There is a large square one, truncated, fourteen feet high and twelve hundred feet in circumference, a few miles below the mouth of Clark's river, a little distance from the banks of the Ohio. Below Hunting creek, on the elevated lands, one-fourth of a mile back from the Ohio, are five parallel rows of mounds, of unequal sizes, placed close together. Just above fort Jefferson, on the Mississippi, are many little mounds, and other monuments.

Pendleton County.—Near Falmouth, an ancient enclosure, on elevated and commanding ground, between two rivers. It is circular, with four openings at right angles to each other and corresponding very nearly with the cardinal points. There are numerous mounds in the vicinity.—*Collins's Kentucky*, p. 494.

Warren County.—1. An ancient work on the east bank of Barren river, one mile east of Bowling Green. It is an irregular octagon, 1,385 feet in circumference, with an exterior ditch, and a small mound at each angle. There are two rectangular, truncated mounds within the walls, the largest of which is one hundred feet long and fifty wide.—(R.)

2. There is also a large hill work near by that just mentioned. It occupies a bluff inaccessible except at a single point. It is square, and has a line of mounds extending from it for more than a mile, gradually becoming smaller as they recede.—*Collins's Kentucky*, p. 542.

Hickman County.—On the bank of the Mississippi, a few miles below "Ironbanks," is a large and beautiful mound. It is four hundred and fifty feet long, thirty broad at top, and ten high. Bones are found within it.—(R.)

Montgomery County.—Great numbers of ancient monuments occur in this county, some of which possess peculiar interest.

Mounds are particularly numerous, and are remarkable for their size and regularity of construction. The seat of justice of this county, Mt. Sterling, derives its name from a large mound which formerly existed within its corporate limits. This mound was cut down in 1846, and was found to contain human bones, copper plates, beads, bracelets and other ornaments.

Rafinesque, in a published letter addressed to Hon. Thomas Jefferson, dated "Transylvania University, August 7, 1820," gives an account of six groups of ancient works found in this county. They all occur in the vicinity of Mount Sterling. The account is herewith presented. The plan of the first group described is published in A. M. of M. V., Plate XXXIII, No. 1.

"Group I.—A compact group of monuments on the west side of Brush creek, a branch of Slate creek, six miles S.E. from Mount Sterling, between Montgomery's farm, and a Methodist meeting house, which has taken from them the name of 'Fort Meeting-house.' They are on a fine level high ground, not far from the creek, and which has never been cultivated as yet: they are five in number.

"No. 1. The nearest to the meeting-house towards the south is a square enclosure, 400 feet in circumference; the sides are equal, corresponding to the cardinal points. The parapet is 15 feet broad, four feet high from the bottom of the inside ditch, and two feet above the level of the ground. There is a gateway due east, in the middle of the eastern side. The central area is a small *oblong* square, greater length from east to west, 35 feet; breadth 25.

"No. 2. Is about 200 yards east from No. 1, and at nearly an equal distance from Nos. 3 and 4, forming with them the center of a figure shaped like the letter Y. It is a singular elliptical mound; circumference 270 feet, height nine feet, top elliptical, 100 feet round with raised ends, and a small central rounded mound about one foot high, over which were lying, in a square form, some loose flat stones. A short appendage to the south connects it with a small circular mound, 100 feet round and four feet high.

"No. 3. Is N.E. from No. 2. It is a circular enclosure, 510 feet in circumference. Parapet 20 feet broad, five feet high over the ditch which lies inside. Gateway due east, 15 feet broad. Area perfectly square, 300 feet in circumference, or 75 feet on each side. The sides correspond with the cardinal points. There is a small circular mound, 42 feet in diameter, and one foot high, on the western side of the area opposite the gateway.

"No. 4. An hexagonal enclosure, south of No. 3, and S.E. from No. 2. Sides equal, each 50 feet. Whole circumference 300 feet. Parapet 25 feet broad, four feet above the inside ditch. Gateway at the eastern corner 15 feet broad. Area square, sides equal and 40 feet long, corresponding with the cardinal points.

"No. 5. An oblong mound, lying south of No. 1, on the opposite side of Brush Creek. I have not measured it.

"Group II. A scattered group immediately in the vicinity of the town of Mount Sterling, on each side of Hinkston creek. It consists of six monuments.

"No. 6. A simple enclosure, one mile east of Mount Sterling, on Smart's farm, in a fine level high ground, on the east side of Hinkston creek, between the Mud Lick road and the Salt-works road. It consists of a simple ditch without visible parapet. The form is a decagon nearly regular; but two sides appear to be somewhat shorter, or of 75 feet, while the eight others are all 125 feet. Total circumference 1150 feet. Ditch about two feet deep and six to eight broad; but often obliterated. No gateways could be perceived; they may have been where the ditch is not easily seen. There are two small eccentric circular mounds in the inside towards the west. Largest 105 feet in diameter and two feet high. Smallest 50 feet in diameter and one foot high, and near to the ditch. This has all the appearance of a very remote origin. It is in the woods and has never been ploughed.

"No. 7. A circular mound, about 350 feet in circumference, and 20 feet high, situated half a mile N.W. of No. 1, on the east or right side of Hinkston creek.

"No. 8. A circular mound 400 feet in circumference and 24 feet high, lying in the town of Mount Sterling, to which it has given its name. It has been partially excavated on the side and the summit, and found to contain bones mixed with the earth.

"No. 9. A simple enclosure about one mile N.N.E. from Mount Sterling, round the hill on the west or left side of Hinkston creek and the Flemmingsburg road. It is a polygon, but whether a regular or irregular one, is rather difficult to ascertain; I could not even trace the number of sides. It is in an iron weed brake in the woods; but the ground being on a slope, the rains have filled up the ditch in many parts; towards the west the ditch is yet four feet deep. I was told that it was much plainer about 20 years ago; a few years make, therefore, great alterations, even without the help of the plough. I have traced, however, the outlines, and reckoned the circumference at about 1,500 feet.

"No. 10. A circumvallation in Read's cornfields, about one mile N.N.W. of the town, near a small branch of Hinkston Creek. It has been ploughed up for many years, and has nearly disappeared; I could not trace its circumference, but it was very plain a few years ago.

"No. 11. Singular mound, about one mile north from Mount Sterling, near the Blue Lick road. It is of an oval shape; smallest end to the south, where it is lower and only 14 feet high, while it is 24 feet high to the north. Circumference 575 feet. Summit somewhat inclined, 135 feet long, and 40 broad, with a circular concavity to the northern extremity.

"Group III. Compact, on level ground, about two miles north from Mount Sterling, on Jameson's farm, and on the left of the Paris road. Sommerset creek is half a mile to the west, and there are no springs in the immediate neighborhood at present. It consists of five mounds.

"No. 12. A large and singular circular mound 32 feet high, surrounded by a circular parapet and intermediate ditch, interrupted by four large gateways, 50 feet broad, equal in size and distance, looking towards the N.E.—N.W.—S.E. and S.W. The four parts of the parapet are therefore opposed to the four cardinal points; whole circumference 800 feet, ditch four feet deep. Central mound about 500 feet round. Summit 120 feet round and somewhat concave.

"No. 13. Similar mound, smaller, only 15 feet high, and 130 feet distant from No. 12, towards S.E. It has also four gateways, but they are N.—E.—W. and S.W., and the northern one is much the largest and inclined in the shape of an ascent; breadth 40 feet, the others 30 feet. Circumference of the parapet 430 feet; ditch three feet deep. Summit small, somewhat concave.

"No. 14. Simple mound, without ditch or parapet; 250 feet in circumference, and 10 feet high. It lies 80 feet S.W. of No. 13.

"No. 15. A similar mound, lying 312 feet east of No. 13. It is six feet high, and 165 feet in circumference.

"No. 16. Another mound, 80 feet from No. 14, due east. It is eight feet high and 200 feet in circumference.

"Group IV. Compact and remarkable for its size, high parapet, etc., although it is situated in fields which have often been ploughed. It is on Johnson's farm, three miles north of Mount Sterling, on the east bank of Sommerset creek, and on a high hill with a level summit. It contains an enclosure and four outward mounds.

"No. 17. A large circumvallation, quite circular and 1150 feet round, with a high parapet, a deep inside ditch, a single gateway due east, and a central mound. Parapet 55 feet broad, four to five feet above the ground, and eight to twelve feet above the ditch, inside slope 25 feet. Gateway 50 feet broad. Area three feet high above the ditch. Central mound 75 feet from the ditch, 206 feet in circumference and three feet high. Many remains of pottery, fine pipe-heads, and several other implements have been found in ploughing the area.

"No. 18. Large circular mound, 60 feet due north from No. 17, and united to it by a raised platform. It has two spurs, or oval inclined appendages to the north and west; the northern one is the larger. Circumference with the spurs 800 feet, without 600. Height 22 feet, summit level with a small central concavity.

"Nos. 19, 20 and 21. Three outward and unconnected mounds, lying irregularly to the S.E. of No. 17. The largest, No. 19, is eastward of No. 20; it is 220 feet around, and five feet high.

"No. 20 is in the middle and only 50 feet from No. 17. It is only 175 feet in circumference and three high.

"No. 21. The smallest and western, is near No. 20, and nearly south from No. 17. It is only 150 feet round and two high.

"Group V. Is quite scattered, and contains three enclosures with two mounds, lying near Sommerset creek, about four miles to the northward of Mount Sterling.

"No. 22. Square enclosure on John Higgins's farm, on the south and left side of Sommerset creek. Each side equal, 150 feet long, and corresponding with the cardinal points; gateway single, due east, 30 feet broad; area square, each side 90 feet long. The parapet is now only one foot high, the ground having been repeatedly ploughed. It was originally three feet high.

"No. 23. A circular enclosure, lying on James Higgins's farm, 300 yards from No. 22, towards the N.W.; but on the opposite side of Sommerset creek, in a corn field, and in the flat bottom of the valley.

This is a singular instance, since nearly all the ancient monuments are on high ground. The place is sometimes overflowed, which, however, is owing to the bed of the creek having been raised of late by alluvium; circumference 800 feet; gateway S.E. directed towards No. 22. Parapet only one foot high, and often obsolete; it was three feet high before being ploughed; but it may easily be traced by the growth of corn on it, being much lower and poorer than inside and outside. This happens in all instances, the ground of the parapets having been made up by throwing on them different and often gravelly earth, taken from the ditch or some deep place.

"No. 24. A large circular enclosure on Colonel Williams's farm, nearly a mile S.W. from No. 22, and near a branch of Sommerset creek called Higgins's branch. I did not visit it, because it was represented to me as lying in several fields which have been under cultivation for 20 or 30 years, and to be therefore very difficult to trace; but it is said to consist of 10 acres of ground, and to have been formerly very distinct.

"No. 25. A mound on Moses Higgins's farm, S.E. of No. 22, and between Sommerset creek (left bank) and Higgins's branch. Circumference about 150 feet, and five high.

"No. 26. Another mound 160 feet in circumference and six high, west of No. 22, about half a mile distant, and near Grass Lick creek.

"Group VI. A small one, consisting of an enclosure and a mound, situated on a high hill in John Wilson's farm, about five miles N.W. from Mount Sterling, above the junction of Aaron's run and Grass Lick creek, and on their left side near Duncan's mill, in a corn field.

"No. 27. A circular enclosure, 1100 feet in circumference. Parapet 40 feet wide, four feet high above the ditch, two above the ground. Ditch 20 feet broad, and inside as usual. Gateway towards the S.E. The ditch was six or eight feet deep formerly.

"No. 28. A circular mound, joining No. 27, and lying to the N.E. Circumference 225 feet, height five feet at present; but it was much higher before being ploughed."

Prof. Rafinesque concludes his notice of the above monuments with the following observations:

"From the above descriptions, it may safely be surmised that each group of monuments belonged to a particular town, and that there were therefore six towns, within the same space of ground, where only one exists at present, whence it might be conceived that the ancient population was there six-fold the actual one.

"From the rapid decay, or rather diminution of height in these monuments, even without the help of the plough, it is evident that they must all have been formerly much higher, with deeper ditches, &c.; therefore much more remarkable and difficult to raise.

"Allow me, besides, to venture a few peculiar suggestions, respecting their ultimate use, which may be considered as a probable hypothesis.

"1. I conceive that each group was surrounded by a town, particularly the compact and complicated groups.

"2. The circular enclosures with outward parapets, were probably temples dedicated to the sun, like those of the Natchez nation.

"3. The square enclosures might have been the palaces of their kings or chiefs, who were called children of the sun, as in Peru, and among the Floridans, Natchez, &c.; or perhaps the council houses, places of meeting for public purposes.

"4. All the mounds are evidently barrows or sepulchral monuments, and natural appendages to temples, as our church-yards are to our places of worship: but No. 12 and 13, by their peculiar enclosures and avenues, must have been the tombs of great kings, heroes, priests or queens, who may have been worshiped after death. Similar apotheoses were common among many ancient nations.

"5. The use of Nos. 4 and 6, is more problematical; but must have been analogous, owing to the connection with mounds. Else No. 4 may have been used for civil purposes, and No. 6 for military ones, as likewise No. 9."

Bourbon County.—1. At the junction of Flat Run and Stoner's creek, an irregular enclosure, containing an area of twenty-one acres. A number of mounds and excavations occur within the walls, together with other remains, consisting of raised outlines, two or three feet broad and one foot high. The latter are called "remains of dwellings" by Rafinesque. Twenty of these are found within, and fourteen without, the walls. A Plan is published in A. M. of M. V., Plate XIII, No. 1.

2. A large enclosure near "Ruddle's Station," on Licking creek, 7450 feet in circumference. Several considerable circular and semi-circular works also occur in this vicinity. One of these is situated three miles from Paris, on the Millersburg road.

3. On the road from Paris to Mt. Sterling, near Gen. Fletchers', an enclosure of large size.—(R.)

Fig. 2.

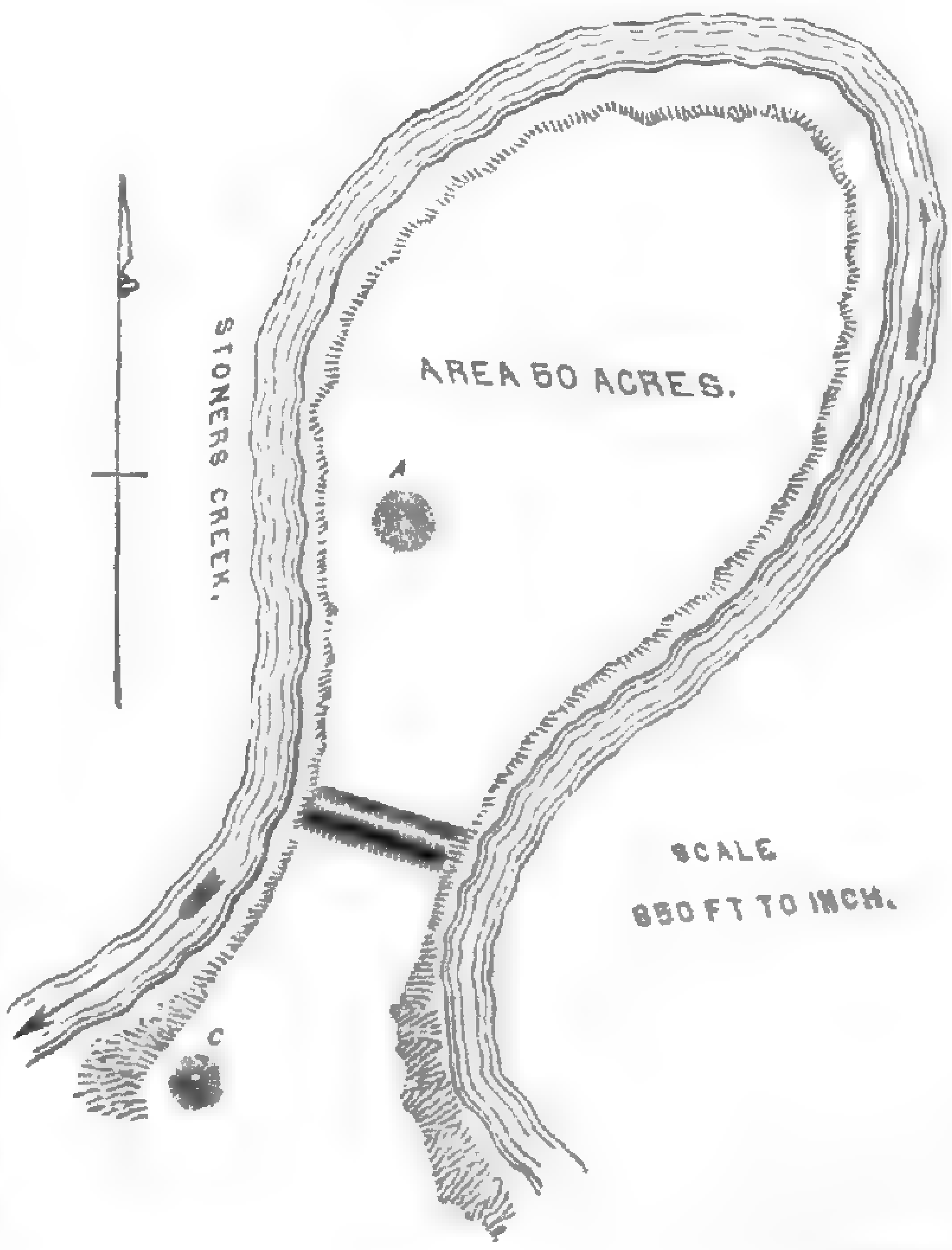


Fig. 2 is a plan of an ancient work, also situated on Stoner's creek, one and a fourth mile below the town of Paris, Bourbon county. At this point the creek makes a large bend; across the isthmus of the peninsula thus formed is carried a ditch and wall, completely cutting off approach in that direction. The area enclosed by the creek and wall is about fifty acres. The letters *a* and *c* indicate mounds; the latter occupies the summit of a commanding cliff. "It is said that a causeway was perceptible at the period of the settlement of the country, extending from this work to a large mound one and a half miles to the westward. This mound is one of a chain which extends quite across the county in a northwest direction; for telegraphic purposes their position could not have been better chosen by the most skillful engineer."

There are a number of highly interesting works of similar character in the neighborhood of those above described. At the junction of Stoner's and Hinkston's creeks is a small circle with gateways opening toward the cardinal points. Three miles distant, on Hinkston's fork, is a similar work, and a number of mounds. Besides these remains, there are here many other vestiges of an ancient population. Numerous graves are to be seen upon all the water courses; sometimes they occur singly, but usually in groups. Single graves are generally indicated by broad flat stones, set in the ground edgewise around the skeleton. When a number of skeletons are deposited together, a rude wall seems to have been raised around them, and then covered with other stones. A large cemetery and numerous traces of an ancient town are to be found near the junction of Pretty-run and Strode's creek. Thousands of human bones are here found scattered indiscriminately over a large area, just beneath the surface of the soil. Five miles below Paris, on Stoner's creek, a cave has recently been discovered, containing a number of skeletons.—*Collins's Kentucky*, p. 193.

Allen County.—1. One of the most remarkable defensive works in the state of Kentucky, occurs on the confines of Tennessee, in the western part of Allen county, thirteen miles from Scottsville and eighteen from Bowling Green. "The fortification is at once romantic and impregnable, presenting one of the strongest military positions in the world. At this place, Drake creek makes a wide bend, running one mile and then returning to within thirty feet of the spot where the bend may be said to commence. The partition which divides the channels of the creek at this point is of solid limestone, thirty feet thick at the base, forty feet high, six feet wide at the top, and six hundred feet in length. The top is level and covered with small cedars. The area included within the bend of the creek is to the eastward of this narrow pass, and contains about two hundred acres of land, which rises from the creek in a gradual ascent of one hundred feet, when it forms a level promontory. The summit of this which is leveled, is covered by a rectangular enclosure consisting of a wall and ditch, and having an area of about four acres. In the rear of this are many small mounds. The only approach to this work is over the main causeway above described, tall cliffs intercepting all access from the opposite banks of the stream."—*Collins's Kentucky*, p. 167.

2. A cave in which were found a large number of marine shells. One was eighteen inches long, cut longitudinally in the middle, with a small hole near the smaller extremity.—*Ib.*, p. 167.

3. Mounds with stone graves in them.

Barren County.—Twelve miles southwest of Glasgow are many small oval mounds, placed fifty yards apart so as to form a circle, 1200 or 1500 feet in circumference. They appear to have sustained structures of some kind. In the center of the group is a large truncated mound, between twenty and thirty feet in height. Another of like size occurs without the circle.—*Collins's Kentucky*, p. 176.

Edmonston County.—An enclosure on Indian Hill near Mammoth Cave.

Art. II.—*Notice of, and citations from a Voyage of Discovery and Research in the Southern and Antarctic Regions, during the years* 1839–43, by Captain Sir James Clark Ross, R. N., Knt., D.C.L. Oxon., F.R.S., etc.; with plates, maps and woodcuts. In two volumes, 8vo, pp. 366 and 447. Lond. 1847.

(Continued from ii ser., vol. vii, p. 329.)

In our last number we followed Captain Ross to his farthest Southern Point in January, 1841,—midsummer of the southern hemisphere. In the following pages we continue our abstracts for the remainder of his cruise.

In latitude 78° 15′ 3″ S., the barrier was 180 feet high, 1000 feet thick and stretched along for 450 miles; a beautiful sketch of a scene in this part of the Antarctic is given at page 232 of the first volume of Captain Ross's Journal. While cruising in these regions, they frequently threw overboard a bottle containing a notice of their proceedings from day to day and the position of the vessels.

Feb. 5.—Three large penguins were brought on board, one of which weighed sixty-six and the smallest fifty-seven pounds; their flesh is very dark and of a rank fishy flavor. Two seals were also captured to furnish oil.

Ice was taken on board to replenish the water—the ice of salt water being fresh.

Feb. 8.—An iceberg shewed a large rock upon it. Soundings were obtained seven miles from the barrier in lat. 77° 39′ in 275 fathoms; in one instance, within a quarter of a mile of the ice cliffs, the soundings were 330 fathoms with a green muddy bottom.

A view of the upper surface of the barrier was obtained on a narrow isthmus where the cliffs were about fifty feet high. The surface was quite smooth like an immense plain of frosted silver. Gigantic icicles hung from every point proving that it sometimes thaws, although in the month corresponding to the August of

England, the thermometer was at 12° and at noon only 14°. This cold was strongly contrasted with that of the northern seas, where in the corresponding season streams of water were constantly pouring from every iceberg.

Feb. 11.—Their escape from the ice barrier was critical. New ice rapidly formed; the pack closed in upon them and they were extricated only by a favorable conjuncture of the wind and great exertions in breaking the ice. They were hardly liberated before a violent gale came on with numerous icebergs all around; one of them was four miles long although not more than 150 feet out of the water, and doubtless a quarter of a mile beneath it. During the gale the decks and rigging of the ships and the clothes of the people were coated with ice.

Feb. 14.—The dip increased to 87°, showing that they were again approaching the magnetic pole now distant about 360 miles; the variation was 91°. The nearest approach to the magnetic pole had been about eighty leagues.

Feb. 16.—Being becalmed in the afternoon, they saw some magnificent eruptions of Mount Erebus. The lighted cinders were projected to a great height, but no flowing lava was seen as before, although the exhibitions were upon a much grander scale.

Feb. 17.—In latitude 76° 12′ S., long. 164° E., the variation was 109° 24′ E. and the dip 88° 40′. They were within 160 miles of the magnetic pole; but an impenetrable barrier of ice prevented a nearer approach. They deeply regretted the impossibility of wintering in those regions: could they have found a nook where the ships would have been safe, land parties could easily have reached the volcano and the magnetic pole. The position of the latter is however accurately known from calculation.

Feb. 19.—Mount Erebus was still in view—distant fifty leagues. The young ice formed rapidly around them presenting a continuous sheet, as far as vision extended; the ships could make little or no headway; but by rolling the boats before the ships' bow they succeeded in breaking it up. Along the barrier every bay was filled with packed ice so that the ships had no place in which to be secure; the cliffs were from 200 to 500 feet high and a chain of bergs ranged for miles in front of them as one outwork of frost.

Feb. 23.—Soundings in 180 fathoms brought up coral; the icebergs appeared to be all aground as none of them were less than 160 feet out of water.

Feb. 24.—An enormous glacier was distinctly traced descending as a continuous mass from near the tops of the mountains several miles into the sea, ending in stupendous cliffs in which a deep bay was formed having no passage except that by which the ships entered.

The variation diminished from 114° W. to 40° W., 74° in about 360 miles; the dip was now 86°.

Feb. 25.—A fine view of the coast was enjoyed in the afternoon. "The lofty range of mountains appeared projected with well defined outline upon a perfectly clear sky: although of a spotless white with but a patch of bare rock, yet the protuberances, cones and smaller eminences and deep valleys produced so much variety of light and shade as to relieve the monotonous glare of the surface.

The season was now so far advanced that great danger attended their lingering longer in these regions. The barrier of packed ice through which they had penetrated threatened to become a formidable obstacle to their escape, and moreover there was a heavy swell, which is characteristic of the south polar seas, rendering the navigation of the Antarctic at all times more hazardous than that of the Arctic ocean.

March 1 *and* 2.—*The aurora australis* appeared in bright colorless corruscations rising to 30° of altitude. This aurora differed from that seen in the arctic regions. The vertical beams were longer and the light came more in flashes; it was perfectly colorless and with a lateral flitting motion. The center of an irregular arch of light bore to the magnetic W., thus implying that as in the arctic regions, the principal seat of the aurora is not in the higher latitudes; in the southern hemisphere it is probably in lat. 68°.

March 7.—The perils of these Antarctic seas were numerous and appalling; but such dangers are of course encountered, more or less, by all navigators in polar regions. When in lat. 65° 31′ S., long. 162° 9′ E., a heavy easterly swell was driving them down upon the pack. From the mast-head, they counted at one time eighty-four large bergs and some hundreds of smaller dimensions.

"We found," says the narrator, "we were fast closing this chain of bergs so closely packed together that we could distinguish no opening through which the ships could pass, the waves breaking violently against them, dashing large masses of pack ice against the faces of the bergs; now lifting them nearly to their summit, then forcing them again far beneath their water line, and sometimes rending them into a multitude of brilliant fragments against their projecting points.

"Sublime and magnificent as such a scene must have appeared under different circumstances, to us it was awful if not appalling. For eight hours we had been drifting towards what to the human eye appeared inevitable destruction; the high waves and deep rolling of our ships rendered towing with the boats impossible, and our situation the more painful and embarrassing from our inability to make any effort to avoid the dreadful calamity that seemed to await us."—"In moments like these, comfort and peace of mind could be obtained only by casting our cares upon that almighty power which had already so often interposed to save us when human skill was wholly unavailing. Convinced that he is under the protection and guidance of a merciful God, the Christian awaits the issue of events firm and undismayed, and with calm resignation prepares for whatever he may order. His serenity of mind surprises and strengthens but never forsakes him; and thus possessing his soul in peace, he can with the greater advantage watch every change of circumstance that may favor his escape."

"We were now within half a mile of the range of bergs. The roar of the surf, which extended each way as far as we could see, and the crashing of the ice, fell upon the ear with fearful distinctness, whilst the frequently averted eye as immediately returned to contemplate the awful destruction that threatened in one short hour to close the world and all its hopes and joys and sorrows upon us forever. In this our deep distress we called upon the Lord, and he heard our voices out of his temple, and our cry came before him." "A gentle air of wind filled our sails; hope again revived and the greatest activity prevailed to make the best use of the feeble breeze; as it gradually freshened our heavy ships began to feel its influence, slowly at first but more rapidly afterwards; and before dark we found ourselves far removed from every danger."

Position of the South Magnetic Pole.—Captain Ross concludes from all the observations that had been made, including those of the French and American navigators, that the South Magnetic Pole is in about 76° S. The theoretical views of Gauss had placed it in 66°.

The return to Van Diemens Land was not marked by any very extraordinary events. The line of no variation was crossed in lat. 62° 0′ and long. 135° 50′ E.

The *aurora* grew more frequent and more remarkable.

March 23.—A bright arch of the aurora australis of a yellow color and a purple hue extended across the zenith; a succession of lower arches was formed in the S.S.W., and the center of each arch gradually rose to the zenith before they disappeared. At the altitude of 45° they generally broke up into smaller streamers; this splendid display was as usual followed by a shower of snow.

March 25.—The aurora gave considerable light in the absence of the moon; it rose in arches of a yellow color with vivid flashes of a bright pink. The aurora appeared in concentric arches of diffused light, with an apparently rapid internal motion like a current passing through and lighting up a mist. At 10 o'clock a bright light appeared behind a dark cloud with pink and green colors; brilliant streamers darted to the zenith forming a corona with bright flashes of all the prismatic colors, green and red being the most conspicuous. This aurora darted and quivered about the sky in every direction.

March 28.—Flocks of small dark colored petrel were seen on wing, which, judging by the time they occupied in passing, were from four to six miles in length and two or three broad.

March 30.—An equal temperature prevails in the ocean all around the earth between 50° and 60° S. lat., and they were now very near that mean as the soundings showed at various depths, even to 600 fathoms, the extremes being 38°·5 and 39°·8′.

The *auroras* appeared frequently and sometimes with great brilliancy.

April 2.—In a calm forenoon they sounded and found bottom in 1440 fathoms, 8640 feet, (almost 1¾ miles.) The latitude was 52° 10′ S., long. 136° 56′ E. The weight employed on this occasion was 336 lbs. The sun's heat was here felt in the ocean to the depth of 450 fathoms or more than half a mile. The specific gravity of the sea was the same below as at the surface, that is 1·0274.

April 6.—They arrived safely at Van Diemens Land and anchored off Rossback Observatory. The crews had enjoyed perfect health and they had not lost a man. Well might they respond with joy and gratitude to the warm congratulations of their friends, and especially of their distinguished patron, Sir John Franklin, the governor of the colony, who was the last to bid them adieu when they departed, and the first to meet them with a warm welcome on their happy return.

Here closes the first volume, we continue on with the second.

Van Diemens Land or Tasmania, 1841.—*April to July.*—*Magnetic Observations.*—The portable observatories of the ships were set up on shore and their instruments were carefully compared with those of the fixed observatory. The plan of observations was changed after the term day of February, in consequence of new instructions.

Fossil Trees are among the most interesting objects in this island. They are found in the Derwent valley, and are thus described by Count Strzelecki:*— "No where to my knowledge is the aspect of fossil wood more magnificent than in the Derwent valley, and no where is the original structure of the tree better preserved; while the outside presents a homogeneous and a hard glossy surface, variegated with colored stripes, like a barked pine, the interior, composed of distinct concentric layers, apparently compact and homogeneous, may be nevertheless separated into longitudinal fibres, which are susceptible of division into almost hair-like filaments."

* Physical Description of New South Wales and Van Diemens Land. London, 1845.

Dr. Hooker, of the expedition, speaks of the vast quantities of silicified wood, either loose on the plains, or imbedded in rocks, both igneous and aqueous;—the former being most remarkable from their singular beauty and the very perfect manner in which the structure of the woody tissue is retained. Many of the specimens perfectly resemble to the eye splintered white deal. The stump of the tree from which they came is a pine, about six feet high, 2½ in diameter at the base, and 15 inches at the top; it is silicified throughout; it stands erect, in a cliff of vesicular basalt, by which it was once enclosed. The exterior,—probably the bark, is beautifully agatized with a brown color and glossy lustre. The concentric annual rings, more than one hundred in number, are perfectly distinct, as well as the medullary rays, and the fibrous structure. The surface (the bark) is marked by those large circular disks which are characteristic of all the pine tribe.

Boulders of Basalt are numerous in the valley of the Derwent —they are cylindrical and flattened columns heaped together, with pebbles and spheroidal boulders of greenstone, piled up against an escarpment of the carboniferous series.

The basalt of Rose Garland contains fossilized trees, probably silicified previous to the irruption of the melted rock—while other trees not fossilized were consumed and have left moulds and impressions—as happened in Hawaii in 1840. In some instances these moulds have been filled by a second irruption, forming casts.

Coal mines and Sandstone quarries have been opened in this country. Copious citations are made in the narrative from Count Strzelecki's work which now lies before us, and to this we must refer for many interesting facts regarding the minerals of this country.

Tasmania abounds with good harbors; it has rivers of considerable magnitude; in many parts there is a rich soil and luxuriant vegetation, with splendid scenery and grand forests, some of the trees in which are 180 to 200 feet in height. It is capable of sustaining a large European population.

Marks to measure the ocean level compared with that of the land, were cut in a rocky cliff in the small island of Point Puer.

Captain Ross well observes, that if similar marks had been made during the early voyages of Bougainville and Cook, we should possess means of judging more perfectly than now, whether secular changes of level are general or local.

July 7.—The expedition again set sail for the Antarctic seas, after a warm adieu to the governor and other numerous friends. They passed port Arthur in Tasmania, one of the best harbors in Van Diemens Land, and steered for Port Jackson, New South Wales, where, without any remarkable event, they arrived, July 14. On their way up, (July 11,) they obtained soundings in twenty-nine fathoms. They remained in the colony till August 5, and were much impressed by its prosperity, and by the opulence and extent of Sydney, the principal city.

Magnetic observations for comparison were instituted here by Captain Ross with satisfactory results.

In company with the governor (Sir George Gipps) he visited the Paramatta Observatory, fifteen miles up the river. It was established by the private munificence of Sir Thomas Brisbane, late governor of the colony. Signals by means of rockets were now arranged between this Observatory and Garden Island as a means of determining the longitude of these places, which was thus correctly ascertained.

Although this country is, not unfrequently, visited by severe drought, it experiences, occasionally, excessive falls of rain. During the twenty-one days that the expedition remained here it rained in all the days except four. On two or three occasions it came down in perfect sheets. On the afternoon of the 16th, during 2½ hours, more than three inches of rain fell; on the 17th, between 7 A. M. and noon, nearly five inches. The governor stated that, on one occasion, twenty-three inches fell in twenty-four hours, a quantity equivalent to what falls in a whole year in some parts of Great Britain. It created a temporary deluge with great destruction of property; indeed the soft sandstone which forms the foundation of the country is every where worn into deep channels by these occasional torrents.*

In New South Wales the country sometimes suffers very severely from want of rain, creating danger of a famine of both bread and water. The soil is extremely sandy and there are no springs and very few rivers. During the drought of 1838, a gentleman rode his horse forty miles without water, and eventually paid half a crown for less than a quart.

Governor Gipps, by damming up the water courses of winter, has obtained a sufficient supply.

August 5.—As they left the harbor, they found the temperature of the air 55° to 60° F., and that of the sea at 55°–63°. The ships were laden for three years even below their bearings, by provisions, stores and fuel, so that with a heavy press of sail they could not make over eight knots an hour. The Terror, being a heavy sailer, detained the Erebus in waiting for her to come up, and they had the mortification to see a merchant ship pass them under easy sail.

Aug. 8.—Falling stars were occasionally sought for, during the night, and as there was a deficiency of observers to watch

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* At Joyeuse, in the department of Ardèche in France, there fell on the 9th of August, 1807, 9·87 inches of rain—then thought to be enormously great, but on the 9th of October, 1827, in twenty-four hours 31·17 descended at the same place.—*Arago.*

all parts of the heavens, some of the more intelligent and careful of the seamen were instructed for the duty, report being made every half hour to the officer of the watch. "One of the more zealous of these observers, who had not been so fortunate as to see any 'falling stars' during his first half hour, did not wish to leave his post when relieved, 'as he was sure two or three stars would fall in a few minutes; he had been watching them and could see they were shaking!'"

At noon, lat. 33° 40′ S., long. 64° 18′ E., temperature of the sea at 300 fathoms, 49°·7—at 150 fathoms 55°·8—at the surface 59°. The specific gravity was 1·0274 at 60°.

Aug. 9.—"*A bright meteor burst in the S. W.*, at the altitude of 20°, exhibiting a shower of beautifully variegated stars." On board the Terror it was observed to emerge from a dark cloud, near the Southern Cross, and in its descent it shewed fine bright lights. Fifteen falling stars were seen between 10 and 11 P. M.

Aug. 10.—*There were no soundings at* 820 *fathoms;* some new self-registering thermometers were tried, constructed to bear a greater pressure than any that had hitherto been encountered. It was ascertained that the mean temperature of the sea is here attained only below 800 fathoms.

Aug. 11.—*There were soundings in* 400 *fathoms;* the bottom was sand and small stones, and the dredge brought up beautiful corals, corallines, flustræ and crustacea. They were at this time about 300 miles N. of New Zealand.

The temperature of the sea-water at various depths was carefully observed in numerous instances. "In low latitudes, the surface water is hotter than that below; generally, the temperature sinks as the water shoals, or even *in passing over banks whose depth was very considerable;* the approach to land or shoal water is indicated by the thermometer, in many places with a high degree of sensibility."

New Zealand.—The first land that appeared in sight in New Zealand was "the high bold cape Maria Van Diemen, of romantic association." "It was so designated by Tasman nearly two hundred years ago, after a young lady of that name to whom he was attached and whom he afterwards married: she was the daughter or near relative of Anthony Van Diemen, the governor of the Dutch possessions in India, a great friend of Tasman, and by whom the expedition he commanded was sent forth." Tasman was therefore the discoverer of the north island of New Zealand, as well as of Van Diemens Land. The name of Tasmania now imposed on the latter island, is only a just tribute to the memory of the great navigator, and it has much the advantage in point of euphony.

August 17th, they arrived at the Bay of Islands. A place for observations was established at Paihia, the station of the English mission under Rev. Mr. Williams. The location was on a low beach very near a place called by the natives "Haumi," marked by a small cluster of trees, "where the bodies of the French navigator Marion and his companions were devoured by the savages." The French provoked this aggression by forcibly persisting to fish on ground which they were not aware was *tabooed* by the natives.

New Zealand having become an English colony, the natives are now only sojourners in their own country. We may refer to the narratives of Captains Fitzroy and Wilkes, and other published works, for a full description of the country and for a history of the English aggressions there. The missionaries have, in the mean time, persevered in their work of benevolence, and through all vicissitudes have maintained their sway over the native mind. To these topics we cannot do justice in so brief a summary, and shall therefore confine ourselves to a few notices on other subjects.

The mean temperature from August 19, to Sept. 17, was 53°·9, and the average 66° to 39°. In England, the mean temperature of March, the corresponding month, is 43·9, and the average range from 66° to 24°. The first month of spring in New Zealand has a temperature ten degrees higher than the corresponding month in England.

The mean temperature of the dew point was found to be 49°·6. The quantity of rain was 11·76 inches, and the greatest fall 5·5, which took place on September 9.

The mean height of the barometer is 30·034, and its range 1·14 inch. Diurnal variations of the barometer from 9 A. M. to 10 P. M., when it is greatest; also from 4 A. M. to 3 P. M., when it is least: difference ·041 inch. Mean temperature of the surface of the sea 56°.

For the next month, September 18 to October 18, the mean temperature was 57°·9, an increase of four degrees, while that of England increases 6°. Mean temperature of the dew point 53°. Greatest fall of rain October 17, was 2·84 in. Mean height of the barometer 30·118; range ·738 in. Greatest pressure, 9 A. M. and 10 P. M.; the least at 4 A. M. and 4 P. M.; difference ·044.

From October 19 to November 17, the mean temperature advanced 2½°, to 60°·5; range 74° to 47°. In England the mean temperature for May, the corresponding month, is 54°—range 70° to 33°. Mean temperature of the dew point 52°. Quantity of rain in New Zealand 9·5 in.; greatest fall, November 8, 2·1 in. In England, rain in May, 1·85 in. Barometer at the mean, 29·904, and wind N.; range of the barometer 1·80. Mean temperature for the year in England 49°·2, differing little from that of the three months of spring. Mean temperature in New Zealand very nearly 59°. According to Dieffenbach, the rain in the North Island is 34·49 in. Mean temperature of the whole year at Wellington

58°·2—that of the three spring months 57°·7. The coldest month is July, the hottest January.

At the Auckland Islands, about 100 miles south of New Zealand, Bay of Islands, the mean temperature is 59°, that of the three summer months 67°·2, that of the three winter months 52°.

They visited the missionary stations and the schools, and found every thing prosperous, and as they travelled the natives whom they met treated them with kindness. A large portion of this part of the island was covered with fern. On their way to the station of the Rev. Mr. Kemp, they met with a beautiful cataract; a broad sheet of water fell over basaltic columns seventy feet high into a deep circular basin. Forests of the Kauri pine were passed, and the Kauri resin was abundant in some places, buried in the soil, where it is supposed to have been derived from the former burning of the trees. This resin is largely exported. They ascended Puki Nui, a volcanic mountain 1240 feet above the sea, and in the vicinity of some small lakes they visited the hot sulphurous springs that rise here, with a temperature of 80° to 150°; they are elevated 648 feet above the sea.

The latitude of the Observatory was found to be 35° 17′ 46″·6 S., long. 174° 8′ 22″·7 E., and the mean magnetic dip from August 23 to October 25, 59° 33′ S. Highest tides 5 feet 10 inches to 6 feet 10 inches.

Departure from New Zealand.—On the 23d of November, 1841, they left New Zealand for Chatham Island, with a view to magnetic observations there, and also to judge of the capabilities for colonization and as a rendezvous for the whale fishery. For this latter purpose, the Auckland Islands are considered preferable, and are much frequented by the American whalers, being at a convenient distance from New Zealand and Australia, and possessing excellent harbors. November 24th they descried the East Cape, and during the 25th saw many sooty albatross, an elegant blue petrel, and the cape pigeon.

On crossing the 180th degree of longitude, they added a day to their week, making it *eight* days instead of the usual number *seven.* Having, by sailing to the eastward, gained twelve hours, it was necessary on entering west longitude to make their reckoning correspond with other places in west longitude; hence it was necessary to have two days following of the same date, so as by this means to lose the time they had gained and still were gaining in their eastward course. "We had therefore," Capt. Ross says, "two Thursdays and two twenty-fifth days of November in succession; so that after crossing the meridian and having made the alteration of a day, instead of being twelve hours in advance, we became this much in arrear of the time in England; this would gradually diminish as we pursued our easterly course, until on our return we should find them in exact accordance."

Nov. 27.—No bottom with 600 fathoms of line. At this depth the temperature of the sea was 44°·9; at 450 fathoms 46°·8; at 300 fathoms 49°·2; at 150 fathoms 53°·5; and at the surface 58°. Specific gravity of the surface water was 1·0274; at 150 fathoms 1·0272, and at 450 fathoms 1·0268. All these specific gravities were taken at the surface of the sea at the temperature of 60°. It was proved that the water beneath was specifically lighter than that at the surface when brought to the same temperature, as was confirmed by almost daily experiments.

Nov. 29.—A long-snouted porpoise was harpooned, and in its formidable jaws they found the teeth which the New Zealanders value so highly as ornaments, and whose source had been unknown.

Thick fogs prevented their landing on Chatham Island, and they kept in company with the Terror only by firing guns.

Dec. 3.—Barometer at the unusual height of 30·45. The cry of the penguins was heard, and the luminous patches in the sea were very brilliant.

Dec. 4.—Soundings were attempted with 1100 fathoms, but no bottom was found, and two new thermometers were lost; they had been attached to the line at intervals of 150 fathoms and the line broke. Another line being prepared, thermometers were sent down to 1050 fathoms and came up safe, having borne this enormous pressure, and recording the temperature at that deep region of the ocean to be exactly 40°, or thirteen degrees below that of the surface.

The mean temperature of the ocean is at least 900 fathoms, or more than a mile below the surface, in lat. 49° 17′ S., and long. 172° 28′ W.

The penguins were now going to the eastward, proceeding to their breeding quarters—perhaps in the Nimrod Islands. "It is a wonderful instinct far beyond the powers of untutored reason, that enables these creatures to find their way, chiefly under water, several hundred miles, to their places of usual resort, as each succeeding spring season of the year arrives."

Dec. 9.—Lat. 52° 32′ S., long 161° 20′ W., the dip had increased to 70° S.; the variation was 15° 10′ E. A breeze became a gale, with rain and snow, and the thermometer sunk from 42° to 34°; the barometer falling to 29·1 at midnight.

It was a severe night, but not expecting ice in so low a latitude they pushed on before the gale in a thick snow storm. They had been drifted by a current fifteen miles daily to the east, and it was concluded that a current circulates round the globe in a belt of about fifty degrees on each side of the fiftieth degree of latitude.

Dec. 13.—The circle of uniform temperature of the ocean was crossed in lat. 55° 18′ S., long. 149° 20′ W. At 600 fathoms the temperature was 39°·7, and at the surface 39°. At profound depths of several thousand fathoms the temperature would doubtless be uniform or nearly so.

In a very dark and foggy night the ships kept company by firing muskets, but the bell and gong were still more audible, and a conversation was carried on with the other ship by a speaking trumpet with almost perfect distinctness.

Dec. 15.—The barometer rose, and although the fog was so thick that the vessels were invisible to each other, still the orders were distinctly given and understood.

Dec. 16.—The fog having cleared a little, several icebergs were seen—temperature of the sea below 33°. The largest berg was 130 feet high and three quarters of a mile in circuit; it was table topped, deep caverns had been worn in its sides, and a long line of loose pieces extended several miles to leeward of it, and other masses were ready to fall.

The latitude was 58° 36′ S., long. 146° 43′ W., magnetic dip 73° 23′ S., variation 14° 40′ E.

On this meridian it was determined to penetrate due south in the hope of discovering land, (which was indicated by the appearance of the ice,) and by a wish to deviate as far as possible from the route of last year.

Dec. 17.—Icebergs and their floating fragments were frequent. The proximity of a large body of ice was indicated by the ice blink and by a sudden fall in temperature to 29° at midnight, and at 3 A. M. the main pack was seen stretching across the course from E. to W.

They ran into it at once, and it being light and open, they made thirty miles south without much difficulty, but as it then became heavy and more closely packed they could not continue to sail exactly on a meridian. Temperature 28°, lat. 60° 50′ S., long. 147° 25′ W. Dip 76 S., variation nearly 19 E.

Myriads of animalcules stained the ice as had been seen in the former cruise off Mount Erebus; they were ascertained at Berlin by Ehrenberg to be creatures with siliceous shells.

Whales were seen among the ice, and so tame that the ship ran upon one and received a shock.

Dec. 19.—The ice was very close, and the vessels forced their way from hole to hole; they had penetrated nearly 100 miles in a S.W. course, and the ice giving way a little the ships were pushed twenty miles further; but on the 20th, the ice again closed and stopped their progress. Soundings were obtained in 1700 fathoms, almost two miles: the mean temperature in this latitude is about 600 fathoms below the surface.

Some seals were killed on the ice; they seemed unconscious of danger and made no resistance. In the stomach of one were nine pounds of granite stones, doubtless from the icebergs, as there was no land above water within 100 miles. In others were found fish and shrimps, their proper food.

Dec. 25.—Christmas day was passed in close packed ice, near a chain of eleven bergs and in a thick fog; but the people were still cheered by Christmas fare reserved for the occasion.

Dec. 26–30.—Becalmed in a sea-lake surrounded by ice; there appeared no chance of escape, and therefore mooring the ships to the ice the crews were employed in filling the water tanks with ice.

Dec. 31.—The year closed gloomily in this icy prison; the ice was much broken and heaped and no piece was on a level, thus proving the enormous pressure to which it was subjected. No piece was seen over a quarter of a mile across, whereas in the Arctic regions, floes and fields of several miles in diameter are common, and sometimes from the mast-head the boundary cannot be discovered. The difference is occasioned by the comparative quiet of the northern, and the turbulence of the southern polar seas.

Jan. 1, 1842.—No outlet was visible from the mast head; they had advanced 250 miles into the pack, and were in lat. 66° 32′ S., long. 156° 28′ W. They had crossed the Antarctic circle this season on the same day as the last, and were now 1400 miles east of the meridian on which they passed it at that time.

Warm clothing was distributed, and new year's day was spent in customary hilarity and festivity. Temperature of the sea at the surface 28°, at 1050 fathoms 39°·6.

Gales succeeded, and drifted the pack with the ships to the north, but they found occasionally some clear water and managed to regain a part of the space they had lost, but it was a severe service in the midst of thick snow storms, and with vessels and rigging encumbered with ice.

Jan. 11.—The great penguins were numerous, and several were brought on board alive, but it was a difficult and cruel operation to kill them, until they resorted to hydrocyanic (prussic) acid, a teaspoonful of which destroyed life in less than one minute. The largest weighed seventy-eight pounds. They are stupid birds and allow themselves to be knocked on the head with a bludgeon. Their food consists of crabs and other crustacea, and in the stomach was frequently found ten pounds weight of pebbles, granite, quartz and trap. When alarmed they skated along over the snow faster than the people could follow them; lying down on the belly they impel themselves by their powerful feet, using their short wings to steady them laterally.

The largest seals that were captured measured twelve feet long by six in circumference—weighed 850 pounds and yielded more than sixteen gallons of oil. In the stomach of one they found twenty-eight pounds of fish. The largest seals have teeth as formidable as those of the polar bear and capable of inflicting dangerous wounds. The males of the middle sized species wound each other severely in their combats.

A small ferocious looking fish inhabits these high latitudes—only 6½ inches long and weighing 2½ ounces; they are preyed upon by the seals and petrels and they in turn devour the smaller crabs and Limacinæ. In a region where there is no vegetation a chain of animal existences is sustained by each preying upon that below it, and ultimately the infusorial animalcules afford a pabulum* which forms the last link in the chain.

Jan. 19.—They contended for several days with the ice, availing themselves of every opening; when moored to the ice floes their eight inch cables were snapped like cords, for the wind had risen to a heavy gale. Soon after midnight they found it impossible, any longer, to hold on to the floe, and therefore took shelter under a berg, nearly a mile in diameter, dodging about in the mean time in search of an opening. The sea rose to a fearful height breaking over the loftiest bergs; the ships were entangled in an ocean of rolling fragments of ice hard as granite, and which were dashed against them with so much violence that the masts quivered to their fall, which was instantly expected. Both ships having carried away their rudders their condition seemed desperate; hour after hour passed without relief, and it seemed almost impossible that the ships should any longer sustain the shocks which were every moment received. The loud crashing noise of the straining and working of the timbers and decks was sufficient to appall the stoutest heart, but during the twenty-eight hours of this fearful struggle all did their duty with composure and firmness. The storm was at its height at 2 P. M. when the barometer stood at 28·40 inches; after that time it began to rise. But the swell had not subsided; the ships still rolled and groaned amidst the ruins of crashing icebergs, over which the ocean poured its mountainous waves, throwing large masses upon one another, and then submerging them again, dashing and grinding them together with fearful violence. The awful grandeur of the scene can neither be imagined nor described; the people watched with breathless anxiety the effect of each collision and the vibration of the tottering masts whose fall it would have been impossible to prevent. The ships were so near to each other that they mounted the ridges of two contiguous waves, while the deep chasm between was filled with rolling masses of ice; and as the ships descended into the hollow between the billows, the main topsail yard of each could be seen from the deck of the other just level with the crest of the intervening wave.

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* These, however, must ultimately derive their support from vegetable infused matter brought, it may be, from other climes.—*Ed.*

Jan. 21.—The storm abated in violence. They found they had made progress. The sea was more open but they judged it best to force the ships into the thickest of the pack, where they moored them to a large cake of ice which lay between the ships and the pack which was now comparatively quiet. By great exertions the damages were repaired in the course of three or four days; new rudders were shipped,—the hulls of the vessels were found to be nearly tight and had sustained no vital injury, and thus after five weeks of the most precious part of the season were lost by their detention in the ice, they were now in a condition to prosecute their enterprise in the brief period of summer that remained.

The next month, January 26 to February 28, was passed in arduous efforts, and severe conflicts were experienced of the same general character as those of which an abstract has been given.

Feb. 1.—Lat. 67° 18′ S., long. 158° 12′ W., the clear sea came into view; and the margin of the pack, seen through the deepening shades of night, presented a fearful line of breakers, but they felt compelled to pass through at all risks.

Feb. 4.—They were in lat. 68° 50′ S., long. 160° 20′; the dip was 81° 37′ and the variation 29° 41′ E. The Terror was on fire for two hours near the kelson, but a deluge of water poured from a powerful engine, making it two feet deep in the hold, extinguished the fire without giving the alarm to the other ship.

Feb. 8.—They passed a berg of four miles in diameter, believed to be the same they saw last year, February 13, in lat. 76° 11′ S., long. 172° 7′ W.; that seen to-day was in 70° 30′ S., long. 173° 10′ W.

Feb. 21.—A small fish was found in the ice, frozen upon the bow of the Terror supposed to have been suddenly caught by the freezing of the water.

Feb. 22.—In lat. 76° 42′ S., a piece of ice was seen bearing a black rock apparently six feet in diameter, and the next day numerous stones and patches of soil were observed upon the bergs indicating the proximity of land.

The barrier of ice was seen rising 107 feet above the sea; it was probably attached to the continent in lat. 78° 11′ S., long. 161° 7′ W. This, the extreme southern latitude attained, was six miles south of that which had been reached last year.

Mountains of great height with an undulating surface entirely covered with snow were seen from the mast head; such at least was the appearance, but the conclusion was adopted with some caution.

Feb. 24.—The young ice formed so fast as to present an unbroken sheet from the mast head, and a very short delay might fix the ships and detain them through a south polar winter; with a favoring breeze they therefore pushed on with all sail set, and after breaking through thirty miles of ice they were once more in clear water.

Feb. 28.—The ships were in lat. 70° 54′ S. and long 175° 36′, and the crew were in perfect health notwithstanding the severity of the service which they had performed.

March 1, 1842.—The attempt to reach a higher southern latitude being relinquished, the vessels sailed for the Falkland Islands.

In lat. 69° 52′ S., long. 180°, they passed a chain of the most magnificent bergs they had yet seen; they were of a blue color and much worn by the action of the sea. Some hundreds of seals were plunging and splashing about, and two or three on a point of ice maintained their position with much difficulty as the waves broke over them.

The sea had assumed its oceanic blue color, free from the ferruginous tinge of the animalcules which give a dirty brown tint to the waters of the southern ocean, whose frigid temperature they appear to prefer.

March 5.—They passed the Antarctic circle after being sixty-four days to the south of it, and two days later, several pieces of sea weed gave them the first returning notice of the vegetable kingdom in lat. 64° S.

On the 16th of April the ships dropped anchor in St. Louis, the principal port of the Falkland Islands.

The three succeeding chapters of this work, covering eighty pages, are engrossed by the Falklands and by Cape Horn, Fuegia and its inhabitants, and by other topics which have been so fully reported in the narratives of the Adventure and Beagle, and of the American Exploring Expedition, that we pass them by with only a few notices. The wild cattle of the Falklands and their important relation to the supply of ships, give a principal interest to this group of cold and stormy islands. The hunting of these powerful, courageous and savage animals, is a highly exciting and dangerous employment carried on principally by the Gauchoes or original natives of the islands.

The provision of nature for the support of the cattle is remarkable, especially in the tussock grass of which Dr. Hooker the botanist of the expedition has given a very interesting account. The tussock grass contains a sweet edible core which will sustain human life.

These islands are rich in certain families of plants. The lichens are very abundant and conspicuous. Sea weeds abound on the rocky coast. An enormous mass of marine vegetation is cast upon the shores, chiefly the *Macrocystis pyrifera*, *Lessoniæ*, and *D'Urvillæa utilis.* Wrenched from the rocks and twisted together by the rolling surf, they form enormous vegetable cables much thicker than the human body and several hundred feet in length. The *Lessonia* is like a small tree eight or ten feet high; the stem is as large as a man's thigh, the leaves are two or three feet long and three inches broad, and when in the water they hang down like the boughs of a willow. In many places the plant is so abundant as to form a submersed forest, presenting, when seen from a boat, through the clear water, a mass of green foliage.

It is the residence of a vast exuberance of animal life,—worms, sponges, corals, crabs and other crustacea, flustræ, eggs of fishes and mollusca, serpulæ, &c. Some of the large sea weeds of the Fuegian shores are rich in manna and iodine, as ascertained by Dr. R. D. Thomson.

Cape Horn always disappoints the voyager, in his first sight of it. It is only part of a small island and being only 500 to 600 feet high it has no grandeur; yet it becomes invested with terror when it is lashed by the stormy billows of an Antarctic winter.

Third Voyage to the Antarctic regions.—This voyage was less remarkable than either of the two former, and without following it in much detail, we present only a few of the more interesting results.

Dec. 17, 1842.—The expedition left Port Louis intending to penetrate by the meridian of 55° W., or in case of insuperable obstructions by that in which Weddell reached the latitude of 74° 15′ S., three degrees farther south than any preceding navigator. On December 24th, they saw the first iceberg in lat. 61° S.

Dec. 25.—Although surrounded by a multitude of icebergs, they kept a merry Christmas with roast beef from the oxen of the Falklands, presented by Governor Moody for the occasion.

Dec. 27—Frequent loud reports were heard from the crashing icebergs as they broke up and rolled over, making it dangerous to approach them. On the 28th, land was seen, supposed to be the "Point des Français" of Admiral D'Urville. An enormous glacier several miles in breadth descended from an elevation of 1200 feet into the ocean, presenting a vertical cliff 100 feet high.

They bore away to the south, along a coast line of icy cliffs in a sea thickly studded with grounded bergs. The 29th, they saw a great number of the largest sized black whales, so tame that they would hardly move to get out of the way of the ships; any quantity of oil might have been obtained in a short time. A few days after they saw them lying upon the surface of the water in all directions, and were astonished by their enormous breadth.

Dec. 30.—Lat. 63° 36′ S., long. 54° 33′ W. Land to the S. and S.W. entirely covered with snow, except in a few places where vertical cliffs broke through the mountain glacier; elevation of the highest peak 3700 feet.

Jan. 1, 1843.—In lat. 64° 14′ S., long. 55° 54′ W. A new mountain 7050 feet high was named Haddington. At evening being beleaguered with icebergs they made fast to a floe two or three miles in diameter, and had a berg of four or five miles diameter and 150 feet high for a dangerous companion through the whole day.

Magnetic observations were made upon the ice; the results were entirely satisfactory; the magnetic dip was 63° 17′ S., and the variation 20° 53′ E. Soundings in 152 fathoms, bottom blue mud.

Jan. 6.—The two commanders went on shore on an island and took formal possession of it and of the neighboring land; it was of volcanic formation and here the last vestiges of vegetation are found, not rising on the mountains above 1400 feet of elevation.

Penguins and cormorants are found in these stormy islands lying immediately south of Cape Horn, and in their precipitous cliffs the petrels build their nests.

Jan. 24.—Unavailing struggles with packs of ice prevented the ships from penetrating farther south at this time than 64° 24′ S., in long. 55° 11′ W.; magnetic dip 63° 4′.

Feb. 4.—They got clear of the pack in lat. 64°, long. 54°. On February 6, seals were numerous and they killed one that measured twelve feet four inches long and weighed 1145 lbs. On the 22d, they crossed the line of no variation in lat. 61° 30′ S., long. 22° 30′ W., magnetic dip 57° 40′; they concluded that the position of the magnetic pole was on a meridian half way between this and New Zealand and that there is only one pole in the southern hemisphere.

Feb. 27.—In a snow storm so thick that the ships could not be seen, a diffused auroral light gave considerable assistance.

March 1.—They passed the Antarctic circle three days earlier than in former seasons. On the 2d, a splendid morning of sunshine after six weeks of cloudy weather, gave opportunity for experiments on the heating power of the sun's rays in these latitudes.

March 3.—No soundings with 4000 fathoms of line—more than four miles. March 5, lat. 71° 30′ S., long. 14° 51′ W., the highest which they attained this cruise; a cask was thrown overboard containing a paper stating the fact with the attestations of the officers.

March 10.—They saw the tail of the great comet which was seen a few days sooner at the Cape of Good Hope, St. Helena and Barbadoes. In the morning they recrossed the Antarctic circle in long. 13° 30′ W. On the 20th at noon they crossed the meridian of Greenwich in lat. 54° 7′ S., and still icebergs were visible causing false outcries of land.

Circle of mean temperature of the sea.—In their various wanderings they crossed this circle on seven different occasions in the extreme latitudes 52° and 57° 52′ S., and in five intermediate latitudes, giving a mean latitude of 56° 14′. "It is evident therefore that about this parallel of latitude there is a belt or circle round the earth, where the mean temperature of the sea obtains throughout its entire depth, forming a boundary or kind of neutral ground between the two great thermic basins of the ocean. To the north of this circle, the sea has become warmer than its mean temperature, by reason of the sun's heat which it has absorbed, elevating its temperature at various depths in different latitudes. So that the line of mean temperature of 39°·5, in lat. 45° S., has descended to the depth of 600 fathoms; and at the equatorial and tropical regions, this mark of the limit of the sun's influence is found at the depth of about 1200 fathoms; beneath which the ocean maintains its unvarying temperature of 39°·5, whilst that of the surface is 78°." "So likewise to the south of the circle of mean temperature, we find that in the absence of an equal solar supply, the radiation of the heat of the ocean into space occasions the sea to be of a colder temperature as we advance to the south; and near the 70th degree of latitude, we find the line of mean temperature has descended to the depth of 750 fathoms, beneath which again, to the greatest depths, the temperature of 39°·5 obtains whilst that of the surface is 30°."

"This circle of mean temperature of the southern ocean is a standard point in nature, which, if determined with very great accuracy, would afford to philosophers of future ages the means of ascertaining if the globe we inhabit, shall have undergone any change of temperature, and to what amount during the interval."

"These observations force upon us the conclusion that the internal heat of the earth exercises no influence upon the temperature of the ocean, or we should not find any part in which it was equable from the surface to the great depth we have reached; a new and important fact in the physics of our globe."

April 4.—They arrived at the Cape of Good Hope, returning for the third time from the Antarctic circle "without a single individual of either of the ships upon the sick list."

April 30.—They left the Cape, touching at St. Helena and the Island of Ascension, and at all these places as well as at Rio Janeiro, the magnetic experiments were repeated to their satisfaction. On the 3d of June, in lat. 15° 3′ S., long. 23° 14′ W., they failed to obtain soundings at the depth of 4600 fathoms, or 5¼ miles, the greatest depth of water in the ocean that had been actually ascertained; but it is not improbable that there are depths still more profound.

July 3.—They crossed the line of no dip, in lat. 13° 20′ S., long. 28° 11′ W., and of course were on the magnetic equator. Their "barometrical experiments had proved that the atmospheric pressure is considerably less at the equator than near the tropics, and south of the tropic of Capricorn, where it is the greatest, a gradual diminution occurs as the latitude is increased." The mean elevation of the barometer in the Antarctic latitudes is about an inch greater than in other parts of the world. "It had been considered that the mean pressure of the atmosphere at the sea level was nearly the same in all parts of the world, as no material difference exists between the equator and the highest parts of the world."

Sept. 2.—They descried the shores of Old England; the ships anchored off Folkstone, and in the morning the commander of the expedition hastened to London to make his report to the Admiralty.—B. S., Sr.

Art. III.—*On Ancient Sea Margins;* by R. Chambers, Esq., (from a letter to one of the Editors, dated Edinburgh, April 10, 1849.)

I have read with much interest, Mr. Dana's remarks on my 'Ancient Sea Margins,' inserted in your Journal for January, and reprinted in this month's number of Jameson's Edinburgh New Philosophical Journal. These remarks do not the less please me, that they are mainly an expression of the doubts and difficulties which the announcement of the subject is apt to raise in an ingenious and enlightened mind. I should be most happy if by a few observations in reply I could in any degree remove, or even soften those doubts: for their complete removal I believe I must be content to wait till one or two candid enquirers shall take the trouble to go over the ground which I have traversed.

Mr. Dana is perfectly right in his descriptions of river-side terraces, and in all his speculations as to their cause. They are undoubtedly the relics of sheets of alluvial matter which originally filled the bottoms of the valleys where they occur. They mark a former height at which the river had run, and the reason of the river having cut down the original alluvial sheet so as to leave only these terraces high above its present waters is undoubtedly the withdrawal of a body of water, which formerly received the river, to a lower level. The matter is very much overlooked in my volume, because few examples of such terraces had come under my attention in Scotland; but it is amply treated in a paper which I read in December last before the Royal Society of Edinburgh, and which has been since printed in Jameson's Journal.

It is unfortunate that the 'Ancient Sea Margins' should have contained so little on this subject, since, had the case been otherwise, Mr. Dana's doubts might have been much extenuated, and he might have left the American geologists in a more hopeful frame of mind as to the line of investigation which I have humbly ventured to point out. He may be assured that there is in my book no such extensive mistake as he is apprehensive of. The terraces and other markings there described are (overlooking a few peculiar cases where an explanation has been supplied) all of them, as far as the fidelity of my observations may be depended upon, strictly level. They are distinguished from ancient river alluvia, not merely by this powerful feature, but still more decidedly by local situation, their whole form and character, being manifestly not the remains of sheets of water which originally spread across the whole of certain valleys at the lowest and narrowest point, but the remains of benches of alluvium (if I may so express myself) left in greater or less extent along the side of wide valleys, altogether out of the range of any fluviatile operations (except in the special case of the deltas of side rivulets, which I am here leaving out of view.) In Scotland, the sea line of which is so irregular, a terrace is seen on a line of coast towards the ocean—it turns round and passes also along the country fronting towards a frith :—pass beyond the head of the frith, and you still find the terrace, always level, and always at the same level, where found at all. Let this kind of observation be repeated many times, and what can be concluded but that the part of the valley now far removed from salt water, was once the bed of an estuary prolonged much beyond its present limits? We may ascend the valley till it becomes narrow enough to have river terraces also; but these are of a strikingly different character, much more palpable, of declining surface, always near to the river both in horizontal and vertical space—in short, not to be mistaken for the other class of objects by any but a very unprepared observer. Standing, therefore, on the facts which I have amassed, I deny Mr. Dana's conclusion, that 'the terraces in the higher portions of a country are not satisfactory evidences of as many distinct elevations, nor of the actual height of any elevations the country may have experienced'—and that 'the terraces towards the sea are more trustworthy.' There is positively no distinction between them, beyond the simple fact that the sea may still be visible from one position and not from the other.

Mr. Dana's doubts lead him to call for observations of a more searching and exact nature than he supposes to have yet been made, and he lays down certain tests which he deems essential in the investigation. Being conscious of having done only what may reasonably be expected of one individual to open up the enquiry, I desire nothing so much as to see others, both in this country and elsewhere, engage in the same pursuit; but I demur to some of the tests, and a few of the particulars for examination instituted by Mr. Dana, I deem unnecessary. I confine myself, however, to a denial of Mr. Dana's proposition, that 'the marine origin of a bed [understanding this term to include terraces] is *to be proved* [that is, I presume, only] by its resemblance to marine formations and its containing marine relics,'—as far as the latter term is concerned. The terraces which I have spoken of as ancient sea margins do, in many instances, present such an arrangement of water-worn materials as might be expected on a coast. In many cases, there is no decisive feature of this kind, or I have not been able to ascertain particulars. On this point I am hopeful of seeing much new light as the investigation proceeds, particularly if I may believe that M. Morlot, of Vienna, is not deceived in thinking, as he informs me, that he can distinguish sea from river pebbles. With regard, however, to marine relics, I think the importance which Mr. Dana attaches to them is unduly exclusive. It might even be that they would prove a fallacious guide in the present enquiry, as indicating only the general fact of a former presence of the sea (for which indication they are in a manner superfluous), and not the special fact that the spot where they were found was a *margin* of the sea. In the climate of Scotland, it is quite hopeless that shells should be preserved in a porous bed for a great length of time, and I am not therefore surprised that no such relics are found in any but comparatively recent sea margins. But if we find other proofs, as in the form of the ground recalling exactly the forms of existing beaches, the character and arrangement of inorganic materials, and identity of levels over a wide area, (a kind of proof the most rigid of all, being mathematical,) are we to hold them as nought merely because we lack a kind of proof which is not reasonably to be expected in the case? Against such reasoning I must enter my humble, but energetic protest. And I believe that Mr. Dana, on going into a practical investigation, would very quickly justify me in doing so.

Let me conclude with the expression of a hope that some of the American geologists will ere long go into the enquiry with more or less regard to the rules laid down by Mr. Dana.

Art. IV.—*On the Diurnal Variations in the Declination of the Magnetic Needle, and in the Intensities of the Horizontal and Vertical Magnetic Forces;* by William A. Norton, Professor of Mathematics and Natural Philosophy in Delaware College.

In a memoir published in vol. iv of this Journal,* I gave an exposition of a new theory of Terrestrial Magnetism, of which the following are the fundamental principles: 1. Every particle

* Pages 1 to 12 and 207 to 230.

of matter at the earth's surface, and to a certain depth below the surface, is the centre of a magnetic force exerted tangentially to the circumference of every vertical circle that may be conceived to be traced around it. 2. The direction of this force is different, according as it solicits the north or south end of the needle; and it is always such, that to the north of the acting particle the tendency is to urge the north end of the needle downward and the south end upward, and that to the south of the same particle it is to urge the north end upward and the south end downward. 3. The intensity of the magnetic force of a particle of the earth, at a given distance, is approximately proportional to its temperature, or amount of sensible heat; and at increasing distances, diminishes according to some unknown law. I was conducted to these principles by the theory which I had been led to adopt concerning the physical nature of the Imponderables: which is, that all the phenomena of the imponderables are but different effects of different vibratory motions of the particles of matter, and of the ethereal undulations produced by these vibrations. I accordingly conceived each particle of the earth's mass to be the centre of a system of undulatory movements propagated through the surrounding ether, and of every variety of time and intensity of vibration within certain limits—waves of light, heat, and magnetism. The vibrations of the ethereal particles, in a wave of magnetism, I supposed to be in the surface of the wave, or transversal to the line of propagation of the wave, as is known to be the case with a wave of light, and I regard the magnetic forces as probably due to these transversal vibrations. I was thus led to consider the sun as the probable source, at the same time, of waves of heat, light, and magnetism, and that the molecular forces of vibration due to the different kinds of waves would probably vary according to the same law, or approximately so, in passing from one point to another on the earth's surface, and accordingly that the temperature of a particle might be taken as a measure of its magnetic force. Although I was thus conducted, by these physical speculations, to the fundamental principles of what may be characterized as the Thermal Theory of Terrestrial Magnetism, these principles may nevertheless have no real connection with the physical theory in which they originated. The tangential magnetic forces which I suppose, may be due to electric currents or may be fundamental properties of matter. The investigations of this and the previous memoir, conclusively establish the fact of the existence of these forces, and of their supposed connection with the thermal state of the earth, but are in no way essentially dependent upon any physical speculations concerning their origin. These form a debatable ground beyond the thermal theory which I have undertaken to develop and follow out into some of its consequences, about which I do not at present concern myself.

From the fundamental principles which I have stated, I deduced, in the memoir referred to, three simple formulæ; one, for the horizontal component of the directive force of the needle, or the horizontal magnetic intensity of the place; a second, for the vertical intensity; and a third, making known the declination. These formulæ were afterwards tested by numerous comparisons with the results of observations made in every variety of locality in the northern hemisphere of the earth. The agreement was found to be very close—the differences amounting only to a few hundredths for the horizontal and vertical forces, and less than 2° 40′, and in most cases less than 1° for the declination. The positions of the magnetic poles, the pole of maximum intensity, and the magnetic equator were also theoretically deduced, and shown to correspond very closely with their observed positions. In view of the whole discussion the following great truths were supposed to have been established.

1. All the magnetic elements of any place on the earth may be deduced from the thermal elements of the same; and all the great features of the distribution of the earth's magnetism may be theoretically derived from certain prominent features in the distribution of its heat.

2. Of the magnetic elements, the horizontal intensity is nearly proportional to the mean temperature, as measured by a Fahrenheit's thermometer; the vertical intensity is nearly proportional to the difference between the mean temperatures at two points situated at equal distances north and south of the place, in a direction perpendicular to the isogeothermal line (that is, a line conceived to be traced through all points at which the mean temperature of the matter of the earth, near its surface, is the same as at the station of the needle): and, in general, the direction of the needle is nearly at right angles to the isogeothermal line, while the precise course of the inflected line to which it is perpendicular may be deduced from Brewster's formula for the temperature, by differentiating and putting the differential equal to zero.

3. As a consequence, the laws of the terrestrial distribution of the physical principles of magnetism and heat must be the same, or nearly the same; and these principles themselves must be physically connected in the most intimate manner.

4. The principle of Terrestrial Magnetism, in so far as the phenomena of the magnetic needle are concerned, must be confined to the earth's surface, or to a comparatively thin stratum of the mass of the earth.

5. The mechanical theory of terrestrial magnetism which has been under discussion, must be true in all its essential features.

6. We may derive the magnetic elements by very simple formulæ, and with an accuracy equal to that of Gauss's formulæ,

from a very small number of magnetic data determined by observation, and the mean annual temperature of the place.

From the theoretical investigation of the normal state of the terrestrial magnetic elements, I propose, in the present article, to proceed to the discussion in the light of the same theory, of their Diurnal Variations. This theory furnishes us the following general principles as a basis for this discussion. 1. The horizontal magnetic intensity of a place is proportional to its temperature. 2. The vertical intensity is proportional to the difference between the temperatures of two places situated at equal distances north and south of the isogeothermal line, in a direction perpendicular to it. 3. The direction of the needle is nearly perpendicular to the isogeothermal line. From these general principles we may draw the general conclusions, that the variations of the horizontal and vertical magnetic intensities must be linked to the variations of the temperature of the station of the needle and of the differences of temperature of places north and south of this, and that the variations of declination must be connected with the variations in the position of the ideal line passing through all places which have the same actual temperature as the given place; which line may be called the *true* isogeothermal line. If the latter conclusion be true, it may be added that the variations of declination must also be connected with the variations in the differences of temperature of places situated to the East and West of the station of the needle.

The data for the detailed discussion have been chiefly taken from the Report of the "Observations at the Magnetic and Meteorological Observatory at the Girard College, Philadelphia, made under the direction of A. D. Bache, LL.D., 1840 to 1845," and the Report of the "Magnetical and Meteorological Observations, made at Washington by Lieutenant J. M. Gilliss, U.S.N., dated August 13th, 1838." The first Report contains a complete series of Magnetic and Meteorological Observations, generally either bi-hourly or from hour to hour, extending from June, 1840, to June, 1845, besides Term Day Magnetic Observations, and Extraordinary Observations. Tables of the daily, monthly, quarterly, semi-annual, and annual means, and of the hourly or bi-hourly means for months, are given; and curves traced exhibiting these results to the eye, and showing the Extraordinary and Term Day Observations. The second Report comprises a Journal of Meteorological Observations made at four different hours during the day, (3 A. M., 9 A. M., 3 P. M., 9 P. M.,) kept from July, 1838, to June, 1842; a set of bi-hourly meteorological observations and observations of declination extending from June, 1840, to July, 1842; Term Day and Extraordinary Observations; and occasional observations of the dip of the needle. Tables of abstracts are also given, and curves showing the variations of declination and temperature on the term days.

Diurnal Variations of the Horizontal Magnetic Intensity.

The formula which the Thermal Theory of Magnetism has furnished for the horizontal magnetic intensity of a place is

$$H = C' T$$

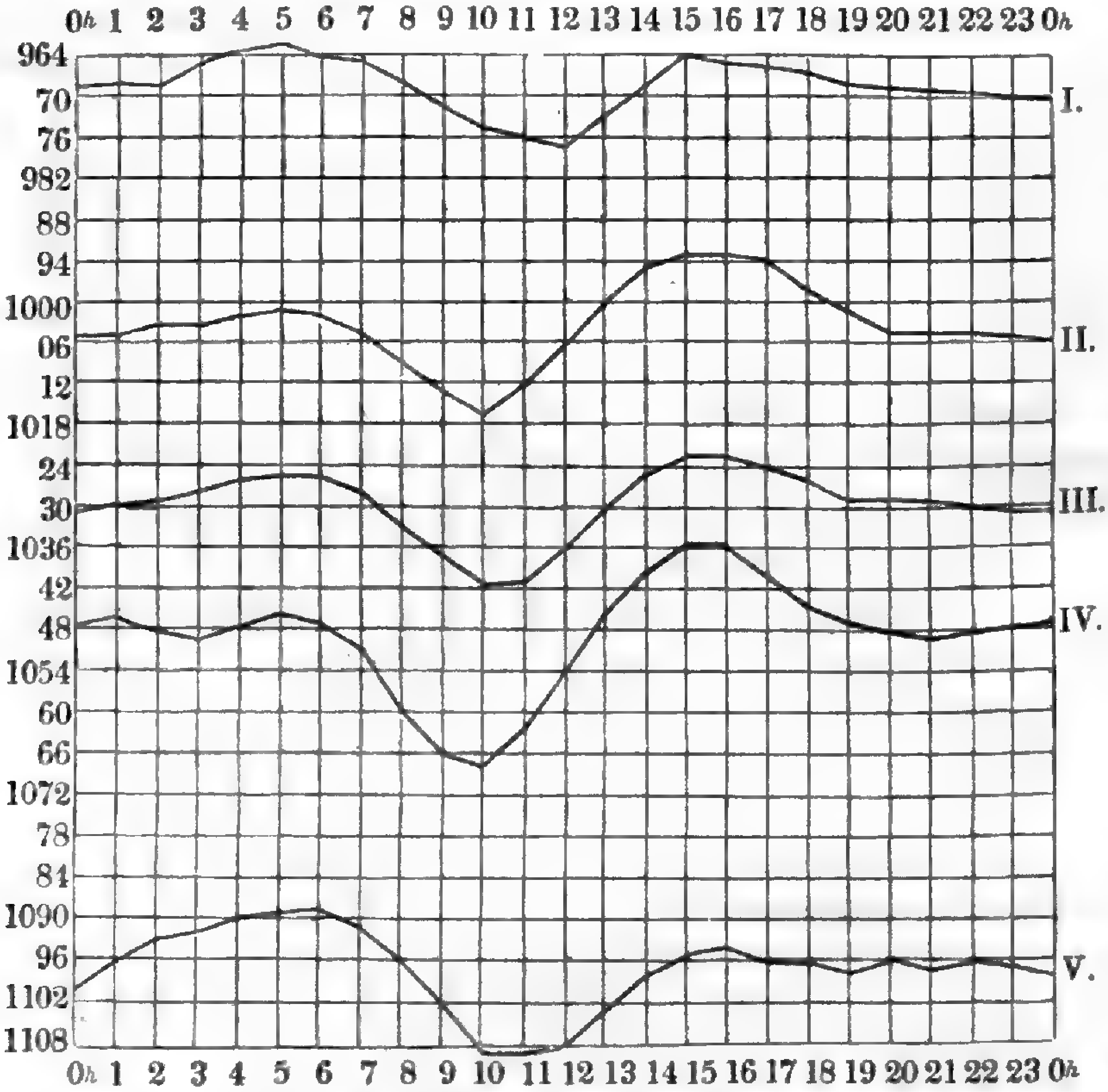
in which C' is a constant, and T the mean annual temperature of the place. This formula is equivalent to the statement that the mean horizontal magnetic force is proportional to the mean temperature. We have therefore to compare the diurnal variations of the horizontal force with the diurnal variations of the temperature of the place. The theory strictly requires that the comparison should be with the daily variations in the absolute amount of sensible heat near the earth's surface, but we know, from the laws of the heating and cooling of bodies, that when the temperature is rising at its surface the earth is, in general, receiving more heat than it loses, and that when the temperature at the surface is falling, it is losing more heat than it receives—so that a rise or fall of surface temperature will in general indicate an increase or decrease of the total amount of heat. This consideration suffices for the enquiry which first arises, viz.: whether the horizontal force increases and decreases with the total amount of heat. A good set of observations of the daily variations of the temperature below the surface would be required for a thorough and minute discussion of the subject before us, but the facts already known and the established theory of the heating and cooling of bodies appear to supersede the necessity of such observations, except when the attempt is to be made to obtain precise quantitative determinations.

We will begin by comparing the curve showing the mean daily variation of the horizontal intensity at Philadelphia for the year 1844 (fig. 3), with the curve showing the mean daily variation of temperature for the same year (fig. 8).

It will be observed that the horizontal intensity attains its maximum at from 15^h to 16^h, or from 3 to 4 P. M., and that the maximum temperature occurs at the same hour;—also that the horizontal intensity increases with the temperature in the forenoon (after 10^h), and decreases with it in the afternoon and evening. The same correspondences are observable in the curves for the other years and for the quarters of years, with the single qualification, that the maximum of horizontal intensity sometimes occurs an hour or two later than the maximum of temperature. They are an indication that the daily variation of temperature is, in all probability, at least one cause of the variation of horizontal intensity. When we compare the curves still farther we notice the following points of difference between them. 1. The horizontal force increases during the latter half of the night until 5 to 6 A. M., and then decreases until 10 A. M., whereas the temperature falls steadily until from 5 to 6 A. M., (the hour of the second maximum of horizontal intensity,) and after that begins to rise. Thus the one curve has two maxima and two minima, and the other one maximum and one minimum. 2. While the temperature falls in the afternoon and evening as rapidly as it rises in the forenoon, the horizontal force decreases less rapidly during the former period than it increases during the latter; and at the same time, as already intimated, the maximum of horizontal intensity frequently occurs an hour or two later than the maximum of temperature.

Figs. 1, 2, 3, 4, 5.

Curves of the Mean Diurnal Variations of the Horizontal Force for 1844 and the different quarters of the same year.



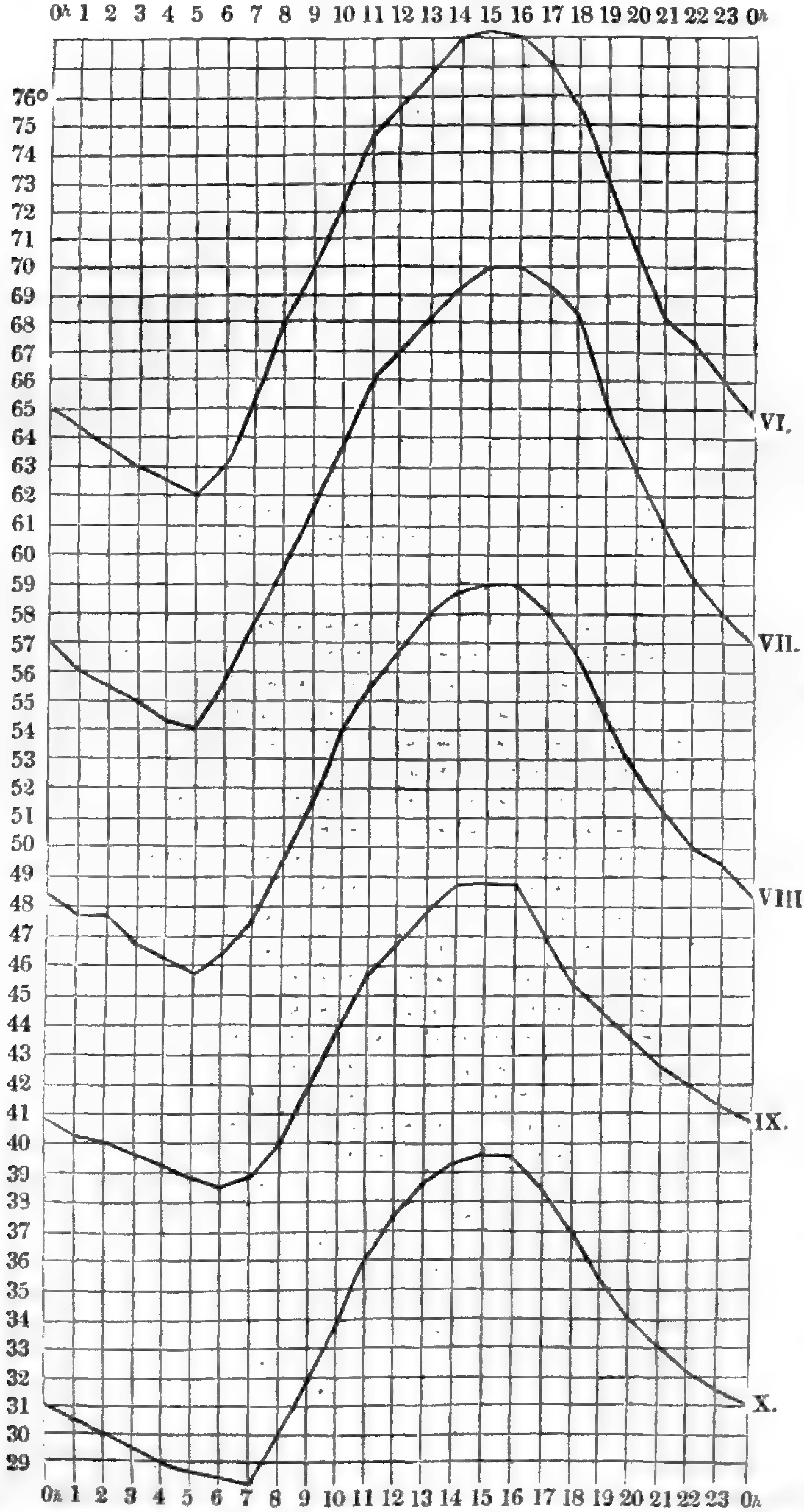
I. Jan., Feb. and March.—II. April, May and June.—III. 1844.—IV. July, Aug. and Sept.—V. Oct., Nov. and Dec.

Increase of numbers corresponds to decrease of force. One division of Magnetometer scale = ·000036 of horizontal force.

How are we to account for these discrepancies between theory and fact—these deviations of the actual daily variations of the horizontal force from the theoretical variations? To distinguish them from those which have just been considered, and which accord with our theory, let us call them the *secondary variations* of the horizontal force, without meaning thereby to intimate that they are of minor importance. The inevitable inference from the first mentioned fact, is that if the daily variation of temperature is one cause of the daily variation of the horizontal force, there must also be some other cause in operation besides the mere variation of temperature. Is this cause one entirely unconnected with the variation of temperature, or is it some indirect effect of this variation? The Newtonian principle of not multiplying causes would prompt us to try the latter supposition. Besides a connection exists between the time of the secondary maximum of horizontal intensity and the time of maximum temperature, which serves to render it probable that this supposition is the true one. This connection may be inferred not merely from their coincidence in the mean curves for the year, but also from their approximate coincidence in the different curves for the quarters of the year (see figs. 1, 2, 3, &c., to 10);—in other words, from the fact that the time of the secondary maximum of horizontal intensity moves forward and backward, during the year, with the time of sunrise. It should be observed, however, that this fact is less distinctly shown by the curves for some years than for others. It has been recognized by Professor Loyd, in his observations at Dublin. He says, "The epoch of the morning maximum moves forward as the time approaches the winter solstice, appearing to depend upon the hour of sunrise which it precedes by a short interval." The manifest inference from this connection is that the increase of the horizontal force during the latter part of the night, when the temperature is on the decrease, and the decrease of this force for several hours after sunrise, when the temperature is on the increase, are in all probability indirect effects of the change of temperature. While making a hasty comparison of the daily variations of the horizontal force with the theory that its intensity varies with the temperature, about a year since, it occurred to me that the secondary changes of this force, just noticed, were probably due to the deposition of condensed vapor from the atmosphere during the night, and the evaporation which immediately succeeds in the morning. These are well established effects of the daily fall and rise of temperature. The tendency of the deposition of vapor that goes on while the temperature is falling, must be to augment the horizontal force, and the tendency of the evaporation of the dew that falls at night, produced by the heat of the sun in the morning, must be to diminish this force. The deposition of vapor must tend to increase this force in two ways; viz., by the heat given out in the act of condensation, and by adding to the amount of matter at the earth's surface which acts upon the needle. The evaporation must also tend to diminish the force in two ways; viz., by the loss of sensible heat accompanying the vaporization, and by the loss of a certain amount of matter, from the earth's surface, whose horizontal magnetic action had formed a part of

Figs. 6, 7, 8, 9, 10.

Curves of the Mean Diurnal Variations of the Temperature, for 1844, and the different Quarters of the same year.



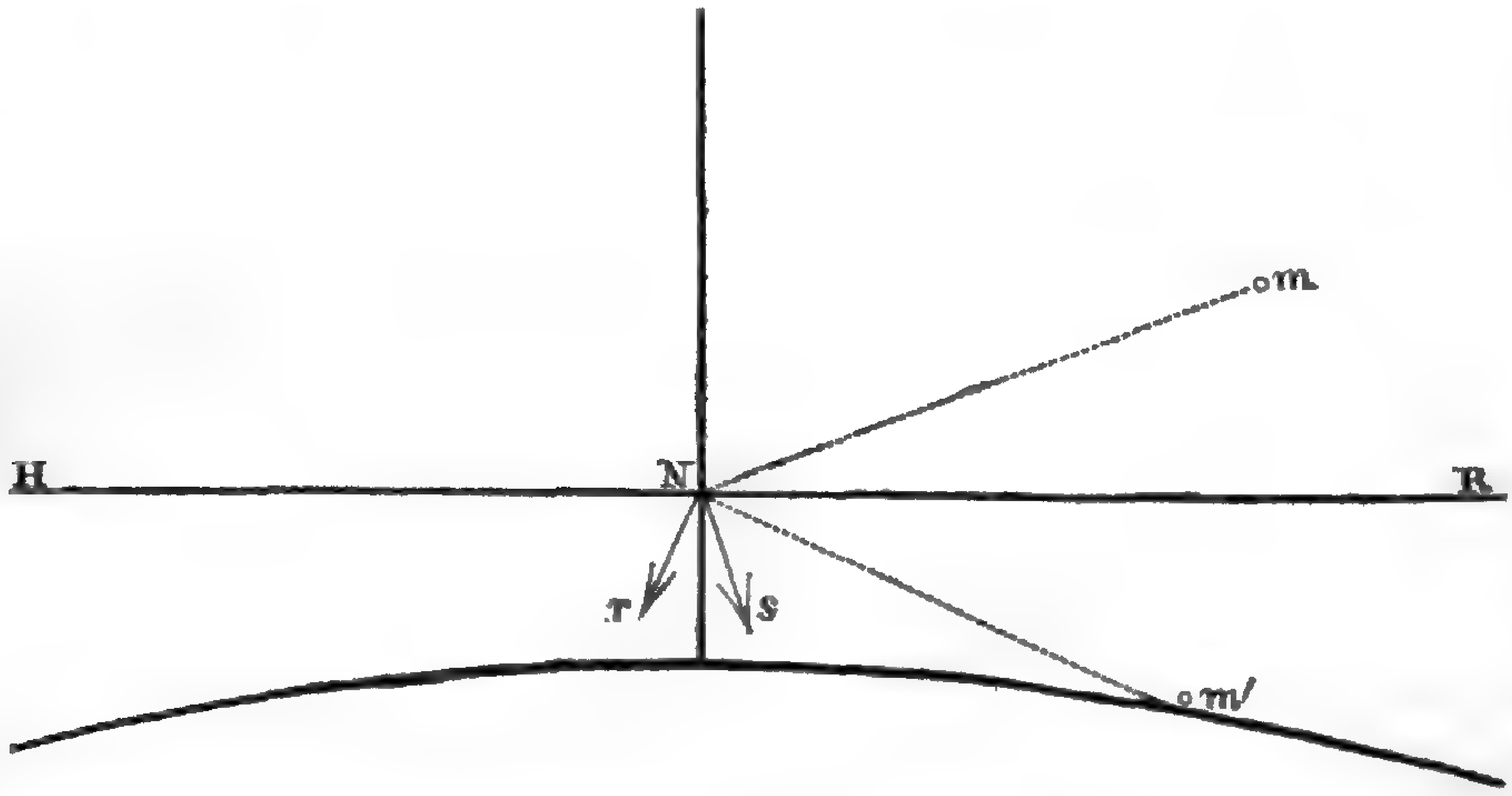
VI. July, Aug. and Sept.—VII. April, May and June.—VIII. 1844.—IX. Oct., Nov. and Dec.—X. Jan., Feb. and March.

the horizontal force. It would seem that the increase of the horizontal force during the night and decrease in the morning, cannot be attributable solely to the heat given out by condensation and abstracted by vaporization, since, notwithstanding the deposition of vapor at night and the evaporation in the morning, the temperature continues to fall until morning, and after that rises steadily during the forenoon:—unless it should chance that a considerable portion of the heat evolved by the condensation penetrates below the surface, so as to augment the average temperature of the stratum which is subject to daily variations of temperature, and that, in like manner, the cooling due to evaporation lowers the average temperature of this stratum, at the same time that the surface temperature rises. I am disposed, therefore, to attribute the secondary variations of the horizontal intensity, under consideration, chiefly to the variations in the quantity of condensed vapor at the earth's surface, attending the fall and rise of temperature. But, whether the morning maximum and minimum are principally effects of variations in the quantity of magnetic matter in action, or of variations in the absolute amount of sensible heat due to the fall and rise of vapor, the effect in a given time, will on either supposition, be proportional to the amount of vapor deposited or of water evaporated. When we consider the entire secondary variations during the night, it is to be observed that, upon the view which I have adopted, the fall of vapor has two effects; it diminishes the rate of cooling of the earth, by the heat evolved, which makes the decrease of horizontal force less, and it augments the quantity of magnetic matter in action, which makes the diminution of this force still less, or converts the decrease into an increase, according to the amount of vapor deposited. In like manner the evaporation after sunrise has two effects. If any heat be evolved or abstracted, in addition to that connected with the variations of temperature at the surface produced by the rise and fall of vapor, it will conspire with the changes in the quantity of condensed vapor acting upon the needle, to produce an augmentation of the horizontal force during the forenoon.

Before presenting the considerations which I have to urge in support of the theory which I have now advanced, let me consider an objection which has probably occurred to the reader; viz., that the quantity of vapor that falls during the night is altogether too trifling to produce an effect so considerable—to more than neutralize the effect of the decrease of temperature; and, in like manner, that the loss of matter from the surface of the earth, by reason of the evaporation in the forenoon, is too small, in comparison with the whole amount of matter which has a variable action upon the needle, to have the effect attributed to it.

In answer to this objection, I have to offer the following considerations. 1. It is to be observed that the entire horizontal magnetic force of the vapor is added or abstracted with it, while the horizontal force is otherwise affected only by the variations of temperature. 2. The force of the vapor, which, from a situation above the needle falls below it, is changed from a diminishing to an increasing action. This will be readily seen on referring to fig. 11; in which N represents the position of the needle,

Fig. 11.



and H N R a horizontal line at the height of the needle and situated in the plane of the magnetic meridian. A particle *m*, in this plane will exert its force in the direction N*s*, and therefore tend to diminish the horizontal force (R being supposed to be south of N), but when it falls to the position *m'* it acts in the direction N*r*, and therefore now tends to increase the horizontal force. It is here taken for granted that a particle continues to act magnetically after it has left the earth's surface. It is only by a detailed discussion that we can determine whether this supposition be true or not. It is enough, for our present purpose, that it is not at variance with the theory. 3. The depth to which any considerable daily variations—or at least variations which indicate a change in the absolute amount of heat—extend, does not probably exceed nine inches. For, according to the observations of Quetelet, Director of the Observatory at Brussels, made from 1834 to 1839, the velocity of propagation of the diurnal variations of temperature is less than $1\frac{1}{2}$ inches per hour, or less than 18 inches in twelve hours; and, the variations of temperature will be very much less below the depth of nine inches than above it. We may form some estimate of the difference from the following statement of the annual variations of temperature at various depths, given by Quetelet. The depths are in metres, and the degrees Centigrade.

Depth.—Metres.	Annual Variations.
0·19	13° 28
0·45	12 ·44
0·75	11 ·35
1·00	10 ·58
1·95	7 ·59
3·90	4 ·49
7·80	1 ·13

They become entirely imperceptible at the depth of about 24 m. If we suppose the daily variations of temperature to decrease from the surface downwards at the same proportionate rate, it will become less than 1° F. at the depth of 9 in., (taking the variation at the surface at 12° F., which is about the average for the year.)

4. Although the amount of vapor deposited during the night, may perhaps not exceed the $\frac{2}{100}$ of an inch, on the average, the loss of its entire amount of sensible heat may still be more than an equivalent for the daily variations of temperature of a depth of six or nine inches of soil.

In view of these statements it will not be deemed idle to enquire whether the alternate deposition and rise of vapor may not afford an adequate explanation of the secondary variations of the horizontal force. But before entering upon this enquiry, let us go back, and following the indications of the observations endeavor to ascertain whether there is any known phenomenon that satisfies the prominent conditions which they furnish. As preparatory to this it is important to state the laws according to which heat is radiated from the earth's surface into space, and propagated from particle to particle below the surface. These are as follows,

1. The loss of heat, from nocturnal radiation, in a calm clear night, is uniform at all temperatures. This law, we are told (see the No. of this Journal for November, 1848, p. 420), has recently been announced by Wilson, and has since been confirmed by the Observations of Melloni. It is, moreover, in approximate accordance with the general theory of radiation. The formula which this theory, in conjunction with experiment, has furnished, for the velocity or rate of cooling of a body by radiation is

$$V = ma^{t+\theta} - ma^{\theta} \qquad (1.)$$

in which θ denotes the absolute temperature of the enclosure, or external medium, toward which the body radiates, and t the excess of the temperature of the body over that of the enclosure. If θ and t are expressed in Centigrade degrees, then $a = 1{\cdot}0077.m$, for a vitreous surface, is 2·037; and it is about the same for the soil, which has about the same radiating power as glass. According to Pouillet the temperature of space is about $-142°$ C.

If we denote the temperature of the earth, in Centigrade degrees, by T, we shall have for the velocity of cooling of the earth, by radiation into space,

$$V=2{\cdot}037\left((1{\cdot}0077)^{T}-\frac{1}{(1{\cdot}0077)^{142}}\right)=2{\cdot}037\left((1{\cdot}0077)^{T}-{\cdot}339\right)$$

According to this formula the velocity of cooling of the earth's surface at 0° C., (32° F.,) is to the velocity of cooling at 15° C., (59° F.) as 67 to 78—that is, the rate of cooling diminishes, from 59° F. to 32° F., $\frac{1}{7}$ of its amount at 59°.

Formula (1) was obtained by a comparison of theory with the experiments of Petit and Dulong. It may well happen that when we come to apply it to a case in which the temperature of the medium exterior to the cooling body is far below the range of the experiments, it will not give exact results.

In the application of this formula, I have supposed the radiation of the earth to be directly into free space. As a matter of fact, it is through the atmosphere, and therefore the rate of cooling of the earth must depend upon the mean temperature and also the absorptive action of the atmosphere. To apply formula (1) to the case of the earth, θ should therefore be taken equal to the temperature of the sky, instead of the temperature of space: or, we may introduce into the formula another subtractive term, representing the emissive power or absolute radiation of the atmosphere. We must also allow for the absorption of heat by the atmosphere. Pouillet estimates this at a little less than $\frac{1}{2}$. Supposing it to be $\frac{1}{2}$, and also that $\frac{1}{n}$ of the heat radiated downward from the air reaches the surface of the earth, and denoting by t the mean temperature of the air, we have

$$V=ma^{T}-\frac{ma^{\theta}}{2}-\frac{ma^{t}}{n} \quad . \quad . \quad . \quad . \quad (3.)$$

It appears from the observations made by Pouillet with the actinometer, that the mean temperature of the atmosphere is about 35° C. below the temperature of the air, and falls, during the night, at about the same rate as the temperature at the earth's surface. Taking this result, and making the calculations for $n=1$, we find the velocities of cooling at 32° F. and 59° F. to be to each other as 77 to 86, or that the diminution is a little more than $\frac{1}{10}$ of the velocity of cooling at 59° F. According to Pouillet, the absorptive power of the entire atmosphere for terrestrial heat is greater than 0·8, but as the heat radiated downwards from the atmosphere passes only through a portion of it, the value of $\frac{1}{n}$ is doubtless less than 0·8. It is to be taken into account also, that the difference between the mean temperature of the air and the temperature at the earth's surface appears to be, in general, from 3° to 5° C. lower at the end than at the beginning of a night. This being done, and $\frac{1}{n}$ being taken equal to 0·5, the rates of cooling at the beginning and end of a night, upon which the thermometer falls from 59° to 32°, are found to be nearly as 47 to 46, or very nearly equal.

The experiments of Melloni and others have established, "that the portion of the sky concerned in the radiation is included within 30° to 35° of the zenith ;—that clouds beyond this have but little interfering effect."

The air cools, by radiation into space and the upper regions of the atmosphere, like the surface of the earth, by radiation to the earth's surface which cools more rapidly than the air from its superior radiating power, by contact with the earth and objects connected with the earth, and by condensation. The difference between the temperature of the earth's surface and of the air at the height of four or five feet may amount to several degrees. The most recent experiments upon nocturnal radiation, viz., those of Melloni, have established, "that while under certain circumstances some bodies can be cooled to 8° C. below the temperature of the air four or five feet above, in general, the effect of radiation is to reduce the temperature of vegetation, &c., not more than 2° below that of the surrounding air." Ordinarily the agitations of the air will be sufficient to establish very nearly an equilibrium of temperature between it and the earth's surface.

2. Heat is propagated from one particle to another of the earth's mass by ordinary radiation. Hence when two contiguous particles have the same temperature they exchange, by reciprocal radiation, equal quantities of heat, and when their temperature is different, the one will gain and the other lose, in a given time, an amount of heat proportionate to their difference of temperature. The rate at which this gain or loss takes place in any body, constitutes its conductibility. If we conceive the matter near the earth's surface to be divided into layers of particles, of indefinitely small thickness, in the cooling of the earth at night the heat lost by any one layer is gained by that next above it. The flow of heat from below upward will diminish the fall of temperature at the surface of the earth; and the velocity of flow will be proportionate to the difference of temperature of the first and second layer. As the cooling goes on this difference will increase, and at the same time the difference between two consecutive differences will become less, and therefore the velocity of cooling will diminish. If the night were to continue for an indefinite time, this change would go on until the first differences attained to a maximum value, and the second differences became zero, when

the earth would have attained to a "movable equilibrium" of temperature. Pouillet has calculated that this would be the case at the temperature of $-89°$ C. Taking the fundamental principle that one layer gains what the next below it loses, we can derive a very simple formula, connecting the loss of heat at the surface of the earth in a given time with the losses of temperature of the different layers during the same interval of time. Let L = absolute loss of heat at the earth's surface, in a given time, by nocturnal radiation; l, l', l'', &c., denote the losses of temperature of the first, second, third, &c. layers in the same time; a, a', a'', &c., the quantity of heat received by the successive layers from the layer next below. Then $L=l+a$, $a=l'+a'$, $a'=l''+a''$, &c., and hence

$$L=l+l'+l''+l'''+\text{\&c.} \qquad (4.)$$

The losses of temperature, l, l', l'', &c., of the different layers decrease with the depth, and for a night of twelve hours become zero at the depth of about eighteen inches. After sunrise, when the temperature at the surface is rising, the losses of temperature will still continue with the layers below the surface until the heat propagated downward reaches them in succession, and the cooling will gradually extend below 18 in., but these variations of temperature are not attended with any absolute loss of heat. It appears from observation that the law of decrease of the annual variations of temperature at different depths is that of a geometrical progression for depths which increase in an arithmetical progression. The same law probably holds good for the entire diurnal variations. The losses during the night simply probably decrease more rapidly, for, while the entire fall of temperature at and near the surface is about the same as for the night, lower down it is greater, and for a number of inches below 18 in. takes place during the day.

It is to be observed that formula (4) is equally applicable if we suppose L to represent the absolute loss of heat from the combined action of all the causes which affect the temperature of the surface. The same relation also obtains between the gain of heat during the day and the increments of temperature at different depths.

Since the loss of heat, L, by nocturnal radiation from the earth's surface is the same at all temperatures, for any given interval of time, it follows that whatever may be the variations of l, l', l'', &c. during the night, the actual loss of heat from the whole stratum which undergoes a daily variation of temperature, occasioned by nocturnal radiation, is uniform at all temperatures. Accordingly any variations of l that may arise from the flow of heat towards the surface cannot be the cause of the observed variations of the horizontal magnetic intensity during the night.

Notwithstanding such variations of *l*, the horizontal force, as it depends only on the absolute quantity of heat, would decrease uniformly during the night.

Having laid down these general principles, let us enter upon the general enquiry to which the statement of these principles is preliminary. If we compare the nocturnal variations of the horizontal force with those of the temperature, as shown by the curves, (see figs. 1, 2, &c. to 10,) we find that the deviations from uniformity in the diminution of the horizontal force are attended with like deviations in the fall of the thermometer:—thus, while the thermometer falls less and less rapidly as the night advances, the diminution of the horizontal force becomes less and less; also, while during the fall and winter months the fall of temperature during the night is materially less than in the spring and summer months, the nocturnal diminutions of the horizontal force are less. It is true that the diminution of the horizontal force gradually passes into an increase, but this is only the result of a certain increase in the amount of the deviation from uniformity of diminution. The deviations therefore are of the same character—lie continually in the same direction—for the temperature and horizontal force. They are also cotemporaneous; they differ only in proportionate amount. We have therefore to seek for the cause of the secondary variations of the horizontal magnetic intensity of a place in the cause, whatever it may be, of the changes in the rate of diminution of the temperature during the night, and from one season to another. The former cause is probably identical or closely connected, physically, with the latter, but it is possible that the connection may be more or less remote, or even that the correspondence between their variations is accidental. Now the cause of the nocturnal inequality of temperature must be found in some phenomenon or fact connected either with the relations of the surface of the earth to the atmosphere, or with its relations to the matter below the surface. If it be a meteorological phenomenon, we may suppose it to consist in variations in the clearness of the sky, in the quantity of rain, in the quantity of dew, or, speaking more generally, of vapor deposited in other forms than that of rain, in the direction and force of the wind, and in the amount of heat absorbed by the atmosphere or exchanged with it. We may reject the phenomenon last mentioned at once; for, as we have seen, in a calm clear evening the nocturnal radiation is uniform at all temperatures, and this radiation is the actual radiation, one element of which is the exchange of heat with the atmosphere, and another the absorptive action of the atmosphere. If it be surmised that it is only the maximum radiation on clear evenings that is uniform at all temperatures, such is not the statement of the law, and if it were, then the uniformity must be independent of the density of the air and of the quantity of vapor suspended in it; and if it be independent of the density of the air it must be independent of the density of the vapor, so long as this retains the aeriform state. It is also independent of any differences that may subsist between the temperatures and densities of the different strata of the atmosphere, for it is a well established fact that the temperature falls more rapidly, as we ascend in the atmosphere, in a summer than in a winter night. In other words, it holds good whatever may be the state of all the various particulars upon which the absorptive action of the atmosphere when transparent, can be supposed to depend.

As for the relative clearness of the sky, I find, on referring to the Report of the Meteorological Observations made at Philadelphia, that during a period of two years and three months, viz., from March, 1843, to July, 1845, the average clearness of the sky was somewhat greater after midnight than before it. The following numbers show the averages of the

Mean Sky Covered by Clouds.

	From 6 P. M. to midnight.	From midnight to 6 A. M.
1843 (from March),	·63	·59
1844,	·72	·62
1845 (to July),	·64	·61

The numbers for the different quarters of years are as follows:

Mean Sky Covered by Clouds.

		From 6 P. M. to midnight.	From midnight to 6 A. M.
1843.	April, May, June,	·53	·51
	July, Aug., Sept.,	·66	·66
	Oct., Nov., Dec.,	·72	·59
1844.	Jan., Feb., March,	·71	·62
	April, May, June,	·90	·83
	July, Aug., Sept.,	·65	·56
	Oct., Nov., Dec.,	·61	·56
1845.	Jan., Feb., March,	·61	·60
	April, May, June,	·67	·63

For the entire night, from 6 P. M. to 6 A. M., we have—

	1843.	1844.	1845.	Average.
Jan., Feb., March,	. .	·66	·60	·63
April, May, June,	·52	·86	·65	·67
July, Aug., Sept.,	·66	·60	. .	·63
Oct., Nov., Dec.,	·65	·58	. .	·61

These numbers show that during these years the clearness of the sky was no greater from March to October than during the first and last quarters of the year, and therefore that the more rapid fall of the temperature at night toward the middle of the year, than toward the beginning and end of it, during the interval of time embraced in the above table, cannot be ascribed to a greater average amount of nocturnal radiation resulting from a greater clearness of sky.

For the years 1841–2, the observations only furnish the averages for the entire day, of twenty-four hours. These, with the averages for 1843 and 1844, and from January to June, 1845, are as follows:

	1841.	1842.	1843.	1844.	1845.
Jan., Feb., March,	·63	·55	. .	·80	·65
April, May, June,	·56	·49	·59	·92	·72
July, Aug., Sept.,	·48	·52	·75	·70	. .
Oct., Nov., Dec.,	·59	·44	·79	·67	. .

These numbers serve only to confirm and extend the conclusion drawn from the previous table.

The following table, giving for each quarter of the year the mean number of days, during the years 1839, 1840–1, and parts of 1838 and 1842, on which the wind prevailed, at 9 P. M. and 3 A. M., from each direction, at Washington, will furnish the means of judging of the influence of particular directions of the wind.

		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January, &c.	9 P. M.	6·1	10·0	7·5	5·0	12·3	11·1	8·5	15·5	15·5
	3 A. M.	6·1	10·7	6·0	3·0	11·3	11·5	6·0	16·8	17·8
April, &c.	9 P. M.	4·6	9·7	3·3	8·0	11·0	8·7	9·3	11·6	22·8
	3 A. M.	4·8	13·7	4·6	8·3	6·0	12·0	9·6	11·0	19·2
July, &c.	9 P. M.	5·6	5·0	4·0	7·3	9·7	9·0	10·5	11·1	21·6
	3 A. M.	6·2	10·9	5·7	3·6	5·4	14·3	9·3	11·0	20·0
October, &c.	9 P. M.	6·8	12·3	7·8	2·7	6·8	11·0	8·8	19·0	16·3
	3 A. M.	9·5	12·0	6·9	4·2	3·8	9·7	7·7	22·4	17·4
Entire year,	9 P. M.	23·1	37·0	22·6	23·0	39·8	39·8	37·1	57·2	76·2
	3 A. M.	26·6	47·3	23·2	19·1	26·5	47·5	32·6	61·2	74·4

From this table we derive the following, showing the relative frequency of the cold and warm winds.

		N., N.E., W., N.W.	E., S.E., S., S.W.
January, &c.	9 P. M.	40·1	35·9
	3 A. M.	39·6	31·8
October, &c.	9 P. M.	46·9	28·3
	3 A. M.	51·6	24·6

		N., N.W., N.E., E.	S., S.W., S.E., E.
April, &c.	9 P. M.	29·2	37·0
	3 A. M.	34·1	35·9
July, &c.	9 P. M.	25·7	36·5
	3 A. M.	33·8	32·6

		N., N.W., N.E.	S., S.W., S.E.
Entire year,	9 P. M.	117·3	102·6
	3 A. M.	135·1	93·1

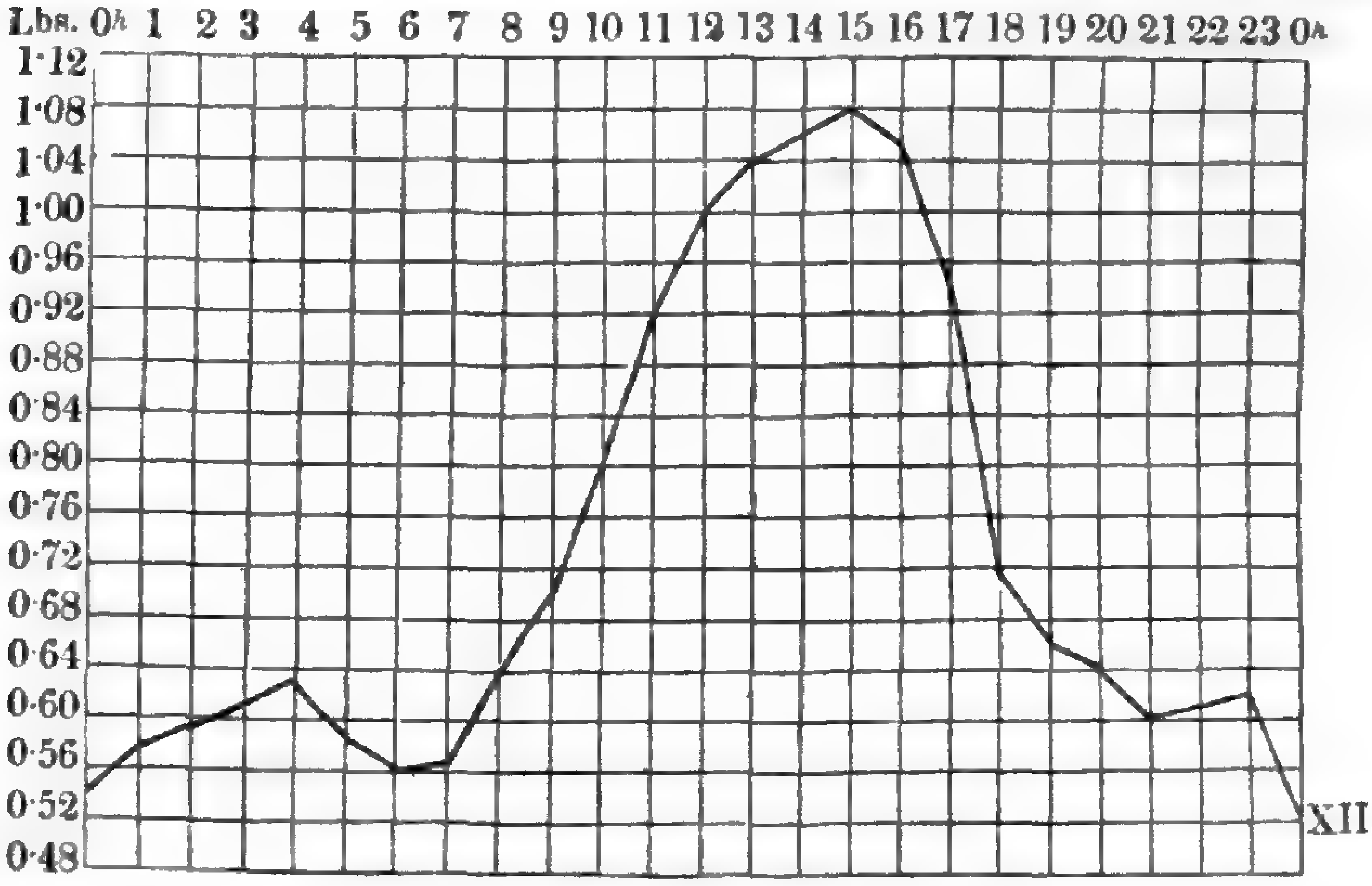
On examining these tables, it will be seen that calms are about equally frequent before and after midnight, and that cold winds are rather more frequent and warm ones less so, throughout the year, after than before midnight. It appears also that cold winds are more prevalent, and warm winds less so, in the first and last than in the middle quarters of the year. Both of these facts are opposed to the idea that difference of direction of wind may be the general cause of the diminution in the hourly decrement of temperature as the night advances, and in the nocturnal decrease of temperature from the warm to the cold months.

If we reject the N.E. and W. winds from the list of cold winds, that is, regard them as not affecting the mean temperature, in the colder months, cold winds will still be as prevalent after midnight as before: and if we reject the W. wind, in the warm months, from the list of warm winds, it will still be true that warm winds will prevail no more in these months after midnight than before. But upon these suppositions the cold winds will become more frequent in summer than in winter in the proportion of 31 to 22, and the warm winds less frequent in the proportion of 27 to 33: and both cold and warm will occur with about the same degree of frequency in summer as in autumn. It is to be observed, however, that the relative cooling effect of northerly winds in different seasons is not in exact proportion to their relative frequency, for the relative force of the wind is to be taken into account. Now it appears on examining the curves showing the force of the wind in the different quarters of the years 1843–4–5 at Philadelphia, that the force of the wind at night is from two to three times greater from September to April than from March to October. If we connect with this the facts, that the strong winds in winter are most frequently from the N.W., and that, as shown by the first of the above tables, N.W. winds are much more frequent during the former than the latter of the above mentioned period, it will be seen that there is little room to doubt that the greater nocturnal decrease of temperature in the summer than in the winter, must be due to some other cause than the differences, generally subsisting, between the directions of the wind in these seasons. If there be any lingering doubt upon this point, it will be removed, if we reflect that the law of variation of the nocturnal decrease of temperature from one season to another, which we have been considering, is as true for one place as for another. It is found to hold good, with occasional partial exceptions, at all places, both in this country and Europe, where meteorological observations have been made. In fact, this law is essentially connected with the general fact that the loss of temperature, by nocturnal radiation, is equal to the daily rise of temperature, both in January and July. So universal a law cannot, it is believed, be dependent upon the direction of the wind, since the prevalent winds are often very different in different localities.

The question of the influence of the force of the wind follows next in order. Fig. 12 exhibits the mean variations of the force of the wind during the year 1844.

Fig. 12.

Curve of the Mean Diurnal Variations of Force of Wind for 1844, in Lbs.



On inspecting this curve it will be seen that the force of the wind is nearly the same before and after midnight, and that its principal variations occur during the day. The same law is shown by the curves for other years, and for quarters of years, so far as given. The nocturnal loss of temperature cannot therefore be materially modified by variations in the force of the wind, in the average of months and years. The curve showing the variations in the average force of the wind from month to month, which cannot conveniently be given here, indicates that the wind is highest in February or March, and is much higher during the first and last quarters of the year than toward the middle of the year. Since these strong winds are more apt to be from the N.W. than from any other quarter, their tendency will be to cause the temperature to fall more during the night, in the fall and winter, than in the spring and summer, instead of less as it does in fact.

Let us next consider whether it may chance that the variations in the nocturnal loss of temperature which I have specified, are due to the cooling or heating effect of rain. The observations in my possession do not furnish me with the means of making any but a very partial examination of the relative quantities of rain that fall during the first and last halves of the night. But the following facts will serve to show that the influence of rain, whatever it may be, can have no part in determining the law of the decrease of temperature for a single night. 1. Of twenty-one term days, observed at Washington, for which the curves of the daily variation of temperature are given, there are only five exceptions to the general fact that the temperature falls most slowly during the latter half of the night. 2. Of twenty-three days observed in Philadelphia, in October, 1843, there are but six exceptions to the same general fact. We may conclude from these facts, that the slower rate of cooling after midnight is too common a phenomenon to depend upon rain, or prevailing direction or force of wind. Moreover, of the seventeen days observed at Washington, on which the law held good, as a matter of fact only two were rainy. The exceptional days were, with one exception, either rainy or foggy.

The following table shows the total quantity of rain that fell at Philadelphia during each quarter of the years 1842–3–4, and the first two quarters of 1845.

	1842.—Inch.	1843.—Inch.	1844.—Inch.	1845.—In.
Jan., Feb., March, . .	6·29	4·710	7·305	6·503
April, May, June, . .	10·59	10·330	5.244	6·604
July, Aug., Sept., . .	11·39	15·704	10·787	. .
Oct., Nov., Dec., . .	7·85	8·672	8·017	. .

Now, if we compare the numbers for 1844 with the mean nocturnal losses of temperature, in the different quarters of this year, which are 11°, 16°, 16°, 10°, we see that while the fall of temperature is the same for the two middle quarters of the year, the quantity of rain fallen is about twice as great for one of them as for the other. The cloudiness of sky for these periods is ·92 for the first, and ·70 for the second. Again for the middle quarters of the year 1843 the quantities of rain are $10^{in}·3$ and $15^{in}·7$, while the decrements of temperature are 15° and 12°—the reverse of what should be the fact, since if rain is the determining cause of the greater loss of temperature in a summer night, it can only have this effect by cooling the earth in summer and warming it in winter. These statements are sufficient to make it evident that the cause we are seeking does not consist in variations in the quantity of rain that falls at different seasons. The truth of this conclusion may be confirmed by the consideration already urged, in considering the influence of the wind, that the laws of the variation of the nocturnal loss of temperature are too general to depend upon a cause which must differ so much in its effects in different places.

It will have been observed that in considering the question of the influence of variations in the cloudiness of the sky, it was tacitly implied that the numbers representing the proportion of sky covered by clouds represented also the proportion of that part of the sky which is concerned in the nocturnal radiation, that was covered by clouds. This it will be recollected, is the part which lies within 30° or 35° of the zenith. Now it is not difficult to see that this portion of the sky will be, in the average of months, less cloudy than other parts, and especially than the parts near the horizon. For, the clouds in the horizon are much more distant than those of the zenith, and consequently are seen very obliquely, and as they are generally of considerable thickness, and there are often several layers at different elevations, they will be frequently projected upon each other. Or the case may be stated thus; if we suppose isolated clouds to be scattered uniformly throughout the cloudy stratum, the line of sight which makes a small angle with the plane of the horizon will cross this stratum very obliquely, and be proportionally more likely to meet with a cloud than a line traversing this stratum perpendicularly at the zenith. Besides from the obliquity of this line a haziness which would scarcely be observed in the zenith might amount to a positive cloud at a distance from the zenith. This is well illustrated when a fog or mist is gradually being dissipated, and the sky is first seen in the zenith.

In this way it may very well happen that, although there may be considerable differences among the numbers representing the cloudiness of the sky in general, for the quarters of years, there may be no material variations in the nocturnal decrements of temperature, corresponding to these differences.

(To be continued.)

ART. V.—*On the Theory of Numbers;* by J. B. LUCE.

HAVING read with much satisfaction, in the American Journal of Science and Arts, the very ingenious method of interpolations, as explained in a plain, elegant and very satisfactory manner by J. H. Alexander; it induces me to send you my new theorem in the theory of numbers. I call it new, because it is probably so, having never read it in any treatise on the theory of numbers, and particularly in that of Peter Barlow, who, as it is well known, published a useful and elegant book on these matters.

The equation $p^2-nq^2=1$ is well known to be a fundamental one in the resolution of indeterminate problems of the second degree, since, in frequent cases, this solution depends on the finding of integral values for p and q. I use here the same symbols as Peter Barlow. But not having now with me his book, I do not recollect precisely the method he uses to find integral values for p and q; all I remember is that it is performed by a long and tedious process of continued extractions of the square root of n, coëfficient of q^2, a method which I laid aside since the finding of the theorem which I am going to expose, and may, in all circumstances, supply the old method.

I propose to myself the resolution of the more general equation $x^2-ny^2=z^i$, where i may be 0, 1, 2, 3, &c. It is evident that we can always assume $n=a^2\pm b$. Hence $\sqrt{n}=\sqrt{a^2\pm b}$. Assume $\sqrt{a^2\pm b}=a\pm f$, which gives $f^2\pm 2af=\pm b$; which expanded in a continued fraction, and, for abbreviation's sake, putting

$\frac{2a}{b} = m$, is

$$\sqrt{n} = a \pm \cfrac{1}{m \pm \cfrac{1}{2a \pm \cfrac{1}{m \pm \cfrac{1}{2a \pm \cfrac{1}{m \pm \text{\&c.}}}}}}$$

ad infinitum, where the square root of any number n, either integral or fractional, is transformed into a continued fraction, and may be converted into a series of converging fractions as follows,

$$\overset{1.}{\frac{a}{1}},\ \overset{2.}{\frac{am \pm 1}{m}},\ \overset{3.}{\frac{2a^2m \pm 3a}{2am \pm 1}},\ \overset{4.}{\frac{2a^2m^2 \pm 4am + 1}{2am^2 \pm 2m}},\ \overset{5.}{\frac{4a^3m^2 \pm 10a^2m + 5a}{4a^2m^2 \pm 6am + 1}},\ \text{\&c.}$$

If instead of m we supply its value $\frac{2a}{b}$, we shall have the following converging fractions:

$$\overset{1.}{\frac{a}{1}},\ \overset{2.}{\frac{2a^2 \pm b}{2a}},\ \overset{3.}{\frac{4a^3 \pm 3ab}{4a^2 \pm b}},\ \overset{4.}{\frac{8a^4 \pm 8a^2b + b^2}{8a^3 \pm 4ab}},\ \overset{5.}{\frac{16a^5 \pm 20a^3b + 5ab^2}{16a^4 \pm 12a^2b + b^2}},\ \text{\&c.}$$

Now, if in the equation $x^2 - ny^2 = z^i$, we assume $x =$ the numerator, and $y =$ the denominator of successively the first, second, third, &c. fraction, according as $i = 0, 1, 2, 3$, we shall have $a^2 - n = \mp b$; $(2a^2 \pm b)^2 - n \times 4a^2 = b^2$; $(4a^3 \pm 3ab)^2 - n(4a^2 \pm b)^2 = \pm b^3$, &c. Thus when i is an odd number, every odd power of z shall be positive if $n = a^2 - b$; and negative if $n = a^2 + b$.

Let us apply this theorem to some examples; and in the first place let it be proposed to find the expression of a right angled triangle, or solve the equation $x^2 + y^2 = z^2$.

Here $n = -1$. We may assume $-1 = \frac{\alpha^2}{\beta^2} - \frac{\alpha^2 + \beta^2}{\beta^2}$; which gives $a = \frac{\alpha}{\beta}$, and $b = \frac{\alpha^2 + \beta^2}{\beta^2}$. By placing these values instead of a and b in our second converging fraction $\frac{2a^2 - b}{2a}$, we obtain $\frac{\alpha^2 - \beta^2}{2\alpha\beta}$, and the numerator $\alpha^2 - \beta^2 = x$, and the denominator $2\alpha\beta = y$, where α and β may be any number assumed at pleasure. If we assume $\beta = \alpha - 1$, we find $x = 2\alpha - 1$, $y = 2\alpha(\alpha - 1)$, and taking successively $\alpha = 1, 2, 3, 4$, &c., we obtain the following series,

$x =$ 3, 5, 7, 9, 11, 13, &c.
$y =$ 4, 12, 24, 40, 60, 84, &c.

and assuming $\beta = \alpha - 3$, it is $x = 3(2\alpha - 3)$, $y = 2\alpha(\alpha - 3)$,
which gives $x = 15, 21, 27, 33, 39$, &c.
and $y = 8, 20, 36, 56, 80$, &c.

By assuming $\beta = \alpha - 5$, we find

$x = 35, 45, 55, 65$, &c.

$y = 12, 28, 48, 72$, &c., and so of others.

This problem, of course, has been most satisfactorily answered by all who have written on the theory of numbers; and I have proposed it only as an illustration of our theorem. But as a further illustration, let us come to some new problems.

Let it be required to find three numbers such, that the square of the first shall bear the same arithmetical proportion to the square of the second, as this does to the cube of the third.

Here we have to solve the equation $x^2 + z^3 = 2y^2$, or $x^2 - 2y^2 = -z^3$. I assume $n = \frac{\alpha^2}{\beta^2} + \frac{(\beta^2 n - \alpha^2)}{\beta^2}$, which gives $a = \frac{\alpha}{\beta}$, and $m = \frac{2\alpha\beta}{\beta^2 n - \alpha^2}$. I put these values of a, and m, in our third converging fraction, and find $x = \alpha^3 + 3\alpha\beta^2 n$, and $y = 3\alpha^2\beta + \beta^3 n$, where α, β, n, may be any number ad libitum. But in the present example $n = 2$, and in order to have the least integral numbers that satisfy the conditions of the problem, we must take $\alpha = 1$, $\beta = 2$; and the result is $x = 25$, $y = 22$, and $z = 7$.

It is required to find two arithmetical proportions, each composed of the four least possible numbers, such that the sum of the terms of the one shall be equal to the sum of the terms of the other; and such at the same time, that the sum of the cubes of the two middle terms subtracted from the sum of the cubes of the two extremes, shall, in each case, leave the same cube.

Answer, 19, 17 : 7, 5.
17, 13 : 11, 7.

I do not work these problems, my object being to come to the equation $p^2 - nq^2 = 1$, which is of greater importance. I only mention them to show the nature of problems that this method solves with the greatest ease: and indeed there is scarce any indeterminate problem of the second, and higher degrees, that it would not solve; in so much that this theorem may perhaps become, in better hands, the fundamental one of the theory of numbers, especially if it solves the equation $p^2 - nq^2 = 1$.

Since $n = a^2 \pm b$, and $m = \frac{2a}{b}$, it follows evidently that if $\frac{2a}{b}$ is a whole number, by placing its value in the second converging fraction $\frac{am \pm 1}{m}$, we shall obtain $p^2 - nq^2 = 1$. For instance, let $n = 11 = 9 + 2$, from which we infer $a = 3$, $m = \frac{2 \times 3}{2} = 3$. Hence

$p=am+1=10$, and $q=m=3$; and it is $10^2-11\times3^2=1$, without the necessity of continued extractions.

When n is such that we can obtain a whole number for $\frac{2a}{b}$, I call n a *simple number;* and when such that $\frac{2a}{b}$ is a fraction, it is called a complex number. Thus the problem is already solved in a simple and easy manner for at least half all numbers that are likely to be needed, since the simple numbers exceed the complex in the table of complex numbers hereafter presented.

When n is complex, we must find a square factor by which n being multiplied, the product shall be a simple number. For if α^2 be that factor, we shall have $p^2-n\alpha^2y^2=1$: but $\alpha^2y^2=q^2$, therefore it will be $p^2-nq^2=1$.

For instance, $13=9+4$, is a complex. But if I multiply 13 by 5^2, or 25, the product $325=18^2+1$, which is a simple number. Hence $a=18$, $m=36$, and $p=am+1=18\times36+1=649$; and $y=m=36$; wherefore, $p^2-13\times5^2\times y^2=649^2-13\times180^2=1$.

The finding of these square factors is a very nice problem, and in some particular cases, rather intricate. The least number that will make 109 a simple number is $(851325)^2$. I shall not presume to lay down any certain and satisfactory rules for the finding of them; I shall only content myself with a few hints on that subject.

When we have obtained the least values of x and y, in the equation $x^2-ny^2=1$, we can readily obtain the least values of p and q, in the equation $p^2-4nq^2=1$. For if y be an even number, $y^2=4q^2$, or $q=\frac{1}{2}y$, and $p=x$. But if y be an odd number, then will $p=2x^2-1$, and $q=xy$. For by hypothesis, we have $x^2-ny^2=1$. Multiply all the terms by $4x^2$, and transpose, it will be $4x^4-4x^2-4nx^2y^2=0$. Add one to each side, and it is $(2x^2-1)^2-4nx^2y^2=1$; this compared with $p^2-4nq^2=1$, shows evidently that $p=2x^2-1$, and $q=xy$.

Again, if n be divisible by any square, we can obtain the values of x, and y, without the aid of any square factor, if we have p, and q, in the equation $p^2-\frac{n}{a^2}q^2=1$.

For instance, let it be required to find $x^2-234y^2=1$. As $\frac{234}{9}=26=5^2+1$, we say $a=5$, $m=10$; and placing these values of a, and m, in the fourth converging fraction, we find $p=2a^2m^2+4am+1=5201$, and $q=1020=3\times340$, and it is $5201^2-234\times340^2=1$.

If the quotient of n by any square be of the form β^2-1, we place the values of a, and m, in the third converging fraction, since under such form we always have $(2a^2m-3a)^2-n(2am-1)^2=1$.

For instance, let $n=216=24 \cdot 3^2$. We have $24=25-1$, where $a=5$, $m=10$. These values placed in the third converging fraction, afford $x=2a^2m-3a=485$, and $y=2am-1=3\times 33$, and it is $485^2-216\times 33^2=1$.

When n does not fall under any of these cases, we are obliged to find its square factor; to do which, we must consider that simple numbers are necessarily of some of the following forms, $\beta^2\pm 1$, $\beta^2\pm 2$, $\beta^2\pm\beta$, $\beta^2\pm 2\beta$, &c. Thus if we wish to find that series of complex numbers which require 2^2 for their factor, I assume $(6\alpha\pm 3)^2+3=4n$, $(10\alpha\pm 5)^2-5=4n$, $(14\alpha\pm 7)^2+7=4n$, $(22\alpha\pm 11)^2+11=4n$, &c., and making α successively 1, 2, 3, 4, &c., I find the series of complex numbers 3, 21, 57, 111, 183, &c., 5, 55, 155, &c., 14, 112, &c., 33, 275, &c., all of which require the factor 2^2 to become simple numbers.

In like manner, for the square factor 3^2, I shall assume $(9\alpha\pm 4)^2+2=9n$, which brings 2, 3, 19, 22, 54, 59, 107, 114, 178, &c. Also, $25\,(9\alpha\pm 4)^2+5=9n$, which brings 45, 70, 470, &c. all complex which are not found in the other formula.

The formula $(25\alpha\pm 7)^2+1=25n$, gives 2, 13, 41, 74, 130, &c., each of which complex requires the factor 5^2.

The formula $(49\alpha\pm 10)^2-2=49n$, shows that the complex 2, 31, 71, 158, &c., must be multiplied each by 7^2. From $(81\alpha\pm 22)+2=81n$, we derive 6, 43, 131, 242, &c. From $(121\alpha\pm 19)^2+2=121n$, we find 3, 86, 162, &c. And other similar formulæ may be found for all square factors.

If a complex be of the form α^2+4, or may be brought to that form by the multiplication of any square factor, we can readily obtain its square factor as follows:

Let it be $29=25+4$; which gives $a=5$, $m=\frac{5}{2}$. I place these values of a, and m, in the third converging fraction, and find $2a^2m+3a=140$, the half of which is 70: and $2am+1=26$, whose half is 13. Wherefore we have $70^2-29\times 13^2=-1$, or $70^2+1=29\times 13^2$; which shows that 13^2 is the factor of 29, since 70^2+1 is evidently a simple number.

Again. Let it be 61. This number is not of the form α^2+4; but if we multiply it by 5^2, the product $1525=39^2+4$; which worked as above, shows 3805^2 for the least square factor that will make 61 a simple number. In like manner, we find that 109×25^2 is of the form α^2+4; hence we infer that 851325^2 is the least square by which 109 must be multiplied to obtain a simple number.

It is by such, and other artifices which it would be too long to enumerate, that we have been able to construct a table of all the square factors by which every complex number must be multiplied, to obtain a simple number, up to 158.

If in the equation $x^2 - ny^2 = 1$, n be of the double form β^2+1, and $4\alpha+1$, then will always the least value of x be of the form $4\alpha+1$, and y of the form 4α. For $y=m=2\beta$; and β is necessarily an even number when n is of the form $4\alpha+1$. If we subtract 1 from $x=am+1$, the remainder am shall have $2d$ divisors, and we shall have d different ways of obtaining the product am; that is, we shall have so many different square factors of n, each of which will give the least values of x and y.

For instance, in how many different ways can we obtain the least values of x, and y, in the equation $x^2 - 13y^2 = 1$?

*Table containing the least square factor by which each complex must be multiplied to obtain a simple number.**

C. N.	Sq. fact.	C. N.	Sq. fact.	C. N.	Sq. fact.	C. N.	Sq. fact.
13	5^2	59	3^2	94	151^2	127	419775^2
19	3^2	61	3805^2	97	569^2	128	51^2
21	2^2	67	27^2	103	47^2	129	14^2
22	3^2	69	13^2	106	389^2	130	5^2
28	3^2	70	3^2	107	3^2	131	9^2
29	13^2	71	7^2	108	5^2	133	261^2
31	7^2	73	125^2	109	851325^2	134	33^2
41	5^2	74	5^2	111	2^2	135	3^2
43	9^2	75	1^2	112	2^2	137	149^2
44	3^2	76	39^2	113	73^2	139	747^2
45	3^2	77	4^2	114	3^2	149	9305^2
46	23^2	85	41^2	115	7^2	151	3383^2
52	5^2	86	11^2	116	13^2	153	8^2
53	25^2	88	3^2	117	5^2	154	22^2
54	3^2	89	53^2	118	51^2	155	2^2
55	2^2	91	11^2	124	273^2	157	315645^2
57	2^2	92	5^2	125	61^2	158	7^2
58	13^2	93	14^2	126	40^2	. .	. .

Having already found $13\times25=18^2+1$, we inferred $a=18$, $m=36$, $am=648$, whose divisors are 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 27, 36, 54, 72, 81, 108, 162, 216, 324, 648. Consequently, we ought to obtain 10 different factors of 13 which will, each of them, give the least values of x, and y. These factors are, 10^2, 15^2, 20^2, 30^2, 45^2, 60^2, 90^2, 180^2, $\left(\frac{15}{2}\right)^2$ and $\left(\frac{20}{9}\right)^2$.

I shall say no more upon this new theory, fecund as it is in the resolution of indeterminate problems of all degrees, except the first; leaving it for others to bring it to its highest degree of perfection, if they think it worthy of their attention.

Troy Ladies' Seminary, March 20th, 1849.

* Each column marked *C. N.*, contains the complex numbers, and the column marked *Sq. fact.*, their square factors. Every number not found in this table, up to 158, is a simple number.

Art. VI.—*Review of M. Tuomey's Final Report on the Geological Survey of South Carolina*, presented to the Boston So. Nat. History, May 2d, by Thomas S. Bouvé.

The State of North Carolina has the distinguished merit of being the first among the governments of the world, to authorize at its own expense, a full survey of its territory for the purpose of developing its resources, and enlarging the boundaries of human knowledge.

Since this most worthy act on the part of her government, her sister confederacies have one after another followed her example; and the result is that we as a people have a degree of information in relation to our resources, which could have been reached in no other way, and which is of the utmost importance to our progress, while the scientific world at large has been led to rejoice in the acquisition of a vast amount of knowledge of which it would otherwise have long remained ignorant.

The State of South Carolina was the second to move in this great work. By order of her legislature, a report upon a geological and mineralogical survey was made by Mr. Lardner Vanuxem as long ago as 1826, and a collection of the minerals of the state deposited in the cabinet of South Carolina College. In 1842 this state authorized an agricultural survey. The work was entrusted to Mr. Edmund Ruffin of Virginia, who conducted it with great ability, but who resigned his office at the close of the first year, making a valuable report of his labors. M. Tuomey, the author of the work now under consideration, succeeded him in the survey, and upon the renewal of his commission in 1844, it being found difficult to separate an agricultural from a geological survey, he was directed by the government to make a report both upon the geology and agriculture of the state, and this he has done in the volume before us.

Introduction.—As an introduction to the subject of the work, we have quite an interesting treatise on the science of geology, embracing a general description of the formations of the earth's surface, stratified and unstratified, with remarks upon the relation of the igneous and metamorphic rocks; upon metallic veins; and upon the phenomena of volcanoes and earthquakes. We have also a chapter devoted to palæontology, or the knowledge of animal remains, and to fossil botany. The characters of the classes of the animal and vegetable kingdoms are given, and some account of the fossil remains of the various orders and genera, with their geological distribution. To this succeeds a chapter upon the fossiliferous rocks and the succession of organic remains. Figures illustrate the facts stated in this part of the work, and a table is included showing the order of superposition of the fossiliferous strata with the localities of the characteristic deposits in Europe and America. It would perhaps be difficult to find even in double the number of pages elsewhere, a better abstract of geological knowledge than that presented to us in this introduction, and we think the author has done wisely in appending to his work so much matter of a general scientific character.

Report on the geology of the state.—The report on the geology of the state, commences with an account of the unstratified rocks, found in South Carolina, exclusively in the upper or northwestern districts. Although this section of the state is known as the granite region, yet true granite is found over but a small portion of the surface. It is seen perhaps in a more continuous range than elsewhere along the line of the tertiary deposits, between the Savannah river and the Congaree below Columbia, separating by an anticlinal axis those strata, which dip south, from the clay slates which have a northern inclination. Granite also appears at the surface to some extent in the counties of Newberry and Lancaster. Nowhere does it rise, however, to any great elevation. In some localities the rock has disintegrated, and masses cover the surface of the ground, which from their form and detached position are often taken for transported boulders.

M. Tuomey accounts for them as follows:

"The rock originally presented a jointed structure, the seams dividing it by their intersection into cubical blocks of various sizes. Disintegration commences at the angles, which being the points of least resistance, are removed by exfoliation, or converted into a slightly cohering mass, that finally becomes a loose earth, enclosing the rounded pieces of rock. This earth is frequently removed from the crevices, and the globular masses remain standing alone, or piled upon each other, as they are often seen. It is in this manner that all the rounded masses of granite in the state have been formed, which can always be distinguished from transported rocks by their identity with the rocks with which they are associated."

A coarse feldspathic granite rises into quite a conspicuous hill in Newberry district, lifting the slates which rest upon it, and giving them a northern and southern dip. This passes at some distance into a fine-grained rock which affords an excellent building material.

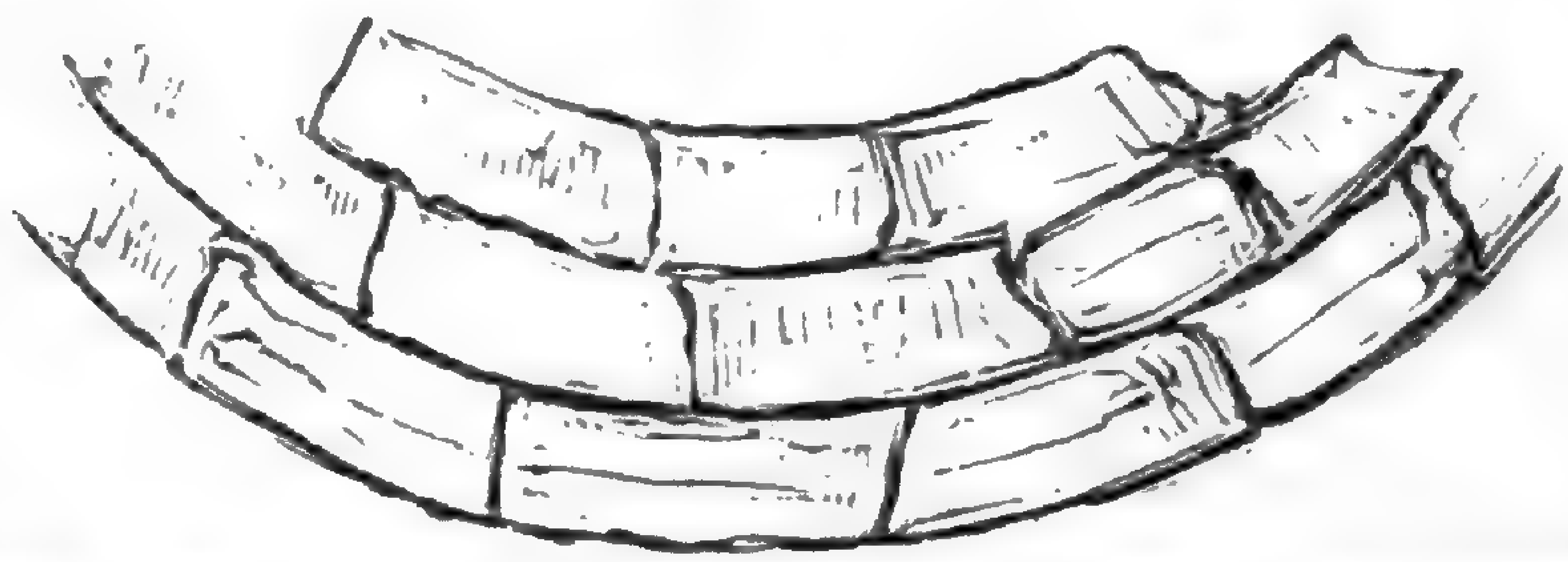
The mineral contents of the granite are but few. Auriferous veins are found in it which have been worked, and there exist some beds of porcelain clay derived from its disintegration.

Trap and other intrusive rocks.—An extensive series of trap dikes, which extend from Virginia to Alabama, cross the northwestern section of this state, and this rock composes a considerable portion of the surface of some districts. Generally this, with the associated rocks, have become so much disintegrated as to make the boundary of the dikes obscure; and our author states that he did not meet with a single instance where anything like an escarpment was presented. The direction of the dikes is uniformly between 15° and 35° east of north, and they are rarely inclined much from the vertical.

In Chester district the trap is more developed than elsewhere, covering over a large portion of its surface, and veins of porphyritic feldspar, quartz and graphic granite, intersect it.

The dikes of intrusive rock are not all trap throughout this region. Some are of syenite, others of hornblende rock and of eurite. One of the syenitic veins in York district is intersected by veins of quartz which have been worked for gold. Evidence of the igneous nature of all these rocks is seen in various localities. By their junction with the clay slates of Edgefield, the latter are changed to porphyry, and in Chesterfield the new red sandstone is blackened and otherwise altered, so as to resemble overburnt brick.

In Abbeville district, at a locality on Little river, the trap presents a remarkable structure on its surface, being divided by concentric joints, which are crossed by others nearly coincident with the radii of the curves. This is illustrated by a cut as follows:



The trap rocks of the state have not been found to contain any minerals of interest.

Stratified metamorphic rocks.—*Gneiss.*—The non-fossiliferous series of stratified rocks present themselves at the surface over a large portion of the primary region, and of these gneiss is by far the best developed. Of the prevalence of this rock Mr. Tuomey remarks, that "although its continuity is often interrupted by the protrusion of the underlying granite, or the alternation of beds of other rock, and may be covered by patches of the overlying slates, yet it is seen forming a vast plain that extends from the mountains to the middle of the state, forming, with a few exceptions, all the obstructions to the rivers. The strike being at right angles with the courses of the streams that drain the Atlantic slope, a series of falls is produced by the outcropping edges of the rock, that extends from its southern limit to the mountains."

The outcropping edges of this rock, it is stated may be traced across the state from the Savannah to the Broad river by parallel ranges of natural dams which they form in the rivers, and over which the water flows, forming picturesque cascades of from ten to eighty feet in height. These phenomena Mr. Tuomey thinks are due to the result of the alternation of more and less destructible beds, the former of which have been washed away, leaving the latter projecting; rather than to a series of uplifts. The strike of these rocks is northeast and southwest, and their dip very nearly that of the Atlantic slope, excepting in a few instances at the southern extremity, where they have been elevated so as to dip in an opposite direction.

Hornblende slate.—This rock alternates with the gneiss in some localities and passes into it. Its extent is limited compared with the gneiss in mica slate.

Mica slate.—Mica slate alternates with both hornblende slate and gneiss. In the extreme northwest of the state, it is the prevailing surface rock of the rounded hills of that region. It passes into talco-micaceous and talcose slates by the substitution of talc for mica. These latter rocks are found only in the gold regions of the state, and in a belt in York and Spartanburg districts that contains magnetic iron ore.

Clay slates.—An extensive deposit of these slates occurs along the northern boundary of the tertiary, from the Savannah river nearly across the state, finally disappearing at the north under the new red sandstone.

Limestone.—Beds of limestone are found both in the gneiss and mica slate, and are quarried to some extent for agricultural and architectural purposes.

Quartz rock.—The rock so designated is a stratified deposit, and differs from the common massive quartz in its granular structure, though it is sometimes compact and resembles the common variety. It is associated with the mica and talcose slates and passes into them. It seems, says Mr. Tuomey, to be the result of the gradual disappearance of the matter forming the micaceous or talcose portion of the rock in which it occurs, and the introduction of a proportionably large amount of siliceous or arenaceous matter during its deposition. One of the varieties of this rock is the itacolumite, or flexible quartz. This variety is found at some localities in this state, and also in the neighboring states of North Carolina and Georgia. It is known as the repository of the diamond both in Brazil and the East. None of these gems have as yet been found in South Carolina, but as our author remarks, thousands may have escaped with the refuse gravel at the gold mines. Both in North Carolina and Georgia diamonds have been discovered at the gold workings in this itacolumite formation.

Iron ores.—The magnetic oxyd, the specular oxyd, and the hydrous peroxyd of iron, are all found in the talcose and mica slates of some of the districts. The ore Mr. Tuomey thinks cotemporaneous with the slates, being frequently so intermingled with them, as to prevent their being readily distinguished one from the other. In examining one of the beds of specular iron, he comes to the conclusion that it was originally sulphuret of iron, and in connection makes the following remarks, which are worthy of notice.

"It is not a little curious that pyrites will resist decomposition when placed under water, while, if it be exposed to the atmosphere, it is readily acted upon and reduced to an oxyd. Nearly every gold mine in the state offers examples in illustration of this fact. For wherever oxyd of iron is found mingled with the ores, when water is reached, it is invariably found in the form of iron pyrites.

"We have first the sulphuret, or iron pyrites, which by decomposition becomes probably the protoxyd, a portion of which combines with another atom of oxygen, and forms peroxyd, the mixture of the two now existing together, producing the magnetic oxyd. The remaining protoxyd is converted into peroxyd, and the whole is now the specular oxyd or red ore, which we find towards the surface. And when during this change water enters into combination with the ore, we have the hydrous peroxyd or brown hematite ore. Every step in this progress may be observed at the furnace bed, on People's creek."

M. Tuomey states that, with a single exception, he nowhere observed iron ore in a true vein. Here the ore was fibrous hematite, and was traced by him for miles.

Gold.—The gold formation, the circumstances under which gold is found, the mines which are explored, and the methods adopted for working the ores, receive from our author particular attention. We must, however, be brief in our notice of this as well as other portions of the work.

After stating that the gold formation of the United States is confined to a band of schistose rocks extending from the Rappahannock in Virginia to the Coosa river in Alabama, Mr. Tuomey remarks that these rocks in South Carolina, as well as in the neighboring states, seldom exceed a breadth of sixty or eighty miles, and that the gold is found at times in veins of granite, syenite, gneiss, hornblende and mica slates, as well as in the talcose rocks, which have been considered the only gold bearing rocks. He speaks of two classes of mines which are explored; the vein mines, where the metal occurs in the solid rock, and the deposit or branch mines, consisting of beds of gravel and pebbles of quartz, which occur in low places, in valleys and along the beds of streams. These streams, it is stated, can have had no agency in their formation, as no cause now in operation would account for the wide spread extent of these deposits, or for the rounding and polishing of the pebbles contained in them. Some of the branch mines, however, are mentioned as having had a later origin than those referred to, in which the quartz pebbles are angular and mixed with detritus of the adjoining hills. The gold of these can generally be traced to its original source in the rock, and thus most of the vein mines of the state have been discovered.

From the notices of the different mines it appears that there is generally but poor management in the working of them. Speaking of Brewer's mine, one of the principal of them, upon which about two hundred men are employed, Mr. Tuomey writes, "when I first saw this mine, open-cast excavations in several places were commenced, and in some spots prosecuted to the depth of fifty feet. When I revisited the place, after an interval of two years, it was scarcely possible to recognize it as the same mine. Had a detachment from an enemy been sent to destroy the mine, I cannot imagine how they could have executed their task more completely. * * * The whole grows out of the system of letting prescribed by the owners; and truly 'killing the goose to get the golden eggs,' seems here scarcely a fable.

"A portion of the mine, equal to about twelve square feet of the surface, is let to a company numbering from three to six persons, who work as they think proper, and abandon it when they please. It requires no argument to show that where twenty or thirty such companies are working in this independent manner, there can be little system and less mining, in the proper sense of the term. No grinding apparatus has been used to any extent—the soft portion of the gangue alone being washed for the precious metal; and even that is excavated in the most reckless and unworkmanlike manner: and in washing, the worst form of the common rocker is the only instrument used. In a common deposit mine, where the auriferous bed is only a few feet thick, the loss from this mode of working would be very considerable; but where a mine is worked to the depth of fifty or sixty feet, it must be incalculable."

We have now passed over that portion of the work which treats of the ancient primary deposits of the state, and proceed to notice what is said of those of a later period.

Palæozoic rocks.—In a locality on Thompson's creek, Mr. Tuomey observed strata of highly inclined rocks, which he was disposed to refer to this period. He found no fossils, however, to corroborate this idea.

Older secondary rocks.—*New Red Sandstone.*—This rock, which is found at intervals from Massachusetts south, finally terminates in South Carolina, four or five miles from the northern boundary, overlying in this State the clay slates unconformably. Trap dikes penetrate it, and the sandstone is much altered by it, sometimes so as to resemble porphyry, having crystals of feldspar imbedded in a black gangue. Veins of carbonate of lime are also found in the sandstone.

Upper secondary or cretaceous rocks.—The cretaceous formation of South Carolina next comes under the notice of our author, for as he remarks, "there is a wide gap in the geological series of South Carolina, extending from the metamorphic rocks to the upper secondary, and unfortunately among the missing rocks, we find the carboniferous system, with its coal measures."

The cretaceous deposits are described as appearing upon the surface in Horby district, where the strata dip beneath the sands of the coast and are covered by tertiary beds, also at a number of other localities in this and the neighboring districts. They are composed generally of marl, marl stone, and shales. It is remarkable that the green sand so characteristic of this formation in New Jersey and Delaware, is absent in the beds of the same age in South Carolina, and still appears again in deposits of a later period.

The fossils of these deposits are not numerous, the following list comprising all yet known.

Carcharodon,	(species?)	Pectunculus hamula,	Mort.
Lamna,	(species?)	Anomia argentifera,	"
Ammonites placenta,	Dekay.	Trigonia thoracica,	
Belemnites vertebroides,	Morton.	" crenulata.	
Natica petrosa,	"	Cardium altum.	
Ostrea cretacea,	"	" (species?)	
Exogyra costata,	Say.	Crassatella vadosa,	Mort.
Plagiostoma dumosum,	Mort.	Hamulus onyx,	Mort.
Cucullæa ovata.			

Tertiary series.—The tertiary deposits of South Carolina are distinguished from those of the cretaceous, not less in their mineralogical than in other characters. Instead of the dark marls and marl stone which prevail in the latter, we find in the tertiary deposits, thick strata of limestone, highly calcareous marl, with beds of loose sand, clay and gravel. From the coast, they cover the surface of the slate inland, with the exception of the small patches of cretaceous rocks, for a distance of more than one hundred miles, occupying about two-thirds its whole extent. Along a line from the Savannah near Hamburg, to Thompson's creek, where it enters the slate from North Carolina, is found their boundary, and they are here observed resting immediately upon the granite, the gneiss, and the clay slates of this region. Along this line too, are found the first falls in ascending the rivers caused by the tertiary which come in contact with the harder rocks, being washed away.

One striking fact mentioned in relation to this boundary is the change observable in the botanical features of the country in crossing it. The Pinus americanus here finds its inland limit, and the common grass of the pine woods of the genus Aristida, here gives place to the brown grass (Andropogon) of the higher lands.

Eocene.—The eocene deposits are represented as occupying a deep depression of the cretaceous strata, which latter are observed only in the northeastern section of the state where they sink beneath the tertiary rocks, not to appear again at the surface; though undoubtedly underlying the vast beds of a later period, which in this region are seen to rest upon them.

The eocene strata Mr. Tuomey describes as occurring in three well marked groups. The Burr-stone, the Santee beds, and the Ashley and Cooper beds.

The Burr-stone formation, the oldest of these eocene strata, is extensively developed at numerous localities, and is made up of sandstone, clay, beds of gravel and sand, and silicified shell or burr-stone; which last gives its name to the whole group. The relative position of these deposits and the calcareous rocks of the Charleston basin, has been a matter of some question, but Mr. Tuomey has settled the point, having traced the burr-stone beds, under those of the calcareous rocks.

The fossils of this group are numerous, and a list is given of 53 species Gasteropoda, 30 species Lamellibranchiata, and three or four undescribed species of corals are mentioned as occurring, together with leaves of exogenous plants of the genera Quercus, Fagus and Salix, and some remains of crustacea.

The predominance of Gasteropods among these fossils indicates, says Mr. Tuomey, the littoral character of the formation, and he draws the inference from this fact and from the existence of land shells and remains of plants, among the fossils, "that the whole group was deposited on the coast of the eocene sea." This formation it will be seen by reference to the map, has its principal development at the surface in the districts of Orangeburg and Lexington.

The Santee beds or Calcareous Strata of the Charleston basin, occupy a large area of the surface of the state south of the Santee, and have been called *the Carolina bed*, because of their great development in the state. They outcrop at numerous localities along the right bank of the Santee, also along the southern line of the burr-stone between the Santee and the Savannah, and on the Savannah. These deposits consist of beds of thick white limestone, marl and green-sand.

The list of fossils collected show the following result: 3 species of Cephalopoda, 8 of Gasteropoda, 8 of Pteropoda, 20 of Lamellibranchiata, 17 of Polyparia, maxilla, teeth, and vertebræ of the Zeuglodon, teeth of an undetermined Saurian, teeth of 8 genera of fishes. Mr. Tuomey remarks, that "this list presents a very different result from that obtained from the fossils of the burr-stone; for besides the introduction of the classes Cephalopoda, and Pteropoda, there is a great numerical falling off in the Gasteropoda; and yet the occurrence of oysters in these beds, and of corals in some of them, would indicate a sea of no great depth at the time of their deposition."

Beds of the Ashley and Cooper rivers.—These are the newest deposits of the eocene in South Carolina, and they are composed principally of dark marls, which are distinguished from the marl of the previously described beds, not less by the difference in their organic remains, than in that of color. Localities of these deposits are described, not only on the Ashley and Cooper rivers, but at numerous other places.

The remains of cartilaginous fishes are very abundant in their beds, and Mr. Tuomey referring to a locality at Bee's ferry on the Ashley, remarks, "It would seem as if about the close of the eocene period, these voracious monsters, conscious of their approaching end, had congregated here to die, and it is no exaggeration to say, that more than a bushel of fishes' teeth had been collected here within a few years. I have visited the locality several times, and never without finding a large number of specimens."

The fossils mentioned as occurring in these beds are the following:—

Mammalia.—Equus,	(teeth.)		Palæotheria,	(teeth.)	
Tapir,	"		Manatus,	(ribs.)	
Zeuglodon,	(head and vertebræ.)				
Reptilia.—Chelonia.					
Pisces.—Pristis,	1	species.	Hemipristis,	2	species.
Ptychodus,	1	"	Glyphis,	1	"
Myliobates,	5	"	Otodus,	4	"
Carcharodon,	10	"	Oxyrhina,	9	"
Corax,	4	"	Lamna,	9	"
Galeocerdo,	6	"	Cælorhyncus,	1	"
Mollusca.—Cephalopoda,				1	species.
Gasteropoda,				7	"
Lamellibranchiata,				12	"

Also of Cirripedia, 3 species, and of Corals 1 species. Of these deposits, Mr. Tuomey remarks, "that the existence of the remains of terrestrial mammalia shows that they could not have been deposited at a great distance from land."

With the account of the eocene strata we have a list of the fossils common to both the burr-stone and the strata of Claiborne, Alabama, which shows conclusively that they are equivalent. This list embraces no less than 58 species.

Fossils common to the Cretaceous and Eocene formations.—The following are given as common to both these periods:—Ammonites placenta, Terebratula Harlani, Plagiostoma gregale, Gryphæa mutabilis, Ostrea panda, Trigonia thoracica? and also two species at least of Echinoderms.

The announcement in this list by Mr. Tuomey, of ammonites common to both the cretaceous and tertiary formations, will not fail to surprise our palæontological readers, as it has been hitherto supposed that this genus ceased to live before the period of the tertiary deposits. As strong evidence of the existence of this fossil in our tertiary will be required, before its presence there will be admitted, we give Mr. Tuomey's account of the discovery.

"In 1846, I happened to be in Wilmington during the progress of an excavation in the conglomerate of that place. The excavation was made on the side of the hill on which the city stands, and in the upper part of the conglomerate, where it was in contact with the miocene. I found the surface perforated with lithodomous shells of miocene species, showing that it was the bed of the eocene ocean at the time that the latter formation was quietly deposited in it.

"I was not a little surprised to find here a Trigonia, at least related to *T. thoracica*, Mort., if not identical with it, together with several well characterized casts of *Ammonites placenta*, Dekay, a fossil found in the cretaceous beds of Delaware, and in those of the Peedee, South Carolina.

"Seeing that this bed is a conglomerate, I set myself to examine the probability of these fossils being washed from the cretaceous beds, higher up the river, upon which it rests. The conglomerate is composed for the most part of rolled calcareous pebbles, agreeing with the mass in which they are embedded, and it is well known that lithologically, the cretaceous beds of North and South Carolina are entirely different, and hence I could not fail to detect any thing brought from that formation. The casts are composed of the white limestone; and the casts of eocene fossils, with which they are associated, are so perfect, that I was forced to the conclusion, that the molluscs belonging to these shells, lived and died where they are entombed."

The fact that ammonites were found only in a bed of conglomerate, and that Mr. Tuomey himself questioned as to the probability of their having been washed from the cretaceous beds, notwithstanding his conclusion to the contrary, will leave some doubt on the minds of many on this point. Considering however, that there are other fossil species, as the Ostrea panda and the Gryphæa mutabilis, which were certainly contemporaneous with the Ammonites placenta in the cretaceous period, and which are now unquestionably found in the eocene tertiary of South Carolina, we see no reason to doubt the conclusion that Mr. Tuomey came to in regard to the Ammonites placenta, found by him at Wilmington, notwithstanding the fact that no Ammonite had previously been found either in the tertiary of this country or in that of Europe. If one species survived the change, many might, and probably did.

Pliocene.—Scattered over the state, at various lccalities, particularly in Darlington and Sumter districts, are marl deposits of an age later than the eocene, and which, following Mr. Lyell's classification, Mr. Tuomey includes in the pliocene; as they are found to contain a much greater proportion of recent shells than the miocene beds of Virginia and Maryland. In the districts named, the pliocene rests immediately on the cretaceous marls.

Fossils of these beds.

Mammalia.—Mastodon, Cervus.

Pisces.—Carcharodon.	Galeocerdo.	Saurocephalus.
Lamna.	Hemipristis.	Cælorhynchus.

Mollusca.—Brachiopoda,	1	species.	
Gasteropoda,	78	"	of which 39 are recent.
Lamellibranchiata,	109	"	" 47 " "
Also of Cirripedia,	2	species,	of which 1 is recent.

Post-pliocene.—The post-pliocene deposits of South Carolina occupy the line of the coast for about ten miles inland, resting upon the pliocene in Horby and Georgetown districts, and south of this upon the eocene rocks. They are composed of beds of sand, clay and mud, their whole thickness being about sixty feet.

Mammalia.—Mr. Tuomey found some fragments of bones in the post-pliocene, which he concluded to belong to the Megatherium.

Pisces.—Carcharias,	Lamna.
Myliobates,	Diodon.
Trichiurus.	

Mollusca.—Pteropoda,	1	species.
Gasteropoda,	39	"
Lamellibranchiata,	65	"

Also of Cirripedia, 1 species, Echinodermata 4 species, and Polyparia 2 species.

Alluvium.—This in turn is noticed, and the question considered here whether the southern coast is subsiding as has been alledged. Our author concludes that it is not, and shows the evidence brought in favor of such a view to be due to other causes.

Recapitulation.—Mr. Tuomey presents the following as the results of his investigations in the tertiary deposits.

"1st. That they are situated in a vast depression in the cretaceous rocks, which however are only visible on the east and northeast.

"2d. That the eocene consists of three well defined groups: 1. *The burr-stone formation*, composed of thick beds of sand, gravel, grit, clay, and burr-stone, amounting to at least 400 feet in thickness—and underlying the calcareous beds. Its upper portions are characterized by beds abounding in silicified shells, for the most part identical with the Claiborne fossils. As these are littoral shells, they probably occupied the coast while the Santee beds were forming in deep water. The materials of which this formation is composed, are the ruins of the granitic and metamorphic rocks of the upper districts, which may often be traced to their origin. 2. *The Santee beds*, consisting of thick beds of white limestone, marl and green sand. These are best seen on the Santee where, interstratified with the green sand, they dip gently towards the south. The coralline marl of Eutaw is found near the upper edge of these beds. 3. *The Ashley and Cooper beds*, which are the newest eocene beds of the state. The marl of these is characterized by its dark grey color and granular texture, while the remains of fishes and mammalia give its fossil remains a peculiar character, and leave no doubt of the position assigned it, at the top of the eocene series. These together with the Santee beds, must amount, at least to a thickness of six or seven hundred feet.

"3d. That although these strata contain, throughout, characteristic eocene fossils, yet they also enclose some cretaceous forms.

"4th. That the middle tertiary of the state, composed of beds of sand and marl, highly fossiliferous, is scattered, like similar beds in other places, over the eocene and cretaceous formations, in isolated patches. That the proportion of recent species increases towards the south; and that the extinction of species seems to proceed in that direction, as is proved by the fact that the recent forms, which are also fossil, belong to a more southern fauna—there being but one or two exceptions.

"5th. That in South Carolina, the proportion of recent species in this formation amounts to forty per cent. I have therefore referred it to the older pliocene.

"6th. That the post-pliocene is confined to a belt along the coast of about eight or nine miles in breadth. The fossils are nearly all referable to recent species now inhabiting the coast: a few, however, belong to the fauna of Florida and the West Indies. An elevation of the coast has taken place since the deposition of these beds, which it is probable has given the rivers of the Atlantic slope a western tendency.

"7th. That the submerged stumps of trees, found below the level of high tide along the coast, are not the result of subsidence, properly so called, but must be referred to the encroachment of the sea upon the land, and to the peculiar character of the deposits in which they grew.

"That the almost entire absence of fluviatile shells in the recent and tertiary deposits, is mainly due to two facts: 1. That there is a considerable space between the line of brackish and salt water, where neither fluviatile nor marine forms can exist. 2. That the streams have not transporting power sufficient to bring down fresh water shells. So long as these circumstances exist there can be no mixture of fluviatile and marine shells."

Practical Geology.—With the tertiary, of course, the portion of the work devoted to descriptive geology ends. The remainder of the volume, excepting the appendix, is devoted to *practical* or *economical* geology. Under this head we have presented by the author an interesting and valuable treatise upon soils in general, their classification, physical properties and chemical composition:—Upon the composition of cultivated plants:—manures, animal, vegetable and mineral, with their effects:—rotation of crops and draining:—lime burning:—metallurgy:—the manufacture of iron:—the extraction of gold from its ores:—and upon the materials used in the arts found in the state, &c. &c. The greater portion of this we pass over without particular comment; not that it is of less interest than other portions of the work, but because it relates to matters not exclusively concerning the geology of South Carolina. We will touch, however, upon one or two points.

Of the extraction of gold from its ores, Mr. Tuomey gives a detailed account, hoping thereby to call the attention of inventors of machinery to the very rude processes by which it is effected, in order that some improvement may be made in the machinery used. He therefore particularly describes all the means adopted at the mines for the separation of the metal, and gives figures of all the various machines used in the state for the purpose. We mention this fact, because our article may meet the eye of some reader, who will learn by it what is required, only to supply the want.

Of the metallic substances found in the state, besides gold and the oxyds of iron, of which notices have been taken, the following are enumerated: *manganese, lead, copper, bismuth, graphite, oxyd of titanium, sulphuret of iron.*

A number of mineral springs are mentioned as occurring in the upper districts, some of which are visited for their medical virtues.

Appendix.—In the Appendix, a catalogue of the fauna of South Carolina is given, prepared by Dr. Lewis R. Gibbes of the South Carolina College.

In concluding a notice of this work, we will remark, that we think a good geographical map should have accompanied it. It is indeed absolutely necessary in order that the text be fully understood, that the reader have one before him. This want would not be felt as it is, if the localities cited were given on the geological map, which is not the case, excepting so far as relates to the districts.

We cannot refrain too from expressing our strong regret, that the figures of the fossils of the state were not published, as was intended by Mr. Tuomey. It seems from a postscript to the preface, that while the report was passing through the press, he was informed, "that the committee on publication had decided that the plates containing the figures *were not essential*," and they were therefore omitted.

We will not however complain of this as showing any want of liberality on the part of the state. She has done well in presenting to the world what she has, and in behalf of that world, we would thank her, and rejoice in what is received from her hands.

To Mr. Tuomey we extend our congratulations, that his labors are now brought to a successful close. We believe he will have constantly increasing evidence that he has not labored in vain.

Art. VII.—*Some Observations upon Emulsine and its Composition;* by B. W. Bull, Hartford, Conn.

The following investigations were made in the summer of 1848, at the suggestion of Prof. von Liebig, in the hope of eliciting some farther information in relation to the constitution and properties of this substance. The method at first employed in preparing emulsine was that of Ortloff, as recommended by him in the Archiv. der Pharmacie, vol. 48, page 12,* which is the following: "The sweet almond powder already freed from oil by pressure, is to be stirred with about three times its weight of water, and the mixture, placed in a wide mouthed loosely covered glass vessel, is to be exposed to a temperature of 15° to 20° R., during five or six days, till all the albumen? is destroyed by the consequent fermentation. The fluid is then to be filtered off, and the emulsine precipitated by adding strong alcohol in sufficient quantity, and subsequently dried at a temperature not exceeding 30° R." It is described as a "reddish gray or reddish yellow mass, gum-like and brittle; in small pieces, horny, transparent, with a glossy lustre externally and internally dull."

* For an abstract of this paper, see Berzelius Jahres-Bericht, 27th volume, page 396, German edition.

Ortloff further mentions that a precipitate in a solution of emulsine is a proof that all the alumina was not decomposed, in consequence of the period allowed for fermentation having been too short; that freshly precipitated emulsine redissolves entirely in water, and after being dried, redissolves, leaving a residue consisting of phosphates of lime and magnesia, while the solution contains only traces of inorganic matter. Among other characteristics of emulsine according to the above chemist, is that of its being free from sulphur, a conclusion based upon the fact that treated with caustic potassa it does not form sulphuret of potassium and continues to precipitate lead salts white; a result quite at variance with those which I have obtained by a similar treatment.

A couple of trials in which the above method was followed, did not afford me favorable results. The mixture became quite sour, but even after the lapse of nine days at the given temperature, a filtered portion continued to give a strong precipitate with acid, and on the addition of alcohol, the substance thrown down did not redissolve by the addition of water. After numerous attempts, I have found it preferable to prepare emulsine as follows. The finely powdered sweet almonds, already freed from oil by cold pressure, are made into an emulsion with as small a quantity of water as possible. Three times their weight of water is sufficient, and with this amount they can be treated twice, using two-thirds of the water at the first, and the remainder at the second treatment. It should be strained through a linen cloth and the residue both times strongly expressed. The resulting fluid is afterwards to be placed in a suitable vessel and exposed to a temperature of 20° to 25° C. Within twelve hours, if untouched, it separates in two parts. A creamy coagulum, forming perhaps one-fifth of the whole, rises to the top. It is generally of a yellowish white color, though sometimes tinged with pink on the surface. The transparent watery fluid undeneath is light yellow, quite limpid, and after standing two to three days, gives no precipitate with acetic acid. By adding alcohol, a precipitate is obtained which entirely redissolves upon the addition of water. If the vessel has not been moved during the process of separation, the coagulum assumes so firm a consistence that the watery portion can be almost entirely removed by means of a small syphon, without admixture with the former, in which case it filters very readily. As soon as the separation has taken place, the liquid is ready to be filtered off and precipitated by alcohol. For reasons which will be given below, I do not think it at all necessary for the preparation of pure emulsine that the fluid shall have ceased to be affected by acetic acid, or that the substance thrown down by this reagent should be removed by the addition of it in excess. As I wished however to examine the acetic acid precipitate, the liquid was generally filtered from the coagulum as soon as the separation had ensued, and to the filtrate acetic acid was added till no farther precipitate was produced. From the liquid filtered from the precipitate, the emulsine was then thrown down by alcohol of 85 per cent., a double volume of which I have found necessary. In the alcoholic fluid a small quantity still remains in solution, and a farther addition of alcohol is necessary if the whole amount is desired. For this reason as small a quantity of water as possible has been recommended in preparing the emulsion.

Obtained in this way, and washed with alcohol of 85 per cent. upon a filter with subsequent drying in the air, I have found emulsine very similar in appearance to that described by Mr. Ortloff, being a transparent gum-like brittle substance of a dark reddish brown color, without odor, and not possessing any positive taste. It dissolves with difficulty after maceration in water or by rubbing in a mortar, leaving behind a residue totally insoluble in water, and containing besides phosphates of magnesia and traces of lime, a large amount of organic matter. This insoluble residue, after being thoroughly washed with distilled water, still gives distinctly the characteristic reaction of emulsine with amygdaline. The proportion of organic matter which it contains is very variable. Four experiments gave me as follows:

	No. 1.	No. 2.	No. 3.	No. 4.
Organic matter,	56	69·45	59·48	80·27
Ash,	44	30·55	40·52	19·73
	100	100·00	100·00	100·00

The solution is opalescent, and possesses in the highest degree the property of decomposing amygdaline into bitter almond oil and hydrochloric acid.

Dried in vacuo over sulphuric acid, it presents very nearly the same appearance. Its color however is not generally as dark, sometimes inclining to a brownish yellow, and at others to a brownish red. When dried with free access of air, it absorbs moisture with avidity while the alcohol is escaping; if the atmosphere is at all damp, and if left upon the filter, it penetrates the pores of the paper in this state, to which it adheres with great tenacity when dry.

The dark colored appearance of emulsine as obtained in this way, so very different, not only from the almonds themselves, but also from that of the most freshly precipitated substance, which is always white, leads to the conclusion, that while drying, it undergoes some change from the action of the air, which, though possibly not affecting its ultimate composition, still would render the analysis of a less colored product more satisfactory.

The use of a few precautions has enabled me to obtain emulsine perfectly white and consequently differing in appearance entirely from that described by Robiquet and Ortloff, who both agree in ascribing to it the color mentioned above.

If the freshly precipitated substance is at first washed out with strong alcohol till all soluble matter is removed, afterwards with absolute alcohol till deprived of every trace of water, and at last dried upon glass in vacuo over sulphuric acid, it is obtained in snow-white brittle masses, entirely opaque, without lustre and breaking with a dull starchy fracture. It is also more soluble than that prepared in the ordinary manner as at first described. I have not succeeded in all cases in obtaining a white preparation, and have found by experience that the following are requisite for success. It should be prepared in small quantities in order that it may dry as rapidly as possible. The powder remaining after pressure of from one to two pounds of the kernels, is a suitable amount to operate upon. From one pound of the kernels I have generally obtained six grammes emulsine, and this quantity can be conveniently dried under one receiver of ordinary size.

It should previously be freed as much as possible from alcohol by pressure between unsized paper, and afterwards placed under the receiver in glass or porcelain vessels, (watch-glasses answer the purpose very well,) in layers of not more than one or two lines in thickness: if thicker, or if from other causes it is not dried by the expiration of twelve hours, it assumes a more or less yellow or reddish tinge. If large quantities are taken, the time requisite for filtering and washing is unavoidably prolonged, and a preparation more or less colored is the result. When dried over sulphuric acid, in a receiver from which the air has not been exhausted, but after having in other respects been treated as above last mentioned, it appears to absorb moisture even then, and becomes upon drying, gum-like transparent and yellow. Still it does not seem to form any definite combination with water, for a portion of this gummy transparent variety upon being reduced to powder and dried over sulphuric acid till a constant weight was obtained, did not suffer any farther diminution in weight by exposure to a temperature of 100° C.

If dark colored emulsine is redissolved in water, separated by filtration from the insoluble portion and re-precipitated by alcohol with subsequent drying *in vacuo*, it becomes snow-white even if not treated with absolute alcohol.

It is generally more or less transparent however, and preserves a glossy lustre externally. But this is not an economical method of obtaining it, as a large amount of the substance employed remains undissolved. Both the white and colored emulsine possess its characteristic property of decomposing amygdaline in the highest degree, and apparently to an equal extent. The presence of foreign substances injures this reaction, and even the presence of a small amount of alcohol or acetic acid prevents it altogether.

The property of being precipitated by alcohol does not belong to emulsine in itself, and this method of its preparation and precipitation from the other substances rests upon the phosphates which are held in solution by it, and they have so much affinity for each other, that I have not succeeded in separating emulsine from these inorganic substances without destroying its property of decomposing amygdaline. Emulsine has a decidedly acid reaction. When washed out with alcohol till the latter comes away entirely neutral, the moist emulsine reddens litmus strongly; dried emulsine is also acid when redissolved. To this acid property is owing the presence of the earthy phosphates in the almond emulsion, and to their insolubility in diluted alcohol and simultaneous affinity for emulsine, must be ascribed the cause of the precipitation of the latter by the addition of alcohol. In proof of the preceding remarks, the following may be mentioned. I neutralized an emulsion of almonds by means of a careful addition of lime water, which precipitated the phosphates entirely. The filtrate did not contain a trace of phosphoric acid, reacted in a marked manner with amygdaline, but was not precipitated by alcohol. Ammonia acts in the same way. The liquid becomes cloudy indeed, on the addition of alcohol, but it is not cleared by filtration, and only after several days does a scarcely appreciable precipitate appear. A solution of emulsine neutralized in this way, if left by itself, exposed to the ordinary temperature of summer, commences to decompose in a few days, and assumes a disagreeable odor; the liquid becomes turbid, deposits, but does not again acquire an acid reaction.

Emulsine is not coagulable by heat. A solution of it becomes cloudy at a temperature of 35° to 36° C., at 45° it is quite opaque and milky, and at 85°–90° deposits a snow-white granular substance. When exposed to the heat of a water bath even a number of hours, the filtrate on additional heating still continues to deposit, but if the liquid is carefully heated over a flame to the boiling point and maintained at that temperature a few moments, the filtrate possesses the singular property, upon again being heated to ebullition, of becoming quite opaque, with separation of bulky flocculent masses, which perfectly redissolve upon cooling, and the liquid becomes as clear and limpid as before. The repeated action of heat is followed by the same result; the flocculent matter redissolving perfectly, after being produced several times. The granular precipitate which is formed amounts to about ten per cent. of the emulsine employed. It is perfectly white, easily reduced to a fine light powder, and leaves a neutral ash, amounting in one instance to 48·74 per cent., and in another to 59·11 do., consisting of phosphate of magnesia with a small amount of lime. The accompanying organic matter contains nitrogen, but no sulphur could be detected by treatment with caustic potassa and lead salts.

It is quite apparent that this is not a coagulation but rather a decomposition, and that emulsine does not possess the property of being coagulated heretofore ascribed to it. The filtrate contains a product of this decomposition which is precipitated by strong alcohol in the form of a white granular substance, amounting to nearly thirty per cent. of the original quantity, and which, when dried, after washing with alcohol and ether, remains in white opaque masses, somewhat tenacious and quite difficult to pulverize. It contains a large amount of earthy phosphates varying in different samples from eighteen to thirty-five per cent. From the following analyses it appears to differ materially from emulsine in its amount of nitrogen, which is in proportion to the carbon as 1 to 12.

I. ·4875 grm. substance containing 81·15 per cent. organic matter, corresponding to ·3956 grm., gave with chromate of lead, carbonic acid ·6265 grm., water ·244 grm.

II. ·4045 grm., as above, corresponding to ·3282 grm., gave with chromate of lead ·519 grm. carbonic acid, and ·199 grm. water.

III. ·423 grm. containing 64·93 per cent. organic substance, corresponding to ·2747 grm., gave with chromate of lead ·4285 grm. carbonic acid, and ·1737 grm. water.

IV. ·4183 grm. as above, corresponding to ·2718 grm., gave with soda lime ·3735 grm. chlorid of platinum and ammonium.

V. ·412 grm. as above, equal to ·2675 organic matter, gave with soda lime ·3555 chlorid of platinum and ammonium, from which the following are calculated,

	1.	2.	3.
C - -	43·17	43·11	42·48
H - -	6·85	6·73	7·02
N - -	8·62	8·34	8·48 mean
O+S -	41·36	41·82	42·02
	100·00	100·00	100·00

Neither of the above bodies possesses any power of decomposing amygdaline. This latter is decomposed by acetate of lead into a body containing sulphur and one free from it. The moist precipitate by alcohol was redissolved in water, leaving a small insoluble residue behind. To the solution was added neutral acetate of lead as long as a precipitate was produced. This precipitate was washed out with distilled water and decomposed by passing a stream of sulphureted hydrogen through it while suspended in water. The excess of sulphureted hydrogren was removed by exposure to gentle heat. The filtrate possessed a strong acid reaction arising in part from phosphoric acid and partly from an organic substance, a product of the decomposition. On concentration it formed a syrupy mass, which was uncrystallizable and decomposed by the action of caustic potassa with evolution of ammonia. The solution gave a reaction of sulphur with lead salts.

The filtrate from the precipitate by acetate of lead, contained a large amount of unprecipitated organic matter. The lead was removed from it by sulphureted hydrogen, and the excess of this latter and the acetic acid, as before by gentle heat. The residue was a neutral gum-like mass, very soluble in water, and forming a jelly with a solution of caustic potassa. This substance contained nitrogen but no sulphur. Another substance ensues by the decomposition of emulsine by boiling, which is not precipitable by alcohol and is about one-quarter of the amount originally employed.

Emulsine is entirely precipitated from its solutions by neutral acetate of lead. The filtrate does not give the slightest reaction with amygdaline, while the lead compound, after being washed and brought in contact with that substance, indicates very perceptibly the formation of bitter almond oil. In this respect my observations agree with those of Ortloff, and give a very simple explanation of the failure which has always attended those who have endeavored to prepare this substance after the method recommended by Robiquet, viz., "by first precipitating all the other organic matter from an almond emulsion by acetate of lead in excess, and then throwing down the emulsine, from the filtrate by means of alcohol." The statement of Robiquet, that emulsine is colored red by tincture of iodine, is not confirmed by my experience. On the contrary, a precipitate of a yellowish brown color is produced. A solution of emulsine exposed to the air at the ordinary summer temperature, begins to decompose in four or five days with evolution of gas. It becomes turbid, precipitates strongly with acetate of lead but not with acetic acid, and for some time does not lose the property of reacting with amygdaline.

The sulphur in emulsine is indicated by treatment with caustic potassa and subsequent addition of lead salts, as also by fusion with saltpetre and soda.

If to a solution of emulsine, neutralized with lime water in order to remove the earthy phosphates and prevent the subsequent presence of phosphoric acid, and afterwards filtered, is added neutral acetate of lead, a bulky precipitate is produced. The precipitate obtained in this way was washed with distilled water and afterwards decomposed by suspending in water and passing through it a stream of sulphureted hydrogen. The resulting liquid, after the acetic acid and sulphureted hydrogen are removed by evaporation, possesses an acid reaction, and on evaporation leaves a gum-like acid uncrystallizable mass. This substance contains nitrogen and is insoluble in alcohol and ether. It forms insoluble salts with baryta and silver, and a soluble one with magnesia, but could not be obtained in sufficient quantity for analysis. The filtrate from the precipitate by acetate of lead contains a large amount of organic matter, which, when the lead is removed by sulphureted hydrogen, reacts quite neutral and leaves upon evaporation a gum-like mass, which also contains nitrogen.

On one occasion, in the hope of obtaining a larger amount of the above mentioned acid substance, I took a number of grammes of freshly precipitated undried emulsine, thinking in this way to avoid the formation of the insoluble compound left behind when dried emulsine is redissolved, and the consequent loss of material, but quite unexpectedly the resulting solution was not precipitated on the addition of the lead salt. On the contrary, redissolved dried emulsine gave invariably a precipitate with that substance.

The behavior of emulsine towards acetate of lead can only be explained by attributing it to the relation in which it stands to the phosphate, a relation so delicate as to be disturbed or materially altered by merely undergoing a drying process over sulphuric acid. In favor of this opinion is the fact of the increase of inorganic matter in the insoluble portion remaining when dried emulsine has been treated with water, and the corresponding decrease of the same in the solutions showing that redissolved emulsine is unable to retain so large an amount of phosphates in solution as when first precipitated and undried, or in the state in which it exists in an almond emulsion. The per-centage of the phosphates present is very irregular and does not seem to be influenced by chemical proportions at all, but the average results obtained confirm the above statement. The large amount of these salts in the substance at present treated of, is but another instance of their almost universal presence in all organized structures, as well as of the important, though it must be confessed, slightly understood *rôle* which they play in the animal and vegetable economy.

Upon distilling the alcohol from the liquid from which the emulsine had been precipitated, the residue became gradually colored, and at the end of the operation was quite dark. Evaporated upon a water bath, it became a thick syrupy acid mass. Agitated with ether, the latter became quite acid, and upon distilling the ether, a yellow acid liquid remained in the retort, which by a second treatment was obtained nearly pure and colorless. By neutralization with carbonate of zinc and concentration, distinct quadrangular prismatic crystals were obtained, resembling lactate of zinc, but not in sufficient quantity for analysis. In the syrupy liquid, crystals were observed which were separated from the fluid, washed out with cold water and redissolved with the intention of recrystallizing. A number of attempts, while operating on the amount obtained from small quantities of almonds, did not succeed, but on evaporating the residue from a large amount, several crops of quadrangular prismatic crystals were observed, which were treated with cold water in which they were not easily soluble, afterwards with alcohol which removed a large amount of the coloring matter, and then recrystallized. This was a magnesia salt, and by treatment with animal charcoal and recrystallization did not become sufficiently pure for analysis. It was transformed into a lime salt, by treatment with milk of lime which threw down all the coloring matter with the magnesia. The excess of lime was neutralized by sulphuric acid and the sulphate of lime removed by concentrating the solution and redissolving in alcohol. From the alcoholic solution white acicular crystals, radiating in star shaped groups, were obtained in abundance.

The following analysis shows that the original crystals were lactate of magnesia, and that the substance analyzed was the corresponding lime salt. I. ·6252 grammes gave with oxyd of copper ·7415 grm. carbonic acid and ·269 grm. water.

II. ·569 grm. ignited with sulphuric acid, gave ·345 grm. sulphate of lime giving the following composition.

	Found.	Calculated.
C - - - -	32·34	33·03
H - - - -	4·78	4·59
O - - - -	37·93	36·69
CaO - - - -	24·95	25·69
	100·00	100·00

Corresponding to the formula $C_6\ H_5\ O_5$ CaO.

The precipitate produced by acetic acid was examined and prepared for analysis, by washing with water and subsequent boiling with alcohol and ether to free it from the accompanying oil. In this state it is a fine light powder of a reddish tint, soluble in alkalies, and in warm concentrated solutions decomposed with evolution of ammonia, insoluble in dilute and partly soluble in concentrated acetic acid and not precipitated from its alkaline solutions by alcohol. It contains nitrogen and sulphur, burns with a smoking flame, and leaves a trifling amount of ash with a neutral reaction. Strong hydrochloric acid dissolves it, forming a fine red liquid, which after a day or two turns to a dark purple. In sulphuric acid, it gelatinizes and turns through red to black with evolution of sulphurous acid.

I. ·274 grm. substance containing 1·59 per cent. ash, equal to ·2697 grm. organic matter, gave with chromate of lead ·5045 grm. carbonic acid and ·167 grm. water.

II. ·5115 grm. as above, corresponding to ·5034 grm., gave with soda-lime 1·266 grm. chlorid of platinum and ammonium.

III. ·4125 grm. ditto, corresponding to ·406 grm., gave 1·083 grm. chlorid of platinum and ammonium.

IV. 1·4428 grm. ditto, corresponding to 1·4199 grm. fused with potassa and saltpetre, gave with chlorid of barium ·058 grm. sulphate of baryta.

The precipitate treated with hydrochloric acid, again ignited and weighed, gave the above result at the second weighing.

V. 2·156 grm. as above, equal to 2·1216 grm., gave with a similar treatment, sulphate of baryta ·086 grm. at the second weighing.

From the above the following results are calculated :

	1.	2.
C - -	51·020 - -	. .
H - -	6·870 - -	. .
N - -	15·800 - -	16·750
O - -	25·744 - -	. .
I - -	·566 - -	·565
	100·000	

The proportion of nitrogen to carbon is as one to seven and a half. The per centage of carbon and hydrogen is very nearly that of the legumin from almonds of M. Dumas, but the per centage of nitrogen is smaller, and its reaction with acetic acid is quite different from that ascribed to this latter substance.

A portion of fresh almond powder was macerated with ordinary alcohol at a moderate temperature, the filtrate evaporated to dryness in a water bath and treated with distilled water. A part consisting principally of oily matter remained behind, while the filtrate possessed a sweet taste, and with Trommer's copper test gave indications of the presence of sugar. From the reduction of the copper, which took place at the ordinary temperature within twenty-four hours, the inference was drawn that this substance was present in the form of grape sugar.

With a view of examining the free acid formed during the fermentation, an emulsion prepared as above mentioned, was exposed to a temperature of about 30° a number of days. The separation of the coagulum ensued, which was separated from the liquid by decantation, and the remainder exposed to the continued action of the air and heat. The watery fluid became more acid each day till after standing five or six days, when it began to acquire a disagreeable odor, became turbid, and a white pellicle covered the surface. As the acid reaction at this stage appeared to diminish, the whole was then submitted to distillation. An aromatic liquor came over resembling very much in odor that of rose water, and containing a small amount of alcohol, but not the slightest trace of acetic acid could be detected even by the delicate test recommended by Bunsen, which consists in evaporating to dryness in contact with caustic potash and arsenious acid. The least trace of acetic acid is revealed by the formation of alcarsin. The distillate was treated with carbonate of baryta in excess, a part of which was dissolved and again distilled. The distillate was neutral and odorless. The residue in the retort was filtered from the excess of carbonate of baryta, and upon concentration a small amount of crystals were obtained, which, with a lens, appeared to be quadrangular prisms. Upon decomposing their solution by the addition of sulphuric acid and gently warming, the aromatic smell was again perceived.

The residue from the first distillation was sour, but the actual amount of acid present was so small that an attempt at analysis would have been useless. It is certain however that during the fermentation, no free acetic acid was formed, and attempts to find it in combination were also fruitless.

The coagulum formed contains a large amount of oil; it is entirely insoluble in dilute acetic acid, is dissolved by caustic alkalies with evolution of ammonia. It is insoluble in carbonated alkalies, and is decomposed by treatment at a very gentle heat (30° to 40° C.) with a moderately strong solution, with escapement of ammonia. As the alkaline solutions of this and of the precipitate by acetic acid are not thrown down by alcohol, it is not necessary that they should be absent from the fluid before proceeding to precipitate the emulsine. The fermentation takes place without any visible evolution of gas, unless allowed to remain till the liquid begins to putrefy.

The ashes from the syrupy liquid from which the alcohol had been distilled have a strong alkaline reaction, and contain a large proportion of potash.

The above facts lead to the conclusion, that the souring of an emulsion of sweet almonds has a very close resemblance to that of ordinary milk. The presence of lactic acid in a state of combination has been proved in the sour liquid, and there can be no doubt that the free fixed acid formed is also the same. The conversion of the sugar into lactic acid and the union of this acid with the bases which had held the caseous substance in solution, accounts for the appearance of the coagulum, and the subsequent non-appearance of a precipitate of acetic acid, as soon as sufficient acid has been generated by the fermentation, to precipitate all this caseous matter from its union with the alkalies.

I come now to the elementary composition of emulsine, the analysis of which was rendered very difficult by the large amount of inorganic matter with which it is encumbered, and which will account for the otherwise too great variation in the results. Notwithstanding this disadvantage they are sufficiently constant to show that the substance precipitated by alcohol has a fixed composition. The analyses were made from emulsine of four different preparations, dried at 100° C., a process which required several days, from the tenacity with which it retained moisture. No. 6, was dried at 130° C. The analysis No. 5, was made from emulsine prepared in the following manner. The fresh almond emulsion thoroughly agitated with ether, to dissolve the oil which was present, was allowed to stand in a closely stopped vessel till the liquid had evaporated in two parts, which occurred in the course of a few days. The upper portion, a solution of the oil in ether, was a thick opaque somewhat gelatinous mass. The under watery liquid was filtered off and immediately precipitated with alcohol. Its composition will be seen not to vary materially from that of the others.

I. ·354 grm. substance containing 23·78 pr. ct. of ash, equal to ·2698 grm. ash free, gave with chromate of lead ·435 grm. carbonic acid and ·170 water.

II. ·565 grm. substance containing 35·79 pr. ct. of ash, equal to ·3607 grm. ash free, gave with chromate of lead ·5825 grm. carbonic acid and ·233 grm. water.

III. ·499 grm. substance containing 35·79 pr. ct. ash, equal to ·320 grm. organic matter, gave with chromate of lead ·5015 grm. carbonic acid and ·2125 grm. water.

IV. ·5475 grm. substance containing 35·79 pr. ct. ash, equal ·3515 grm. ash free, gave with chromate of lead ·5415 grm. carbonic acid and ·2335 grm. water.

V. ·4575 grm. substance containing 21·95 pr. ct. ash, equal to ·357 grm. ash free, gave with chromate of lead ·5735 grm. carbonic acid and ·2235 grm. water.

VI. ·6455 grm. substance containing 34·83 pr. ct. of ash and equal to ·4206 grm. ash free, gave ·6655 grm. carbonic acid and ·280 grm. water.

VII. ·356 grm. substance containing 23·78 pr. ct. ash, equal to ·269 grm. organic matter, gave with soda lime ·492 grm. chlorid of platinum and ammonium.

VIII. ·5203 grm. containing 21·95 pr. ct. ash, equal to ·406 grm., gave with soda lime and subsequent ignition of the precipitate of chlorid of platinum and ammonium ·3265 metallic platinum.

IX. 1·2197 grm. containing 25 pr. ct. ash, equal to ·9147 grm. after mixture with nitrate of baryta and subsequent oxydation by fuming nitric acid, according to Weidenbusch's method of estimating sulphur,* gave a precipitate of ·0935 grm., which after ignition, treatment with dilute hydrochloric acid, and a second weighing, amounted to ·086 grm. sulphate baryta, corresponding to ·0118 grm. sulphur.

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* Annalen der Chemie und Pharmacie, vol. lxi, page 371.

	1.	2.	3.	4.	5.	6.
C	43·59	43·74	42·75	42·09	43·08	43·15
H	6·96	7·33	7·37	7·34	6·81	7·39
N	11·64	11·40	11·52	11·52	11·52	11·52
O	1·25	37·53	38·36	39·05	38·59	37·94
S	36·56					
	100·00	100·00	100·00	100·00	100·00	100·00

The above analyses lead to the formula $C_{36}H_{35}N_4O_{24}$.

	Average found.	Calculated.
C_{36}	43·06	43·29
H_{35}	7·20	7·01
N_4	11·52	11·22
$O+S_{24}$	38·22	38·48
	100·00	100·00

Emulsine loses its capacity of reacting upon amygdaline with formation of bitter almond oil and hydrocyanic acid after exposure to a boiling temperature in solution, but retains this property very distinctly after exposure in a dry state to a heat of 100° C. for hours in succession.

Berlin, Prussia, Dec. 1848.

Art. VIII.—*Observations on Terraces;* by James D. Dana.

(Continued from vol. vii, p. 14.)

There is one point in the history of terraces which was not dwelt upon perhaps with sufficient fullness in my former communication, and an additional paragraph is therefore here presented. But before entering upon it, I may make a few brief remarks on the observations by Mr. Chambers, in a preceding part of this volume.*

In my former article, no particular kind of terraces was described; those in view were such as Mr. Chambers mentions in his work, if I may judge from his descriptions, and his comparisons to the terraces of this country. The remarks offered were intended simply as a statement of the effects of an elevation in producing terraces of different kinds simultaneously,—a detailed enumeration of those tests, which might prove whether a deposit were marine or not,—and a notice of the mode of fixing the exact value of these different tests in the cases in view; and it was added that if no one of the tests of marine action could be detected in the course of one or two hundred miles along the length of a valley, we should hesitate before asserting that the deposits were marine. The evidence used for other strata is no

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* Page 33.

less needed here, especially if we consider the wide theory based upon the facts. And I see not, by what authority, a private "protest" can be entered against such a course of investigation. Marine relics are too common a proof of elevations of coasts in all climates to be pronounced necessarily absent upon an uncertain general principle.

An examination of American terraces, has led me to believe that in general, the terraced plain corresponds in its seaward slope with the descent of the river, although apparently horizontal. The most skillful use of the best instruments is often necessary to test the horizontality: for the descent of most of our rivers, for a considerable part of their course is less than one foot in a mile. The Connecticut, from Springfield to the sea, falls sixty-four feet, which is one foot a mile (not reckoning the irregularities of its line); deducting for Enfield Falls, thirty feet, it leaves only ½ a foot a mile. The same river at Hanover, 175 miles in a direct line from its mouth, is 365 feet above the sea; and deducting 30 feet for Enfield Falls, 50 feet for Hadley Falls, 70 for Miller's and Montague's, 50 for Bellows, and 36 for White River, and also deducting 30 miles in length for the space occupied by these several falls, it leaves for the rest of the descent about $\frac{9}{10}$ of a foot a mile. The Mississippi from the mouth of the Ohio to the Gulf of Mexico, a distance of 1100 miles, has an average descent of only 3½ *inches to the mile*, and the Ohio in 950 miles, averages but 5 *inches.*

Again, if horizontality is proved, as apparently in Glen Roy, *the question of a lake origin* comes up for investigation.

Hence the apparent horizontality insisted upon, may still require further examination; and if absolutely demonstrated for all the various terraces described, the question of origin yet remains open for investigation.

The proof as regards Scotland is not so satisfactory but that some prominent geologists who have been on the ground—Macculloch, Buckland, Agassiz, Mr. David Milne, and others—have taken a view directly opposed to that of Mr. Chambers.

The continuity of line between a seashore and inland terrace, cannot prove the seashore origin of the whole. I have already shown that the same elevation must produce simultaneously marine and river terraces. If the country forming the valley of the Mississippi were raised, from the Gulf of Mexico north, there would in some places be a terrace along the sea;—there would also be rapid excavations by the descending river encroaching on its planes either side, and causing ultimately new bottom-lands many miles in width, with a terrace slope as their boundary; and the terrace slope of the river would be necessarily continuous with the "benches" of land bordering the sea and estuary. Will this continuity prove the whole to have been a sea-beach? And at the mouth of the Ohio, will the height of the terrace plane *above the sea* be a measure of the elevation that took place? Terraces of the same epoch would extend up the Mississippi more or less interrupted, another 1000 miles and beyond; and *the height above the sea,* if the measure of the elevation, would prove an increase northward, while the actual fact might be a uniformity throughout, or even a somewhat less elevation to the north. The formation of wide bottom lands from such a cause cannot be doubted, for their actual existence about nearly all rivers proves it; other considerations may hereafter be brought forward by the writer to illustrate this subject.*

The point to which I would now direct attention is one of fundamental importance in these investigations. It is this:—The *deposition of the stratified material which is terraced, and the formation of the terrace plane and slope, are not necessarily of like origin.*

Whatever be the nature of the material that constitutes the Mississippi region, whether river detritus, accumulations by glacier action, or a filling in from the sea while the land was at a lower level, the river would flow on as now; and if an elevation were to take place, the material existing there would be terraced, whether of one or the other origin. As above explained, there might be terraces of river origin, although the material were from a marine or glacial source: and the evidence from the terraces with regard to amount of elevation would be the same in either case. Hence the question of the origin of the material and that of elevation are in part distinct. There may be river terraces, therefore, with the deposits either fresh or marine; but it still holds that those of sea-beach origin must admit of proof to this effect from some character, manifest in one place or another in the course of a distance of one or two hundred miles.

Here then is another point, complicating still farther the investigations respecting terraces. In the discussions upon drift,—which have referred in part to the very material that constitutes the upland terraces—geologists are divided among the following theories. 1. That of marine transport during submergence;—2. that of marine transport over the emerged land, in consequence of violent earthquake action;—3. that of lacustrine or river origin;—4. that of glacier origin;—5. (as we recently learn) that of sea-beach origin:—and the arguments for each hypothesis are strongly urged. It is hence obvious that there is the highest necessity, before deciding upon these subjects, that every possible aid in search of truth be employed.

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* See Report by the writer on Geol. Expl. Exped., pp. 659, 671.

It should hence be remembered that—

If the material is not marine in origin, in any part, it may be glacial, or lacustrine, or else a result of running fresh waters in one or another mode: and the terraces may be either river, lacustrine, or glacial terraces, and cannot be "sea margins."

If the material is of marine origin, it may be either of sea-beach or deep water formation, and the terraces may be either a result of action along sea margins, or estuaries, or rivers, or bordering lakes, or bounding glacial valleys. These are points for investigation which no protests can set aside.

ART. IX.—*On some principles to be considered in Chemical Classifications*; by T. S. HUNT, Chemist to the Geological Survey of Canada.

(Continued from vol. vii, ii ser., p. 405.)

IN illustration of this proposition, let us consider the basic relations of the different classes of coupled compounds—1st. Acids with alcohols; if in some cases it were difficult to determine which is the body losing the hydrogen replaceable by a metal, an examination of the ethers would readily remove the difficulty, for as already observed, those of the hydracids show that the acid is the species to which the ether is to be referred, and by analogy, all the ethers and vinic acids are to be regarded as species of the saline genus to which the forming acid belongs. In accordance with this deduction and with the law of basicity already cited, the ethers of monobasic acids are neutral, those of bibasic acids, with one equivalent of alcohol monobasic, and with two neutral, while a tribasic acid produces, with three atoms of an alcohol a neutral ether, and with one a bibasic vinic acid. In these the alcohol acts as a neutral body, and hence for phosphovinic acid $3+0-1=2$, but the alcohols are really in a feeble degree saline and monobasic, as is shown in such compounds as $C_2(H_5 K)O$ and the mercaptids; if they were to preserve this character in combination, the ether of a monobasic acid would be itself monobasic. Cahours has found that the ethylic and methylic ethers of salicylic acid, which is monobasic, are capable of exchanging an equivalent of hydrogen for potassium or barium, so that the salts thus formed are in fact the ethers of potassic alcohol and methol. These ethers do not possess the power of combining with ammonia, and are thus distinguished from ordinary monobasic acids; we cannot substitute NH_4 for H in alcohol, which seems to be the reason of this apparently anomalous behavior of these ether-acids with ammonia.

Acids with Ammonia and other alkaloids.—The relations of the amids to the ethers have been before noticed, as showing a close correspondence between the two classes of compounds; the law of their basicity is known to be the same as that of the ethers. The monobasic amid acids correspond to bibasic non-azotized ones, the bi-amids of which are neutral. The suggestion which M. Gerhardt with his usual profound sagacity advanced several years since, that all the azotized acids (the nitric ones excepted) were acid amids, is strongly supported by late researches.*

Ammonia like the alcohols, has the power of exchanging the whole or a part of its hydrogen for a metal, as in Kane's amidids of mercury, and such compounds as NK_3 and NHg_3, and we might therefore expect to find the amids occasionally exhibiting saline properties due to this; accordingly, Laurent has found that asparagine is capable of exchanging one equivalent of hydrogen for potassium, and Piria has described crystalline compounds with silver and copper of analogous constitution. Asparagine is the binamid of the bibasic malic acid, and should therefore in accordance with the general rule be neutral, while it is in truth monobasic; at the same time its acid characters are but feebly developed, when compared with proper acid-amids as the aspartic and oxamic acids, for the reason that they are only those belonging to ammonia. Certain anhydrid amids exhibit the same tendency to exchange their hydrogen for a metal, e. g., paramide, and prussic acid, which is the formic anhydrid amid. The anilids and naphthalamids, as far as examined, appear to be subject to the same laws as the amids.

Acids with Carbohydrogens.—The stronger mineral acids only, form combinations with these bodies; the sulphuric generally yields with one equivalent, a monobasic acid, in which an equivalent of its hydrogen is replaced by the elements of the hydrocarbon $-HO$, and a neutral body with two equivalents, e. g., benzene and naphthalene. These compounds, as M. Gerhardt has observed, are analogous to sulpho-methylic acid and sulphomethol.

Sulphomethylate,	$S(H(CH_3))O_4$
Sulphomethol,	$S(CH_3)_2\ O_4$
Sulphobenzite,	$S(H(C_6H_5-O))O_4$
Sulphobenzid,	$S(C_6H_5-O)_2O_4$

The products which nitric acid forms with an equivalent of these bodies throw much light upon the constitution of these and allied compounds; the first result of the action is generally the formation of a neutral compound analogous in composition to the sulpho-acids just mentioned. Benzene (C_6H_6) yields nitrobenzid ($C_6H_5NO_2$), which corresponds to nitric acid in which C_6H_5-O replaces H, thus $N(C_6H_5-O)O_3$. These analogues of the ethers sometimes regenerate the acid and organic substance

* See Piria on Asparagine, Am. Journal for Nov., 1848.

by the action of alkalies (as nitronaphthalene), but more frequently the decomposition is less simple. By the prolonged action of nitric acid aided by heat or the presence of concentrated sulphuric acid, the compound first formed reacts with another equivalent of the acid, eliminating a second time an equivalent of water; the nitric species indeed comports itself with the acid, in all respects like the normal one, and the product is still neutral. In like manner some monobasic acids, as the benzoic, yield with nitric acid, two or three acids, containing respectively one, two and three equivalents of the nitric elements. These are strictly monobasic, notwithstanding the apparent contravention of the law $S = \Sigma - 1$, and if we consider their constitution in accordance with the principle before laid down, we shall find that the second nitric body is to be regarded as a coupled compound of the first, and so on. Thus nitrobenzid being nitric acid where $C_6 H_5 - O$ replaces H or benzenic nitrate, binitrobenzid is nitrobenzenic nitrate, where $C_6 H_5 NO_2 - HO = C_6 H_4 NO$ replaces the hydrogen of a second equivalent of nitric acid; this being derived from a monobasic acid and a neutral body, is necessarily neutral. The same principle is applicable to the nitrobenzoic acids, as it is each time a monobasic acid which is coupled with the nitric acid; nitrophenisic acid contains the elements of three equivalents of nitric acid, and yet possesses but one equivalent of replaceable hydrogen, because the saline hydrogen of all these has been eliminated, and only the original saline atom of the phenol remains. Representing this acid as phenol, in which $NH O_2$ replaces H_2, thus; $C_6(NH O_2) O$,* it is difficult to see why it should not be tribasic.

The coupled acids which the sulphuric forms with many organic acids, are striking illustrations of Gerhardt's law; with one equivalent of a monobasic acid, the compound is bibasic, but with a bibasic acid as the succinic, it is tribasic; the elements of the succinic acid retaining in combination their saline capacity, while the sulphuric has lost one equivalent of its hydrogen. The ethers and ether-acids of these coupled bodies as the sulphacevinates of Melsens, show how far these principles may be extended in the study of organic compounds.

It now remains to consider the nature of that class of chlorinized compounds in which chlorine may be regarded as replacing hydrogen, equivalent for equivalent. The close analogies subsisting between the ethers of oxygen acids and the sulphuric and nitric copulates of the hydrocarbons being kept in view, we see in $C_2 H_5 Cl$, (acetene chlorè, Gerhardt,) the ether of hydrochloric acid, which is at the same time a chlorinized species of acetene, $C_2 H_6$.

The relation between phenol and benzene, is precisely similar to that which exists between alcohol and acetene, and the hydro-

* Precis, tom. 1ier., p. 97.

carbons are allied to certain oxygenized compounds, as H_2 is to H_2O. Alcohol with H Cl eliminates H_2O, and produces C_2H_5Cl, but if it were to eliminate chlorinized water (Cl H)O, it would afford normal acetene (C_2H_6). Phenol under certain circumstances may probably react with H Cl, and yield chlorinized benzene, C_6H_5Cl.* The monochlorinized compounds correspond to copulates of hydrochloric acid, and the products of the farther action of chlorine with the elimination of H Cl, are species related to the parent acid, as binitrobenzene is to nitric acid; chlorinized acetene is H Cl, in which $C_2H_6-H=C_2H_5$ replaces H, and bichlorinized acetene is equally H Cl where $C_2H_5Cl-H=C_2H_4Cl$ is substituted for the same atom.

The principles which we have attempted to develop in the preceding pages are dependent upon a more fundamental one which I have briefly announced in a late paper, and which assumes that the various saline forms are reducible to two, the types of which are seen in water H_2O, and the protoxyds M_2O, and in hydrogen H_2 or the metals M_2; the first includes all oxygenized acids and the second the hydracids. But as many neutral oxygenized compounds which do not possess the saline character are still derivations of acids which are referable to the type of H_2O, we may regard all oxygenized substances as belonging to this type. As nitric acid and alcohol are water, an equivalent of whose hydrogen has been replaced by non-saline elements, (NO_2 in the one case and C_2H_5 in the other,) and are necessarily monobasic, so is hydric ether, the result of the complete replacement of the hydrogen, a neutral substance.†

In the same way M_2 is the type of the hydracids in which one atom has been replaced by chlorine; of the metallic chlorids; of the molecule of chlorine Cl Cl; of the metals and their various alloys; and moreover it follows from the relations of H Cl to the chlorinized hydrocarbons, of all that numerous class of combinations which are composed of those two elements, as well as the alkaloids which may be regarded as amidized species of them and which are equally susceptible of substitutions by chlorine.

In considering the relations of the various ethers and the chlorinized species of the oxygen acids, the two formed seem so closely assimilated that it is difficult to discriminate between them,

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* This may probably be effected by distilling a sulphophenate with an alkaline chlorid; by substituting a nitrate or other salt, we should expect to obtain a series of compounds corresponding to ethers.

† Am. Jour., Sept., 1848, p. 173, and Memoirs of M. Laurent, An. de Chem. et de Phys., Nov., 1846. While nitric acid NHO_3 is $H(NO_2)O$, the result of the complete replacement of H will be $(NO_2)_2O$ or the unknown dry nitric acid, homologue of the so-called anhydrous phosphoric and arsenic acids, which are equally $(PO_2)_2O$, &c. The formation of the arsenic anhydrid by heat is evidently the reaction between 2 eq. of the acid eliminating an equivalent of water, $AsHO_3=(H(AsO_2)O+(H(AsO_2)O=(AsO_2)_2O+H_2O$.

and a farther inquiry shows that they are indeed the same, or rather that one is a simple derivative of the other. The relation is that which exists between alcohol and acetene, or water and hydrochloric acid. If a molecule of chlorine (Cl Cl) reacts with one of a metallic oxyd M_2O, it generates a chlorid in which one of the atoms of Cl is replaced by M, and a hypochlorite which is (Cl M)O. The origin of the form M_2O is then the replacement of M in M_2 by the elements of an oxygenized body – M; the reaction therefore eliminates two new bodies of the same forms as the originals.

It will be seen that I have in this exposition recognized the theory of double atoms first advanced by M. Ampère and since so ably supported by M. Laurent.* The idea which he at first applied to the reaction of chlorine and hydrogen, to explain the formation of hydrochloric acid in accordance with the received theory of double decomposition, is in fact the principle which governs all that class of reactions which have been considered in the present essay and which find their type in the mutual decomposition by which HH′ and Cl Cl′ become H Cl H Cl′.

The chlorids of bromine and iodine as $I Cl_5$, I have in the paper previously quoted, referred to a polymeric modification of this type which may be represented by M_8, to which belong also $P Cl_5$ and $As Cl_5$, while $P Cl_3$ and the corresponding compounds, are species of another polymere which is composed of two molecules or M_4. The existence of polymeric organic compounds being established, it might be expected that similar affinities would be operative among less complicated bodies and even among the elements themselves; but I believe the first application of the idea was in the paper already referred to, where an explanation of the anomaly in the density and combining volume of sulphur vapor was proposed, upon the ground that crystalline sulphur was a combination of these molecules of sulphur in one, whose equivalent as deduced from its vapor and the comparison of its atomic volume with that of oxygen was shown to be 48, (O=8), and its formula consequently S_3. The *allotropic* form of oxygen known as *ozone* was suggested to be a polymeric modification of the element corresponding to S_3 and SO_2, to both of which it seems allied by its properties.

I think that the application of a similar view will explain many if not all of the so-called cases of *allotropism*, which do not appear to differ from the phenomena characterized in organic chemistry by the terms *isomerism* and *polymerism*. Two states of the metal chromium have been distinguished; the one soluble in hydrochloric acid and the other resisting the action of aqua-regia.

* See his Memoir Recherches sur les combinaisons azotés, already quoted, Ann. de Chem. et de Phys., Nov., 1846.

The first corresponds to iron and the allied metals in their ordinary condition, while the second appears to be connected with M_2 which in permanganic and perchromic acids, is found equivalent to Cl. The *passive* state of iron induced by electricity and many other agencies, suggests itself as analogous to that of insoluble chromium.*

The constitution of gaseous nitrogen as I have shown in the previously quoted paper is probably NN, (N=7 – O=8,) corresponding to the two volumes of vapor, and differs in the condensation of its molecule from its congeners, phosphoric and arsenic in their ordinary condition. May not the allotropic condition of phosphorus alluded to by Berzelius, be an analogous molecular condition of this substance? The question would be solved by a determination of its density in that state.

The difference in the specific densities of the two crystalline forms of carbon, seems to indicate that the diamond has double the atomic weight of graphite, and there are reasons for supposing that charcoal is a still higher polymeric modification of the elementary carbon.† If these suggestions lead to an explanation

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* Those substances which are considered elementary may change their equivalents at the same time undergoing a corresponding change in their density, and as we obtain from the ordinary equivalent and density an idea of "*the volume of the atom*," we say of those forms having an increased density and a corresponding increase of equivalent (so that the atomic volume remains unchanged), that two or more of the ordinary molecules have united in one. This is illustrated in the case of sulphur, and also in those salts of mercury and copper where these metals unite in twice their ordinary equivalents. In the one *mercurecum* (Gerhardt) with an atomic weight of 100, (H=1) is the equivalent of H; in the other, *mercurosum* (G.) =200, enjoys the same power in combination. So of Cu *cupricum*, and Cu_2 *cuprosum*, atomic volume with it,‡ are cases in point, and we might say that the atom of iron has one-third the commonly received equivalent, and that Feβ is made up of two and Fe of three atoms of elementary iron. The so-called elements may then possess different atomic weights which enjoy a simple relation to each other, and in these different states exhibit very different characters. When we speak of one of these as containing two or three atoms of another form, condensed in one, it is only an expression, in accordance with previously existing ideas. We can no longer attach to the atomic weights of the supposed elements, an absolute value, and thus one of the characters which served to distinguish them from known compounds is rendered of no importance.

† The experiments of Mr. Hatchett, (Philos. Trans., 1805,) show that charcoal, by the prolonged action of nitric acid, is dissolved and converted into a soluble, astringent, azotized body, described by him as *artificial tannine*, which has all the characters of an organic substance of a pretty high equivalent. As the action of oxydizing agents seldom if ever results in the production of a body higher in the organic scale than the parent substance, and as we can scarcely expect the polymorphosis of elementary carbon under the circumstances to form an organic body, I am led to suspect that charcoal is a species of anhydrid derived from cellulose, possessed of a high equivalent, and capable under the action of an acid of taking up the elements of water to form a substance which by the fixation of nitric acid and oxydation, produces the substance in question.

The researches of Johnson upon paracyanogen, which is in fact a sort of azotized charcoal, are worthy of consideration in this connection. The body derived from charcoal has not, so far as I am aware, received any attention since the experiments of Mr. Hatchett; I have commenced an examination of it, and hope before long to determine something with regard to its real nature.

‡ This Journal for Nov., 1847, p. 405.

of the hitherto mysterious phenomena which have been designated as arising from *allotropic conditions* of the elements, they may not be deemed unworthy of notice.

Having grouped together under the saline type of M_2, with the oxygen type and their polymeres, by far the greater number of all the forms of matter with which our science is cognizant, we find still unclassified azote, phosphorus, arsenic and antimony, with carbon, boron and silicon. The first four constitute a well defined natural group, and the remaining are generally arranged together from the similarity in their physical characters as well as in their saline derivatives; this is remarkable in the borates and silicates. Silicon is related to the metals through columbium and titanium; these analogies are however found connecting in various ways the other groups, and there appear to be good reasons for making carbon, boron and silicon a fourth class, to which the submetallic bodies above mentioned, may perhaps be added.

This fourfold division of inorganic matter being established, it becomes desirable to find some significant terms which may serve to designate the several groups, and I would suggest the following as perhaps as little objectionable as any. The first four, of which water may be taken as the representative, is the *Hydristic;* the second, of which oxygen is the type, is the *Oxystic;* the third, after its most abundant species, is named the *Nitristic*, and the fourth, for a similar reason is called the *Silicistic* form.

Having in the previous pages advanced some of the principles which, as I conceive, are to guide us in chemical classification, and followed them out to their results, I leave the subject to the consideration of philosophers. Believing in their truth and their universal application, I shall be more than rewarded if the views here developed shall resolve in a single mind, some of the difficulties which environ the science, and shall tend in any way to direct attention to the great field for research which lies before the philosophic enquirer.

I have exposed without hesitation, what I conceive to be the fallacies of the schools of the day; but my object has been to show their merits rather than their defects, and to exhibit their real harmony with each other and with nature. The views which I have advanced, are in fact deduced in great part from the labors and investigations of Liebig, Gerhardt and Laurent, whose illustrious names will be enrolled in the history of the science of their age, as the Coryphæi of chemical philosophers.

Art. X.—*Thoughts on Ancient Metallurgy and Mining in Brigantia and other parts of Britain, suggested by a page of Pliny's Natural History;* by John Phillips, Esq., F.R.S., F.G.S.*

To one who meditates on the progress of natural knowledge, the difficulty of penetrating to a true estimate of its condition in past ages often appears unconquerable, except in cases which admit of the interpretation of ancient results by modern laws and theories. Once in firm possession of such laws, we enclose the old phenomena, so to speak, in a field to which are only such and such possible avenues, and thus can sometimes declare the very mode by which the alchemist was led to his golden error, and the Chaldæan shepherds to brighter truths. Without this principle of interpretation, many almost modern writers, nay authors of this very century, can sometimes not be understood. The laws of modern geology and zoology, for such there are, and well-founded too, are as much required to put a true construction on some of the writings of Lister and Linnæus, as the methods of Ray, Linnæus, and Cuvier are required for the just estimation of Aristotle. We shall probably find the darkest pages of antiquity to be precisely those which refer to subjects where our own knowledge is least clear, least collected into laws of phenomena, and most removed from laws of causation. Ought we not, before declaiming on the ignorance of the ancients, to be careful to make allowance for the differences of form in which knowledge presents itself at different periods, as well as for the incompleteness of *their* records, and the imperfection of *our* interpretations?

Pliny's Natural History appears to me to be precisely in the very position of difficulty which has been alluded to. Its vastness, variety, and seeming disorder, may well deter the most comprehensive master of modern science from duly weighing its mass, or even measuring its surface; and the evident incompleteness and almost hap-hazard character of its chapters are apt to disgust the student of special branches of science and art. Yet, probably, if for each important branch of human knowledge handled by Pliny, a special editor were set to work, well versed in the philosophy of his subject, Pliny would take a higher degree on examination, and the history of human knowledge be amended.

From the thirty-seven books of diffuse and erudite learning, the genuine work of Pliny the elder, let us fix on the part which treats of the nature of metals; and passing over his lamentations on the useless excess of gold and silver—which may be recom-

* From the Proceedings of the Yorkshire Philosophical Society for March, 1848; and here cited from the London, Edinburgh and Dublin Phil. Mag., April, 1849.

mended to the Chancellor of the Exchequer—his accounts of the uses and properties of gold, electrum,* chrysocolla, silver, quicksilver, stibium, scoria argenti, spuma argenti, minium, cinnabar, brass, cadmium, iron, and many compounds of metals, let us pause at the 16th chapter of the 34th book, which treats of the metals of lead, white and black.

"The most precious of these, the white, is called by the Greeks *κασσίτερος*, and fabulously declared to be sought for in isles of the Atlantic, to which it is brought in wicker vessels, covered with leather, (vitilibus navigiis corio circumsutis.) But now it is ascertained to be indigenous in Lusitania and Gallicia, in sandy surface soil, of a black color, and only distinguished by its weight. Small pebbles [of the ore] also occur principally in dried beds of streams. The miners [metallici] wash these sands, and what subsides they melt in furnaces.

"It is also found with the gold ores (aurariis metallis) which are called stream works (elutia), the stream of water washing out (eluente) black pebbles a little varied with white, and of the same weight as the gold. On this account, in the vessels in which the gold is collected, these pebbles remain with it; afterwards they are separated in the chimneys† (caminis separantur), and being melted are resolved into plumbum album.

"In Gallicia plumbum nigrum is not made, because the adjoining Cantabria [Asturias] so much abounds in that metal.

"Not out of white plumbum as out of the black can silver be extracted.

"To solder together [pieces of] plumbum nigrum is impracticable without [the use of] white plumbum, nor the white to the black without the addition of oil. Nor can [pieces of] white plumbum be soldered together without the aid of the black metal.

"That [plumbum] album was in esteem during the Trojan time Homer is witness, who calls it *κασσίτερος*.

"Of plumbum nigrum the source is double: either it comes from its own vein, without admixture, or grows with silver, and is melted while mixed with that metal. The part which is first liquid is called stannum,‡ that which flows next is silver, that which remains in the furnace galena,§ which is the third portion of the vein (or ore). This being again melted‖ yields plumbum nigrum, [the other] two parts [of the ore] being deducted."

* Gold with one-fifth of silver.

† What distinctive meaning should be attached to furnaces and camini is uncertain. It seems that the camini may indicate, if not what we call chimneys, at least cavities in or above the furnace.

‡ Analogous to this is the process of separating silvery lead from mere lead, invented by H. L. Pattison, Esq.

§ Lib. xxxiv, cap. 18. Est et molybdæna, quam alibi galenam vocavimus, plumbi et argenti vena communis.

‖ At the present day we should perform this melting of the residual 'galena' in the slag-hearth, with a flux.

This chapter is a text on which a 38th book of Natural History might be written, embracing the history or fable of the κασσιτέριδες, the ancient arts of metallurgy, and the eager trade in metals which allured the Phœnician sailors on the Atlantic, and led the Roman armies to Britain.

What is κασσίτερος, for which plumbum album is the equivalent? what is stannum, obtained from mixed ores of silver and lead? what is galena, elsewhere called molybdæna? (cap. 18.) We need not ask what is plumbum nigrum, for by that is clearly designated lead.

That κασσίτερος or καττίτερος was tin, appears to be generally allowed. The mineralogist and miner who know the mode of occurrence and character of tin ore, will have no doubt that plumbum album of Pliny is tin, and that author twice positively and expressly identifies this with κασσίτερος.

The uses to which Homer puts κασσίτερος in the thoraca and shields of Agamemnon, Achilles, and Asteropæus, and in the greaves of Achilles, are such as imply easy fusibility and ductility, and indicate that the metal was highly valued and almost precious.*

Virgil puts no tin into the arms of Æneas—perhaps the metal was then of too vulgar use—employed too much by tinkers—to be fit for a heroic shield. Electrum is substituted, and iron is the staple article in the Vulcanian workshop, as brass was in that of *ἩΦΑΙΣΤΟΣ*, 1000 years before.

The picture of the great artist—the Tubal Cain of the west, the cunning worker in metal, who melted, alloyed, inlaid, carved, and polished his work—whose multiplied bellows breathed at the will of the god softly or fiercely—whose brass was hardened to wound, or tempered to bend,—is perfect, and might be paralleled on a small scale till a few hundred years in the famous smiths of

* The following are the principal passages in the Iliad where κασσίτερος is mentioned:—

XI. 25. In the thorax of Agamemnon were ten plates (οἶμοι) μέλανος κυάνοιο, twelve of gold and twenty of κασσίτερος.

XI. 34. In the shield of Agamemnon were twenty white bosses (ὀμφαλοὶ) of tin, and in the middle one of κύανος.

XVIII. 474. For the shield of Achilles ἩΦΑΙΣΤΟΣ throws into his crucibles brass, unconquered κασσ τερος, honored gold, and silver.

XVIII. 564. He pours the tin round the border.

XX. 270. In this shield were five plates; the two exterior ones brass; within these, two of κασσίτερος; and in the middle of all, one of gold.

XVIII. 612. The greaves of Achilles are made of soft κασσίτερος.

XXII. 503. The chariot of Diomedes was adorned with gold, and κασσίτερος.

XXIII. 561. In the brazen thorax of Asteropæus the ornament was of glittering κασσίτερος.

What is here called κύανος, and is apparently a much-valued substance, is difficult to say. From its color, lapis lazuli, turquois, and carbonate of copper have been suggested. As it is only mentioned in connexion with the arms of Agamemnon, which was the gift of Cinyras king of Cyprus, the latter mineral may be thought to have the best title, especially if, as at Chessy, it occurs blue in Cyprus.

Wales, who made their own iron, and were by the laws of that country, as renewed by Howell Dda, allowed to sit next the sacred priest.

Why Pliny treats as a fable the story of the Cassiterides yielding tin, is somewhat difficult to say. He classes the Cassiterides with Hispania, book iv. cap. xxii. (ex adverso sunt insulæ,—Cassiterides dictæ Græcis, a fertilitate plumbi,) and speaks of Mictis (on the authority of Timæus the historian) as six days' sail from Britain, and as yielding candidum plumbum, iv. cap. 16. If the Cassiterides are the Ocrynian Promontory and the Scilly Isles, from which, as recorded by Strabo, the Phœnicians drew their tin, (Ἴκτις of Diodorus, Μίκτις of Timæus, and Οὐῆκτις of Ptolemy being Vectis or Wight, from which the tin was carried through France to Marseilles,) we may suppose that in the early period the only route for the tin of Cornwall to the Mediterranean was by sea to the western parts of Spain; but that in the latter period the track by land through Gaul to Massilia was preferred, and the old trade had become a tradition which Pliny chose not to adopt from Strabo, who is never quoted on this subject by the author of the *Historia Naturalis*, but may be obliquely and slightingly alluded to. Whether tin occurs at all in any part of the Spanish Peninsula can hardly be doubtful after the assertion of Pliny. He had been procurator in Spain, and by his intimacy with Vespasian* must be supposed in position to learn much of Britain, from the despatches of Petilius Cerealis, Ostorius Scapula, and Agricola. But he was suffocated by the fumes of Vesuvius in '79, one year after the appointment of Agricola to Britain—and for the greater part of his literary life, Britain was a scene of never-ending war and confusion. Besides this, the Cornish promontory appears to have been at no time much occupied by Roman stations, or traversed by roads; and it may be thought to have had then, as afterwards in Saxon and Norman times, a history and commerce quite distinct from and little known to the Belgic settlers in Albion. He might be mistaken respecting Britain, of which perhaps he could know only Albion; but his positive assurance of the occurrence of tin in Spain is confirmed by a passage in Bowles's Natural History of Spain, and, as I hear from Mr. Kenrick, by a later German writer (Hopfensach); it occurs, in fact, according to one of our best books of mineralogy,† in beds in the mica schist of Gallicia. Oxyd of tin has been found, besides, on both sides of the Erzegebirge in granite, at Puy de Vignes (Haute Vienne), also in granite in Wicklow, on the east coast of Sumatra, Siam and Pegu, and in Banca and Malacca. It has been found in Mexico, Chili and Greenland, and mixed with other matters in Finland and Sweden.

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* Accessit imp. A. D. 69.

† W. Phillips, 1823.

Upon the whole, the case is probably thus. It is the old Phœnician trade, destroyed with Carthage, which Strabo describes, and Pub. Crassus went to explore in the κασσιτέριδες. Diodorus Siculus narrates the course of trade in the days of Augustus from Ictis, when Gaul offered an easy route to the Mediterranean; but 100 years of war and commotion interrupted this trade of Cornwall with the East, and Pliny was suspicious of the fables of Greece, and knew that tin was obtained in Spain. Notwithstanding this fact, it appears that Cornwall and the Asiatic Isles have been the principal, almost the only sources of the tin of the ancient world, that of Zinnwald being quite unknown till a much later date.

Stannum is evidently an alloy of an argentine or tin-like aspect—a variable pewter—a metal more easily melted than copper, for the lining of which it was much used in Pliny's days to obviate the danger of cupreous solutions. This process we now call tinning; and stannum,* with its variable meanings, is perhaps the common parent of the French *étain*, meaning as often pewter as tin; and of the German *zinn* which like tin in the English workshops, is used sometimes for pewter when lining vessels, and solder when covering surfaces which are to be joined. Our German silver, Britannia metal, &c., belong to this class. The process of illination with stannum must have been well executed to justify the exclamation of Pliny, that it did not augment the weight of the vessel to which it was applied. The Brundisian specula made of it yielded to silver, indeed, at last; but they are declared to have been of admirable efficiency.

Stannum, then, is an alloy of tin with lead, tin with brass, tin with antimony, lead with silver, or other variable mixtures of metals often associated in nature.

Pliny mentions adulterate or alloyed kinds of stannum, composed of one part *white brass* to three parts of candidum plumbum; of equal weights of candidum and nigrum (which is called argentarium); of two parts of nigrum and one of candidum (called tertiarum); with this last lead pipes are soldered.† Fraudulent dealers add to the tertiarium equal parts of album, call it *argentarium*, and with it plate or line other metals.

He gives the prices of these compounds and those of pure album and nigrum; the former twenty, the latter seven denarii for 100 lbs.

Plumbum album, he says, is rather of an arid nature; the nigrum is entirely humid; "therefore the white is of no use unless

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* Pliny's notices of stannum are frequent. See Hardouin, vol. ii, 429, 22; 528, 7; 530, 30, 31, &c.

Stanno et ære mixtis, 627, 11—illitum æneis vasis saporem gratiorem facit, 669, 14—discerni vix possit ab argento, 669, 26—æramentis jungitur, 669, 11.

† Hoc fistulæ solidantur. This is the solder of our tinmen.

it be mixed with another metal. Silver cannot be leaded (lined) with it, it will be melted first."...."It is affirmed that if there be too little nigrum mixed with the album, the silver will be corroded by it. Album is melted into brass-work (inlaid, an invention of Gaul,) so that it can hardly be known from silver—these works are called Incoctilia" (silvered.) He then speaks of the application of this invention to the trappings of horses and carriages, and other curious productions of Alesia and the Bituriges, a subject which our esteemed Kenrick has lately handled with his usual felicity. One of Pliny's sentences is remarkable as narrating a class experiment fit for a chemical school: "Plumbi albi experimentum in charta est, ut liquefactum pondere videatur, non calore, rupisse."

The meaning seems to be, that the metal is fluid at so moderate a heat as when fused to break by its weight, not burn by its heat, the charta on which it is poured. Tin melts at 440° to 442°; lead at 612°.

What follows is a very important passage: "India neque æs neque plumbum habet, gemmisque suis ac margaritis hoc permutat."

May we be justified by this sentence in refusing to credit the supposition that tin (plumbum album) was brought overland or by other routes from the Asiatic Isles and shores towards Western Europe? If so, Cornwall chiefly, if not wholly, supplied the tin which entered so many ways into the comforts and necessities during peace and war of all the nations surrounding the Mediterranean and Euxine, Baltic and German Ocean; in fact, the world, as distinctly known to the Roman geographers.

Let us now inquire into the means whereby the ancient people reduced the metals which they were so earnest in seeking across mountains and oceans at the point of the sword. To confine the inquiry within reasonable limits, we shall speak chiefly of tin and lead, the only metallic products, as it appears, which were regarded by the ancients as abundant in Britain. [Iron is mentioned by Cæsar as of limited occurrence.]

Gold, the most widely if not most abundantly distributed metal—found near the surface of the earth, in a pure and malleable state, easily fused, uninjured by fusion—was probably the metallic substance on which the earliest processes of fire were tried, and they could not be tried unsuccessfully.

Tin, the ore of which has been found at the surface in many situations with auriferous sand and gravel, cannot have been long unknown to the gold-finders of the East and the West. Some one of the many accidents which may or rather must have accompanied the melting of gold, would disclose the nature of the accompanying white metal, whose brilliance, ductility, and very easy fusibility, would soon give it value.

The melting of *tin ore* is, however, a step in advance of the fusion of *native gold*. The gold was fused in a crucible (xxxiii, p. 617, Hard.) made of white clay,* which could stand only the heat and the chemical actions which that generated: but tin ore would in this way of operation prove totally infusible. It must be exposed at once to heat and a free carbonaceous element. The easiest way of managing this is to try it on the open hearth. Perhaps some accidental fire in the half-buried bivouacs of the Damnonii may have yielded the precious secret. As to the fuel, we are told that pine-woods were best for brass and iron, (Hard. xxxiii, p. 621;) but the Egyptian papyrus was also used, and straw was the approved fuel for gold. In the metalliferous country of Cornwall and Devon, peat is plentiful; and an order of King John (1201) allows the miners to dig tin, and turves to melt the tin, any where in the moors, and in the fees of bishops, abbots and earls, as they had been used and accustomed. (Confirmed by Edward I, Richard II. and Henry IV.)†

These and other singular privileges, extending as far as the land on which the crown claimed rights, are long anterior to the other rights of property in Cornwall, Mendip, Derbyshire and the Forest of Dean, and go far to justify the supposition of our modern mining laws, being a relic of Roman, or perhaps of earlier than Roman times.

As the bellows was known at least 1000 years before Pliny, we have here all the materials for a successful tin smelter's hearth. If the smelting work was on waste land, and a little sunk in the ground, we recognize the old 'bole' or 'bloomery' of Derbyshire, now only a traditional furnace, but anciently the only one for the lead and iron of that country.

Pure tin once obtained, there must intervene a long series of trials and errors before its effect in combination with lead, brass, silver, &c., could be known; before the mode of conquering the tendency to rust in the act of *soldering* could be discovered; oil being in this respect as valuable to the tinner as artificial chrysocolla was to the jeweller and goldsmith, (xxxiii, p. 621, Hard.) From all this, it follows that the smelting of tin might be, and probably was, performed by the inhabitants of the Cornish peninsula. This art they may have brought from the far east; Phœnicians may have taught it them; but all the accounts of the ancient tin trade represent the metal, and not the ore, as being carried away from the Cassiterides. Diodorus mentions the weight and cubical form of the tin in blocks, carried from Ictis to Marseilles and Narbonne; and Pliny says of the Gallician tin, that it was melted on the spot.

(To be continued.)

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* Such as now is called Cornish clay, for example.

† De La Beche, in Report on Geology of Cornwall.

ART. XI.—*Chemical Examination of Algerite, a new mineral species;* by T. S. HUNT, *of the Geological Commission of Canada:* including a description of the Mineral, by F. ALGER, Esq. (Read before the Boston Society of Natural History by JOHN BACON, Jr., M.D.)

THE mineral here described was placed in my hands by Mr. Alger, more than a year since, with the following description. "It is found in the town of Franklin, Sussex county, New Jersey. The crystals are imbedded in a white crystalline limestone, and are without any accompanying minerals excepting a few disseminated scales of graphite. They are occasionally two inches in length and rarely three, and are never more than one-eighth of an inch in thickness. Like sillimanite and scapolite they are frequently curved. They occur as single individuals and never in groups or radiating masses. When taken from near the surface, the color is a deep brownish-yellow, which is evidently due to their partial decomposition. Those found at the depth of twelve inches or more, are yellowish-white or straw-yellow, sometimes with a greenish shade; in a few instances I have found them perfectly colorless and possessing a good degree of translucency. Even the dark yellow crystals, when not decomposing, are slightly translucent, and they then bear a striking resemblance to chondrodite, with which the mineral, when first obtained in a few fragments, was supposed to be identical. It has also been referred to scapolite and spodumene, but it differs from both of these in form and hardness, as well as in other essential characters. In fact its hardness is even inferior to that of laumonite in fresh crystals."

"I believe that Prof. Nuttall was the first mineralogist who expressed the opinion that this mineral might prove to be a new species, but I am not aware that he ever entered into any investigation of its character to satisfy himself upon this point, and for the last ten years, it appears to have been entirely overlooked, the locality even not having come under the cognizance of any mineralogist since his visit to it, until recently explored by myself. The crystals are rhombic prisms; the faces M and M′ inclining to each other at an angle of about 94°, as determined by the common goniometer. In no case have I found an individual, having distinct terminal or basal planes by which to determine the angle of P on M, but an oblique termination of the prism is clearly indicated both by its natural joints and cleavage, so that we have an oblique rhombic prism as the primary form; the accurate measurements of which, farther examination must determine. None of the faces are sufficiently brilliant for the reflecting goniometer, although the imperfect cleavage surfaces which may be obtained, parallel with the lateral planes of the prism, sometimes possess considerable lustre; they present a pearly reflection in spots, the prevailing lustre being vitreous. In its general aspect, when taken from near the surface, the mineral would be described as without lustre and transparency.

"The only modifications of the primary, which have been observed, are the replacement of the oblique and lateral edges of the prism by single planes; they exhibit no striæ."

The crystals are very sparsely disseminated through the coarsely crystalline limestone, and it was with difficulty, that I could obtain sufficient for the purposes of analysis. Those exposed to the weather had become quite friable from partial decomposition, and the larger crystals were more or less interpenetrated by the matrix which is a pure calcareous spar.

The specific gravity of four light-colored translucent crystals which had been selected with great care and weighed ·2685 grammes, was found to be 2·697, while 1·8 grammes of fragments gave the number 2·712; and some coarser crystals were found to have a specific gravity of 2·948. The hardness when unaffected by exposure is 3–3·5 (Alger); it is brittle, easily separated into fragments. Before the blowpipe it intumesces considerably, and at a high temperature fuses with phosphorescence into a white porous enamel. Pulverized and heated in a tube it gives off abundance of water; the powder moistened with a solution of nitrate of cobalt and heated on platinum foil, fuses into an ultramarine-blue frit.

The crystals selected for analysis were hard, semi-translucent and undecomposed; their powder even when elutriated and carefully dried was of a buff color which was not changed by ignition. The action of hydrochloric acid upon it at first evolves a little carbonic acid gas from the intermixed calc spar; by digestion it takes up a portion of potash, alumina, iron and magnesia, while a white granular residue remains. It is however impossible in this way to effect a complete analysis of the mineral, for even after long digestion the decomposition is found to be very incomplete. It was accordingly necessary to have recourse to fusion with an alkaline carbonate; the qualitative analysis thus effected, showed the presence of silica, and alumina with small quantities of iron, magnesia and lime; the iron probably exists as peroxyd from the color of the mineral, while the lime is evidently present as a carbonate from the fact that it is at once taken up by hydrochloric acid with effervescence. Another portion of the mineral decomposed by hydrochloric acid, in Laurent's apparatus, gave a large portion of potash, mixed with a little soda; no lithia could be detected in the alkalies.

The quantitative analysis effected by the process above mentioned, gave the following results.

Silica,		49·82		contains oxygen 26·60
Alumina,		24·91		
Peroxyd of iron,		1·85		
Magnesia,		1·15		
Potash, Soda-traces,		10·21		contains oxygen 21·11
Water,		7·57		
Lime,	2·20	3·94		
Carbonic acid,	1·74			
		99·45		

The composition of the mineral, deducting the carbonate of lime, is evidently a hydrated silicate of alumina and potash, in which small quantities of magnesia and iron, replace in part the alumina and water. Representing $Al_{\frac{2}{3}}$ (aluminicum) as $Al\beta$, and $Fe_{\frac{2}{3}}$ (ferricum) as $Fe\beta$,* we have, taking silica as $Si\,O_3$ and considering the Mg as replacing in part H and $Fe\beta$, the following formula as very closely expressing its constitution, $5Si\,O_3 + 4HO$, KO, $6\frac{6}{16}$ $Al\beta O$, $\frac{4}{16}$ $Fe\beta O$ or $5Si\,O_3 + 12MO$, which if we take silica as Si O is evidently at once brought to $Si_5\,M_4\,O_9$, or in M. Gerhardt's notation $Si_5\,M_8\,O_9$, which is one of the typical forms which M. Laurent has deduced from his researches on the natural silicates. This requires a ratio between the oxygen of the silica and that of the other oxyds of 5 : 4, and that of the silica being 26·60, theory demands for the bases 21·28 while experiment gives 21·11. Although it will be difficult to arrange the elements found, in a satisfactory manner, according to the ideas of the dualistic school, this close correspondence establishes beyond a doubt the type of the compound.

I have deducted the carbonate of lime and determined the composition of the mineral for 100 parts, and then in accordance with the above formula calculated its composition according to theory. The two results are subjoined.

	Found.		Calculated.	
Silica,	52·28		52·08	
Alumina,	26·08		26·11	
Potash,	10·69		10·88	
Peroxyd of iron,	1·93	11·05	2·45	10·78
Magnesia,	1·20			
Water,	7·92		8·33	
	100·10		99·85	

The attempts to represent the composition of the natural silicates in accordance with the dualistic system, have tended perhaps more than anything else, to show its inadequacy to the

* Am. Jour. of Science, vol. iv, p. 407.

wants of the science. The unnatural complications of atoms which present themselves to the chemist in the usual mineralogical formulas, suggest that we are yet far from the simplicity of nature. In accordance with the unitary system on the contrary, M. Laurent has shown, that by considering the ratio between the oxygen of the silica and that which is contained in the bases present, and keeping in view two simple principles; first, that in their peroxyds, the metals replace hydrogen in two-thirds their ordinary equivalent, and second, that the molecules of a compound are divisible to an unlimited extent, we may reduce all the mineral silicates to a few simple forms.*

In the calculation of a formula like the above, it is necessary to keep in view this divisibility of molecules and also the fact that H, Mg, $Al\beta$, Fe, $Fe\beta$, K, and other metals, may replace each other to any extent. The $Fe\beta O$ and MgO, which in the calculation are for convenience represented together, supply in the mineral the deficiency which appears in the quantity of water, as well as the fractional equivalent assigned to the alumina.

The mineral above described, from its hardness and specific gravity is evidently to be referred to the order *zeolite.* In its density it approaches datholite and prehnite, to which it is much inferior in hardness, while from the rare species, edingtonite, to which in hardness and density it is closely allied, it is distinguished by its crystallization. Under these circumstances, I offer it as a new mineral species which will take a place by the side of edingtonite; and to connect with his favorite science, the name of one who is among its most successful cultivators, I propose for it the designation of *Algerite.*

Montreal, C. E., May 5th, 1849.

SCIENTIFIC INTELLIGENCE.

I. Chemistry and Physics.

1. *On the Fatty Acids of Castor Oil;* by M. Saalmüller, (Chem. Gazette for Feb., 1848; from Liebig's Ann., lxiv, p. 108.)—The author has submitted to examination the products of the saponification of castor oil, and has corrected the results of Bussy and Lecanu, pointing out the probable sources of error in their investigations. According to him, the oil yields beside glycerine, a mixture of a fluid fatty acid with a crystalline one which may be separated by cold. When purified, so as to burn without residue, it had the melting point and composition of *stearic acid.* Another specimen of the oil furnished a solid acid which

* Compt. Rendus de l'Acad., t. xxiii, p. 1050, et t. xxiv, p. 94. See also Am. Jour. of Science, vol. v, p. 405.

resembled palmitic acid, but differed in its melting point which was constant between 140°–144° F.

The fluid portion could not be separated into different acids as MM. Bussy and Lecanu had found; its lead salt was almost entirely soluble in ether. This solution decomposed by hydrochloric acid, furnished an oily acid which was obtained pure by the process employed by Guttleib in his fine researches on oleic acid. This consists in combining it with ammonia and precipitating with chlorid of barium; the baryta salt is dissolved by a very gentle heat in strong alcohol, and is deposited on cooling in granular crystals which are purified by repeated crystallizations. In this way a salt of constant composition is obtained, which by decomposition yields an acid to which the name of *ricinoleic* is applied. It forms a syrupy liquid, inodorous, but having a disagreeable acrid taste. Its sp. gr. at 59° F., is ·940; between 14° and 21° it forms a granular mass; it mixes in all proportions with alcohol and ether, and the solutions have an acid reaction, decomposing the alkaline carbonates. It does not absorb oxygen from the air; it is decomposed by distillation, but neither in the resulting product nor in those of the distillation of the oil itself, could sebacic acid be detected. The composition of this acid, as determined by its analysis and that of its various salts, is represented by the author as $C_{38}H_{35}O_5+HO=C_{19}H_{36}O_3$. T. S. Hunt.

2. *On Taurine and a substance isomeric with it;* by J. Redtenbacher, (Liebig's Ann., Jan., 1848.)—When taurine is dissolved in caustic potash and the solution cautiously evaporated to dryness, all the nitrogen is evolved as ammonia without any carbonization of the mixture. On dissolving this in water and distilling with dilute sulphuric acid, the distillate contains along with sulphurous, acetic acid, and only sulphate of potash remains in the retort. Taurine, which has the formula $C_4H_7NO_6S_2$, contains the elements of one equivalent of aldehyde, one of ammonia, and two of sulphurous acid; the metamorphosis under the oxydizing action of potash is therefore easily understood. M. Redtenbacher was hence led to expect the artificial formation of taurine, by passing sulphurous acid gas in a carefully cooled solution of aldehyde-ammonia in alcohol. When the solution becomes acid, it begins to deposit a white crystalline substance which when washed with alcohol and dried in a vacuum, forms delicate needles that have an acid reaction, and show by the action of acids and alkalies the presence of sulphurous acid, ammonia and aldehyde. It is readily decomposed by exposure to the air, and is very soluble in water and dilute alcohol, but the solutions on evaporation evolve sulphurous acid, and the salt cannot be obtained again from them. Its analysis as well as its reaction, show that it is a *bisulphite of aldehyde-ammonia*. $C_4H_4O_2, NH_3+2SO_2=C_4H_7NO_6S_2$. It is consequently isomeric with taurine, and as the author observes, may differ from it as cyanate of ammonia does from urea. T. S. H.

3. *On Carbothialdine, a new organic base;* by Prof. J. Redtenbacher and Prof. J. Liebig.—The derivatives of aldehyde-ammonia, have already embraced two new alkaloids besides the isomere of taurine [above described]. In addition to these the present memoir has made us acquainted with a new sulphureted alkaloid, to which the authors

have given the name of *carbothialdine.* When pure aldehyde-ammonia is dissolved in alcohol and sulphuret of carbon added, the mixture loses its alkaline reaction, becomes warm, and in a few minutes deposits shining white crystals, which when washed with alcohol are pure carbothialdine. It is nearly insoluble in water, and cold ether and alcohol, but dissolves in boiling alcohol, and is deposited on cooling without change. When oxalic acid and ether are added to the solution, an oxalate of carbothialdine is deposited in slender white needles. The new base dissolves in muriatic acid and forms a hydrochlorate, which is slowly decomposed at the ordinary temperature, and by boiling, is resolved into sulphuret of carbon, chlorid of ammonium and aldehyde.

The formula deduced from analysis is $C_5\,H_5\,NS_2$, and it is derived from the elements of one equivalent of aldehyde-ammonia, and one of bisulphuret of carbon, by the abstraction of the elements of two equivalents of water.

[This new alkaloid is isomeric with pyrotartaramid, which is a homologue of oxamid, but the results of decomposition by acids show that in constitution it is not allied to the pyrotartrates.] T. S. H.

4. *On the action of Chlorine upon Benzoate of Potash;* by E. St. Evre, (Chem. Gazette, April 15th, 1848; from Compt. Rendus, vol. xxv, p. 912.)—When chlorine gas is passed into a strong alkaline solution of benzoate of potash, an abundant disengagement of carbonic acid gas takes place after some time, with the formation of chlorid of potassium, indicating a partial oxydation of the benzoate. The result of this is a new acid which is separated from the potash salt by sulphuric acid; it is volatile and crystallizable, and fuses between 176° and 182°. Its analysis, with that of its silver salt, lead to the formula $C_{12}\,H_5\,Cl\,O_4$ or $C_6\,(H_5\,Cl)\,O_2$ in M. Gerhardt's notation, evidently corresponding to a normal species $C_6\,H_6\,O_2$, which differs from phenol (carbolic acid) as acids do from aldehydes, by one equivalent of oxygen; this unknown species the author has designated as phenic acid, and the present compound is mono-chlorophenic acid. Like the analogous monobasic crystallizable acids containing O_2, it should yield by the action of caustic alkalies a hydrocarbon *phenylene.*

M. St. Evre has obtained the mono-chlorinized species, $C_5\,(H_5\,Cl)$. This by the action of nitric acid affords a nitric species $C_5\,(H_4\,Cl\,NO_2)$, which by the action of hydrosulphuret of ammonia is converted into a chlorinized alkaloid $C_5\,(H_6\,Cl)\,N$ which corresponds to nicotine. If then we could by the action of an amalgam of potassium upon chlorophenic acid obtain the normal compounds, it would enable us to form nicotine artificially. T. S. H.

5. *On the identity of Picric, Nitrophenisic and Chrysolepic Acids,* (Jour. de Pharmacie, Oct. 1, 1848, p. 318.)—This long disputed question has at last been settled by Prof. Marchand, by the careful examination of their salts as well as a crystallographic examination of the crystals of chrysolepic and picric acids, which Mitscherlich has shown to be identical in form. These results are further confirmed by the conclusion of M. E. Robiquet, deduced from the study of their lead-salts. T. S. H.

6. *On the analysis of some of the Sulphur Acids;* by MM. Fordos and Gelis, (Annales de Chim. et de Phys., Jan., 1848.)—The process for the analysis of some of the lower sulphur acids, by means of chlorine, is not only tedious but liable to error when the acids are readily decomposed. The use of standard solutions having suggested itself to the authors—they tried permanganate of potash and chlorid of gold without success, but at last found every thing that could be wished in the hypochlorites used as decomposing agents.

All the lower sulphur acids, with the single exception of the hyposulphuric, are immediately oxydated by the hypochlorites, and an excess of the reagent is not required.

Dilute solutions of potash or soda saturated with chlorine—hypochlorite of soda obtained by double decomposition or even solution of chlorid of lime will answer for the reagent. Hyposulphite of soda, being easily obtained in a state of purity, answers perfectly as a test of the strength of the reagent—1 part of this salt requires for its oxydation 1·14 of chlorine—the liquid containing this quantity may occupy 50 divisions of the volumeter.

About 1½ gr. of the salt to be analyzed should be dissolved in 1000 times its weight of water—when the decomposition is complete, the smell of the hypochlorite is considered a sufficiently accurate test of excess. The divisions then are to be read off and give at once the quantity of chlorine used. Indigo may be used as in ordinary chlorometric analysis—but in this case the liquid should be acidulated or the indigo may be attacked in preference to the sulphuric acid. If the solutions are neutral, some of the hypochlorite should be added before the acid.

This mode of analysis is suggested as suitable for the lower acids of phosphorus, arsenic and antimony, &c. Hyposulphite of soda is also proposed as a substitute for arsenious acid in ordinary chlorimetry.

G. C. Schæffer.

7. *Ink for Steel Pens;* by M. Runge, (Polyt. Jour. in Chem. Gaz.)—Ten parts of logwood are to be exhausted with eighty of boiling water. To the solution one thousandth of its weight of yellow chromate of potash is to be gradually added—the liquid turns brown and at last blue black—no gum is needed, and the ink is not removed by soaking in water. G. C. S.

8. *On the Application of Liquid Hydrocarbons to Illumination;* by C. B. Mansfield, (Chem. Gaz., May, 1849.)—The fluid called by the author benzole, obtained from coal, tar, or any other volatile hydrocarbon, may be used for this purpose. Through this liquid is to be conducted common air or steam passed over coke, when the air or gas so treated becomes fitted for burning, and gives out a clear white light. Some precautions are to be taken to prevent the evaporation of the fluid, from lowering its temperature below that of the air, which ordinarily is the proper temperature for the fluid. When common air is used, the holes must be larger than in gas jets. The advantages of this mode of illumination are simplicity of apparatus, perfect cleanliness and safety, and great brilliancy of the light. Several years since an apparatus on the same principle was exhibited in this country—spirits of turpentine were

wholly or in part used. The light seemed equal to that from an equal number of gas jets, and was remarkably white. G. C. S.

9. *On a new Acid of Sulphur;* by MM. FORDOS and GELIS, (ibid.)—M. Plessy has recently announced the discovery of several new sulphur acids, but the uncertainty of the analysis left a doubt upon their existence. These acids were supposed to be formed by the reaction of sulphurous acid in solution upon proto- and perchlorid of sulphur. In the present memoir it is conclusively shown that the product is the same in both cases, and if time for spontaneous decomposition is not allowed, the salts of the new acid (and there is but one) may be obtained in a state of almost perfect purity.

To a given quantity of solution of sulphurous acid, one-tenth its weight of perchlorid of sulphur is to be added—the solution, evaporated to one half, is to be saturated with carbonate of lead, to remove sulphuric and hydrochloric acids. The chlorid of lead in solution is thrown down by alcohol. The lead is next precipitated by sulphuric acid and the liquid filtered and saturated by the carbonate of barytes. The filtered barytic solution precipitated by absolute alcohol furnishes the new salt. The salts of this acid are $S_5\,O_5\,MO$. The same formula was assigned by Wackenroder to a sulphur acid formed by the action of sulphureted hydrogen upon solution of sulphurous acid,—although no analysis was made, it now appears that the formula is correct and that the same acid is formed under these very different circumstances. This acid completes the series containing 5 equivalents of oxygen, for which apart from theoretical considerations, Messrs. F. and G. propose retaining the names proposed by Berzelius. We have then—

Dithionic acid,	$S_2\,O_5$	hydrosulphuric acid of Gay Lussac and Walter.
Trithionic	$S_3\,O_5$	sulpho-hyposulphuric of Sanglois.
Tetrathionic	$S_4\,O_5$	first acid of Fordos and Gelis.
Pentathionic	$S_5\,O_5$	new acid of " "

The pentathionate of baryta is white, and can hardly be distinguished from the tetrathionate, but by analysis—it is however more soluble and more easily decomposed; a solution of it is precipitated yellow by nitrate of suboxyd of mercury. Chlorine and hypochlorites transform it at once into sulphate; permanganate however retains its color and only decomposes in presence of much acid. Iodine is not taken up by it. Heat evolves sulphur and sulphurous acid and sulphate of baryta remains. The dilute free acid is very alterable, acid and bitter, and reddens litmus.

The baryta salt contains 2 equiv. water, which may be wholly or in part replaced by alcohol.

The new acid, it is to be remarked, is isomeric with the hyposulphurous ($S_2\,O_2$), but its capacity of saturation, &c., is very different.

In conclusion the authors remark that while studying the chlorids of sulphur, they have ascertained that they correspond in composition with the acids of the thionic series—taking Cl for O. G. C. S.

10. *On a new Borate of Soda;* by Dr. P. BOLLEY, (Liebig's Ann., Oct., 1848, in Chem. Gaz.)—The evolution of ammonia from the mixed

solutions of borax and sal-ammoniac led to the suspicion that a new borate of soda might be formed.

One equivalent of chlorid of ammonium and two equivalents crystallized borax were dissolved and boiled as long as ammonia was disengaged. The filtered solution was evaporated very slowly—the first crops of crystals were borax and the syrupy residue afforded no more crystals—however by very slow evaporation and recrystallization, hard milk-white shining but minute crystals were obtained. This salt contains much water, but does not puff up so much as borax by heat. It is soluble in 5 or 6 parts of water at common temperatures. The solution is neutral to tumeric and litmus paper.

The formula furnished by analysis is $4BO_3$, $NaO+10HO$.

[The proportion of acid and base is the same as in the salt said to be formed by combining borax with as much acid as it already contains.]

The reaction of chlorid of ammonium with borax furnishes the author with a very plausible theory for the formation of native boracic acid. He has found that boracite and datholite have the same reaction as borax. Tourmaline, axinite and other minerals however contain boracic acid. In a volcanic region, sal-ammoniac is abundant, and in contact with any of these minerals, free boracic acid will be produced. An excess of sal-ammoniac will set free all the acid, as it does with borax. The evaporation of the acid with the steam, &c., is well known; hence we have all the conditions for the formation of the lagoons of Tuscany.

This theory is confirmed by the observations of Payen, that ammonia was found by him in the vapors collected at Monte Rotundo in Tuscany. G. C. S.

11. *Solubility of Chlorid of Silver in Hydrochloric Acid.*—M. J. Pierrie states that hydrochloric acid dissolves $\frac{1}{200}$th of its weight of chlorid of silver, and when diluted with twice its weight of water it still retains $\frac{1}{600}$th. G. C. S.

12. *Analysis of Phosphates of Manganese;* by M. W. Heintz, (Jour de Ph. et de Ch., Nov., 1848, in Phil. Mag.)—Phosphate of manganese, a salt of manganese precipitated by phosphate of soda and dissolved in phosphoric acid, yields, on evaporation, small prismatic crystals, very soluble in water, insoluble in alcohol.—Formula PO_5 $MnO+2HO+2HO$. The water goes off between 230° and 248° F.

Trisphosphate of manganese, obtained by precipitating sulphate of manganese with phosphate of soda, is a white amorphous powder, very little soluble. Formula PO_5 $3MnO+3HO+4HO$. 4 equivs. of water expelled between 230 and 248° F., the remainder by calcination.

Ammonia-diphosphate of manganese obtained by adding gradually a solution of sulphate of manganese with ammonia and sal-ammoniac, to an ammoniacal solution of phosphate of soda; the viscid precipitate is converted into crystalline scales. Formula PO_5 $2MnO\,NH_3$ $3HO$.

Diphosphate of manganese—final permanent precipitate from acid solution of sulphate—a reddish crystalline mass, but little soluble in water, readily in acids. Formula PO_5 $2MnO\,HO+HO+5HO$. 5 equivs. water expelled below 248° F., 1 at 392° and 1 by calcination. G. C. S.

13. *Phosphate and Pyrophosphate of Lime;* by W. Baer, (Poggendorff's Ann. in Chem. Gaz.)—The ordinary phosphate is obtained crystallized by solution of phosphate of soda made strong by acid with acetic acid; precipitated with chlorid of calcium, it is PO_5 2CaO, HO+4HO. A part of the water is expelled at 302°, but the remainder only at a red heat.

Pyrophosphate of soda with acetic acid precipitated with excess of chlorid of calcium, gives a crystalline pyrophosphate of lime PO_5 2CaO+4HO. The preceding salt prepared with excess of pyrophosphate of soda always contains soda, and by prolonged digestion, a well defined double salt is obtained which is PO_5 CaO, NaO+4HO.

G. C. S.

14. *Process of extracting Nickel and Cobalt followed in a Manufactory at Birmingham;* by M. Louyet, (Chem. Gazette, April 16, 1849, p. 165; from Bullet. de l'Acad. Royale de Belgique.)—The ore employed in this manufactory is obtained from Hungary. It consists principally of metallic sulphoarseniurets, and contains generally 6 per cent. of nickel and 3 per cent. of cobalt. These proportions however vary.

The ore is mixed with a small quantity of carbonate of lime and fluor spar, and the whole heated to a white-red in a reverberatory furnace; the mass fuses at this high temperature, and a slag is obtained floating on the surface, which is removed, and a fluid mass of metallic appearance; the latter is let out of the furnace by a particular aperture, and watered in order that it may be broken into fragments with greater facility. It has been ascertained from experience that when the slag is of a dull color, it contains iron; but if its surface is black and brilliant, it is free from it. The metallic mass is reduced to a very fine powder, which is then calcined at a bright red in a furnace, graduating the temperature so as to avoid fusion, and constantly raking it: a considerable quantity of arsenious acid is driven off. The air has free access to the mass, which becomes oxydized and diminishd in weight. The calcination, which lasts for about twelve hours, is continued until no more white fumes are given off, and the residue is treated with hydrochloric acid, which dissolves nearly the whole of it; the liquid is diluted with water, and milk of lime and hypochlorite of lime (chlorid of lime) added,* when a precipitate falls, which after being well washed is thrown away. A current of washed sulphureted hydroden, generated from sulphuret of iron and dilute sulphuric acid, is passed into the liquid until it is saturated; it is discontinued when some ammonia, added to a sample of filtered liquid, gives a black precipitate; if there was not an excess of sulphureted hydrogen, the precipitate produced by ammonia would be green. The sulphureted hydrogen causes a precipitate in the liquid; it is washed, and as it is slightly soluble, a current of sulphureted hydrogen is passed into the washwaters. The precipitate is thrown away. The cobalt is then thrown down with a solution of hypochlorite of lime. The precipitate, washed,

* The lime and hypochlorite of lime are added to precipitate the iron and arsenic; the hypochlorite, by peroxydizing the iron, admits of its being precipitated by the lime.

dried, and then heated to redness, is considered to be oxyd of cobalt, and part is sent in this state into the market; another portion is heated to a white-red; by this treatment the oxyd loses in weight, but increases in density; it is sold as protoxyd of cobalt. The liquid from which the cobalt has been precipitated is treated with milk of lime, which precipitates the nickel in the state of hydrate; this precipitate is washed, dried and heated to redness; it is then mixed with charcoal, and by means of a strong heat reduced to the state of a spongy nickel, which is employed in the manufacture of German silver. With respect to the oxyd of cobalt, nearly the whole of it is consumed in the Staffordshire potteries. The oxyd of cobalt thus prepared is remarkably pure.

15. *On Liquid Protoxyd of Nitrogen;* by M. Dumas, (Compt. Rend., Nov. 6, 1848; Phil. Mag., xxxiv, 153, Feb., 1849.)—M. Natterer of Vienna has constructed a forcing-pump for the liquefaction of gases, by means of which carbonic acid and protoxyd of nitrogen can readily be obtained in the liquid state. Having procured one of these instruments, and employed it more especially for the liquefaction of the protoxyd of nitrogen, I soon perceived the necessity of using a series of indispensable precautions, but which, once adopted, have enabled me to effect with promptitude and security, as well as economy, the liquefaction of large quantities of protoxyd of nitrogen.

As this liquid furnishes a means of producing an excessively low temperature, and is very easily operated with, I will here briefly point out the observations I have made. The first relates to the principal piece of the apparatus, that is to say, the reservoir. In my opinion the Viennese manufacturer has not given it sufficient strength. I have had it surrounded with a belt of forged iron, capable of resisting 800 atmospheres, and very nicely made by M. Bianchi. Moreover, I have arranged things so that the reservoir being surrounded by ice, the body of the pump was cooled uninterruptedly by a circulation of water around it, and that even the stem of the piston was always moistened by cold water; in this manner there is no danger of the valve of the piston being injured by the heat proceeding from the compressed gas, and by its special action as a combustible gas. With these precautions, we may compress into the reservoir in the course of two hours 200 litres of gas, of which 20 suffice to produce a pressure of 30 *atmospheres*, about which, liquefaction commences. The remainder of the gas furnishes a liquid; 100 litres yield 200 grms., or very nearly. The gas should be absolutely dry in order to succeed, and likewise as pure as possible. I prepare it from the nitrate of ammonia as usual, and after having dried it, pass it into Macintosh bags; a couple of pounds of nitrate of ammonia suffices.

Once compressed, the liquid gas may be preserved for one or two days at least in the reservoir; the valve however is slightly injured by it. When the stopcock of the reservoir is opened, the gas escapes; a portion freezes at first, but it then flows liquid; the solid portion resembles a mass of snow; it melts upon the hand, and rapidly evaporates, leaving a severe burn. The liquid portion, which is by far the most abundant, and of which it is easy to obtain in one operation 40 to 50 grms., being received in a glass, keeps for half an hour, or even more, in the air.

In order to observe more readily its properties, I collected it in open tubes, contained in vessels at the bottom of which was placed some pumice-stone moistened with sulphuric acid. It then retains its transparency for a very long time.

The protoxyd of nitrogen is liquid, colorless, very mobile and perfectly transparent; each drop that falls upon the skin produces a very painful burn. The gas, which is incessantly liberated by slow ebullition, possesses all the properties of the protoxyd of nitrogen. When metals are dropped into this liquid, they produce a noise like that of red-hot iron immersed in water. Quicksilver causes the same noise, instantly freezes, and affords a hard brittle mass, white like silver, which it perfectly resembles in appearance. Potassium floats upon the liquid, and experiences no change; the same is the case with charcoal, sulphur, phosphorus and iodine. Ignited charcoal floats upon the surface of the liquid, and burns with considerable brilliancy, and frequently until the whole is consumed. Ordinary sulphuric acid and concentrated nitric acid freeze immediately. Ether and alcohol mix with the liquid without freezing. Water is instantly converted into ice; but it produces such a sudden evaporation of a portion of the liquid, that it causes suddenly a kind of explosion, which would be dangerous if merely a few grammes of water were poured at once into the liquid.

16. *On a new Product of the dry Distillation of Amber;* by L. F. Bley and E. Diesel, (Chem. Gazette, April 2, 1849, pp. 142, 143; from Archiv. der Pharm., lv, p. 171.)—This substance, which resembles wax, was obtained in some experiments variously modified in order to obtain the largest possible amount of succinic acid from amber. In one of these experiments 32 oz. of amber were mixed with 2 oz. of crude concentrated muriatic acid, which had been previously diluted with an equal amount of water, and submitted to distillation in a glass retort. By accident a very brisk fire was made. When the operation was finished, a yellow wax-like substance was found in the neck of the retort mixed with the sublimed succinic acid. A somewhat loose cinder remained in the retort instead of the colophony; it weighed 3 oz., whilst the quantity of oil was very considerable, viz., 21½ oz.; whilst in the usual mode of distilling, generally only between 4 and 5 oz. of oil are obtained from 16 oz. of amber. The amount of succinic acid was 1½ oz.

The wax-like substance was well washed and purified by being melted in water and solution in absolute alcohol. In thin layers it is yellowish, in large masses brownish-green, lighter than water, soft, transparent or opake, melting between 185° and 187°, boiling somewhat above 572°, and void of taste and smell. It is insoluble in water, readily soluble in alcohol and ether, fats and liquid oils, and burns with a strong luminous flame. The analysis of the substance dried over chlorid of calcium furnished—

Carbon, - - - - - -	86·123	1 = 6		85·7
Hydrogen, - - - - -	13·691	1	1	14·3

From the properties and composition of this substance, it agrees with a body found near Merthyr Tydvil, in England, in narrow veins, with quartz, calcareous spar and iron ores, at Loch Fyne, in Scotland,

and at Seamick in Moldavia, in layers of bituminous schists, and is described with the same properties by Oken under the name of ozocerite (Hatchetine.) The authors however are of opinion that the muriatic acid used for these experiments has no influence on the production of this wax-like substance, which the authors have provisionally called artificial ozocerite.

17. *On the Action of Chloroform on the Sensitive Plant (Mimosa pudica)*; by Professor Marcet of Geneva, (read before the Société de Physique et d'Histoire Naturelle, Oct. 19, 1848, and communicated by the author to Phil. Mag., xxxiv, 130, Feb., 1849.)—When one or two drops of pure chloroform are placed on the top of the common petiole of a leaf of the sensitive plant, this petiole is seen almost immediately to droop, and an instant after the folioles close successively pair by pair, beginning with those which are situated at the extremity of each branch.* At the end of one or two minutes, sometimes more, according as the plant is more or less sensitive, most of the leaves next to the chloroformed leaf and situated beneath it on the same stalk, droop one after another, and their folioles contract, although generally in a less complete manner than those of the leaf placed in immediate contact with the chloroform. After a rather long time, varying according to the vigor of the plant, the leaves open again by degrees; but on trying to irritate them by the touch, it is seen that they have become nearly insensible to this kind of excitement, and no longer close as before. They thus remain as torpid for some time, and generally do not recover their primitive sensitiveness till after some hours. If, however, when they are in this state of apparent torpidity, they are subjected again to the action of the chloroform, they close as they did the first time. It is not till after they have been chloroformed several times, that they lose all kind of sensitiveness, at least until the next day; sometimes they even fade completely at the end of too frequent repetitions of the experiment. In all cases the effects observed are the more marked in proportion to the purity of the chloroform employed and the degree of sensitiveness in the plant.

An analogous phenomenon is produced if, instead of placing the drop of chloroform on the base of the petiole, it is laid on the folioles situated at the extremity of a branch. The folioles of this branch immediately begin to close pair by pair, the common petiole droops, lastly the folioles of the other branches close in turn. At the end of two or three minutes, the nearest opposite leaf, and if the plant is vigorous, most of the other leaves situated below on the same stalk follow their example. When, after some time, the leaves open again, the same want of sensitiveness is manifested as in the preceding case.

A singular feature in this phenomenon is the manner in which the action of the chloroform is propagated from one branch to another, then from one leaf to another, even when the liquid disappears by evaporation almost as soon as it is deposited. This action, as we have just seen, appears to be communicated from the leaf to the stalk, following in the latter a descending direction; generally the leaves situa-

* I previously convinced myself by experiment that a drop of water, placed delicately on a leaf of the sensitive plant, caused no movement.

ted above the chloroformed leaf are not at all affected. DeCandolle, in making an analogous experiment on a sensitive plant with a drop of nitric or sulphuric acid, remarked on the contrary, that it was the leaves above the leaf touched which closed, without those situated beneath participating in this motion.* The observation of our learned countryman is quite naturally explained by attributing to the ascending sap the transport of the corrosive poison, a transport which, in this case, would take place in the direction from below upwards. But how to account for the apparent transmission of the effects of the chloroform in the contrary direction, from above downwards? Might the descending sap more peculiarly have the property of transmitting the narcotic effects of this singular compound from one part of the sensitive plant to the other; or might there exist in this plant some special organ susceptible of being affected by certain vegetable poisons in a manner analogous to the nervous system of animals? Notwithstanding the interesting investigations of Dutrochet and other physiologists, there still prevails too much obscurity on this subject to hazard an opinion. But in any case the fact is singular, and appears to me to merit the attention of persons accustomed to engage in questions of this nature.

Experiments of the same kind, made on the contractility of the sensitive plant with rectified ether, have furnished me results nearly similar to the preceding; with this difference, however, that whilst one drop of chloroform placed on the common petiole of a leaf situated at the extremity of a branch of a sensitive plant suffices to cause most of the other leaves situated beneath on the same branch to close, ether in general produces an effect only on the leaf itself with which it is put in contact. The next leaves have generally appeared to me not affected. I must however add, that my experiments with ether having been made after others, and at a time of year when the sensitiveness of the plant had already begun to diminish, it is possible that the intensity of the effects produced may have thereby been affected.

18. *Analysis of the Water of the Mediterranean on the Coast of France*, (Phil. Mag., May, 1849, xxxiv, 398; from Comptes Rendus, Oct., 1848.)—M. J. Usiglio analyzed the water from the foot of Mount St. Clair, about 400 metres from the port of Cette.

100 parts gave—

Chlorid of sodium,	2·9424
Bromid of sodium,	0·0556
Chlorid of potassium,	0·0505
Chlorid of magnesium,	0·3219
Sulphate of magnesia,	0·2477
Sulphate of lime,	0·1357
Carbonate of lime,	0·0114
Peroxyd of iron,	0·0003
Water,	96·2345
	100·000

19. *Impurity of Commercial Bromine*, (Phil. Mag., May, 1849, vol. xxxiv, p. 399; from Journ. de Ph. et de Ch., Février, 1849.)—M. Po-

* DeCandolle, *Physiologie Végétale*, vol. ii, p. 866.

SELGER, in distilling some samples of commercial bromine, found that the boiling-point was not 122° F., but 248° F.; and that the color of the liquid became gradually lighter, till it was eventually quite colorless. On continuing the distillation to dryness, he obtained a residue of charcoal. On separating the bromine from the last portions of the distilled liquid by means of a solution of potash, an aromatic, oily, colorless liquid was obtained, which analysis proved to be carburet of bromine; this existed in various specimens of bromine to the extent of 6 or 8 per cent., and there is every reason to conclude that it was derived from the ether employed in the prepartion of this substance.

20. *Method of Soldering cast-iron with wrought-iron*, (Technologiste; Lond. Jour. and Repert., vol. xxxiv, p. 280.)—The following process has been recommended for this purpose:—First melt filings of soft cast-iron with calcined borax in a crucible; then pulverize the black vitreous substance which is thereby produced, and sprinkle it over the parts which are intended to be united; after which, heat the pieces of cast and wrought-iron and weld them together on an anvil, using only gentle blows. This method is peculiarly applicable for the manufacture of iron articles which are intended to be made red hot, and are required to be impervious to fluids or liquids; as such a result cannot be obtained by simple fastening.

21. *Mode of Silvering Glass by the employment of Gun-Cotton*, (ibid.)—M. VOHL has recently discovered that a solution of gun-cotton in a caustic ley, possesses, in a high degree, the property of precipitating silver from its solutions in the metallic form. In fact, on bringing gun-cotton into contact with a caustic ley of sufficient strength, the cotton will become dissolved in the ley, giving out ammonia with a considerable degree of heat, and producing a deep brown liquor, somewhat thick: on pouring an acid into this, a brisk effervescence is produced, carbonic acid and nitrous acid being disengaged.

The action of gun-cotton, in this instance, shews that it is not simply dissolved, but undergoes decomposition, by which the atoms of oxygen, in the nitric acid, enter into combination with the atoms of carbon in the cotton, thus producing carbonic acid, which as well as the nitrous acid produced by the nitric acid, combines with one part of potash. A fresh decomposition of nitrous salt by the potash, in presence of hydrogenated substances, furnishes ammonia.

The most remarkable property of this alkaline solution is the following:—On pouring into it a few drops of a solution of nitrate of silver, and adding ammonia until the oxyd of silver formed is re-dissolved (the mixture being slowly heated in a water bath), the liquor will, at a certain period, assume a deep brown color and effervesce, the whole of the silver being precipitated on the sides of the vessel. The mirror thus produced is much superior in brilliancy to those produced by means of etherial oils or ammoniacal aldehyde; and the facility with which it is produced will doubtless render it of practical importance.

This property is not exclusively possessed by gun-cotton; it is found also in cane sugar, sugar of milk, manna, gums, and other substances which may be rendered explosive by treating them with nitric acid. Picro-azotic acid produces, under the same circumstances, a reflective metallic surface; and it appears that this reaction takes place with all bodies which, when treated with nitric acid, do not furnish products of oxydation, but another series of bodies that admit of carbonic acid forming one of their constituent parts, since they at the same time give up an equivalent of water.

22. *On a Mode of rendering Substances incombustible;* by Robert Angus Smith, Ph. D., Manchester, (Phil. Mag., xxxiv, 116, Feb., 1849.)—I have often been surprised that, considering the number of materials which will not burn and the small number which do burn, we should be compelled to build houses so liable without constant watchfulness to instantaneous destruction; that we should go also to sea in vessels made of a most combustible substance filled with enormous fires, frequently under the care of ignorant men. I think, therefore, I may be excused when I endeavor to add to a knowledge of the mode of rendering substances incombustible, or the theory of the mode to be sought after, even if the addition which I make be but a very small one.

Silicate of potash has been considered good. It is a soluble glass which was expected to cover the fibre of cloth or wood, and so protect it from heat. This does act to some extent, probably in the same manner as stones do when put into a fire of wood or coal; they take heat but give none, and are also bad conductors. If silicate of potash remained as a glass, it would act also by keeping out the air; but this does not seem to be the case, as it falls after a time to a powder.

It struck me that the mode of preventing combustion was not by protecting the wood from the fire merely, as heat must cause combustible gases to rise from wood, whether there be incombustible substances mixed with it or not, and these gases will force their way to the surface where there is no longer any preventive to burning. My object then was to find a substance which would render the wood unfit to burn, and would cause it to give out gases which would not burn; so that whilst the wood itself was being preserved, except where in contact with the fire, the gases would assist in extinguishing the fire.

I first tried phosphate of magnesia and ammonia, thinking the ammonia given out would be of use in extinguishing the fire; but this was of no value, as a piece of calico required to be made quite stiff with it before it was rendered incombustible. The calico was prepared by dipping it in a solution of phosphate of magnesia in muriatic acid and then in ammonia. It seemed to me that the earthy salts are of little use for the purpose required, and that the amount of solid matter incapable of evaporation left on the cloth, assists in a very small degree.

Sulphuric acid, however, seemed to present the most promising characteristics of a substance incapable of burning, and of acting so strongly on vegetable substances as to make them incapable of burning. Sulphuric acid itself is a body perfectly burnt, or we may say overburnt, having an atom of oxygen given to it by artificial means, so to speak, which atom is difficult to separate, and therefore not resembling the oxygen of many highly oxydized bodies. It requires a high degree of heat to raise it to vapor; and the vapor formed is sluggish and heavy, remaining long where formed, and quenching flame wherever it is. It destroys the texture of wood also and other vegetable substances, causing them to give out after a time gases which do not burn, mixed with some which do burn; but if there be enough of acid, forming a mixture which does not burn. The wood also cannot be again induced to become combustible until it be heated to redness, so as to remove all the sulphuric acid, leaving only charcoal.

If sulphuric acid then could be introduced into wood just at the time that the fire was going to take place, the fire would cease to take place; and this we can do easily by saturating the wood with sulphate of ammonia. When there is no fire present there is no sulphuric acid present, as such; but as soon as the heat rises, ammonia goes off, and sulphuric acid is instantly presented to the wood. The ammonia does not come off quite pure, it is mixed with nitrogen and sulphurous acid; and this disengagement of gases is of advantage in extinguishing fire; when the heat rises to 536°, the sulphuric acid is then left to act on the wood in part and to volatilize in part, and that which I have mentioned takes place. The outside of course would first undergo the change, and the inside would be protected by the incombustible outer part; if the fire continued to act long, the inner layer would undergo a similar change. I imagine, then, the acid acts in a double manner; it makes the wood refuse to burn and it puts out fire. As sulphurous acid is given off in this process, the action is also similar in one point of view to that of sulphur, which has long been used for putting out fire in chimneys.

I have no doubt that a house built of wood prepared in this manner might have a fire lighted on the wooden floor without danger, burning only on the spot to which the fire was limited. A ship also would be safe, even if the cinders did fall from the grate in stormy weather.

I know that muriate of ammonia has been used, and that it acts very well; but I think the sulphuric acid is superior, the ammonia being merely to keep it innocent; and other volatile base might do. I am sorry, however, that this is not perfect; its solubility in water is a great disadvantage, as it cannot be applied to clothes to be frequently washed. True, it is so cheap that it might be applied every washing where there are peculiar dangers; but if a person was standing very near the fire, the ammonia would in part be evaporated, and the acid remaining would be enough to injure the fabric. There are however cases, such as curtains, to which this could not apply, and where it would be valuable.

Sir William Burnet's liquid is chlorid of zinc: he uses it for preserving wood and canvas, and also for preventing fire. I am certainly surprised that more use has not been made of it, being as far as I have seen it, so efficient. I believe the manner in which the chlorid of zinc acts is very similar to that of sulphuric acid, destroying the organic matter on the approach of heat, and rendering it incombustible. It can be introduced into wood at a specific gravity of 2000, I believe; sulphate of ammonia cannot easily be used above 1200. By heating the solution more may be attained. Sulphate of ammonia is cheap and easily procured and used, not hurting anything with which it may come in contact, and therefore more easily managed in households.

The chlorid of zinc is said to unite with the fibre. This cannot be said for the sulphate of ammonia. It would not, however, come from the centre of a beam of wood, even if immersed in water, as the water enters with great difficulty into wood; and the solution itself cannot be introduced without forming a vacuum in the saturated vessel, and so removing all the air from the wood.

The first time I used this solution I found a large quantity of mould formed, and indeed it contains all the elements to increase its growth. The second time the solution was boiled in an iron vessel, and no mould formed on it; on the contrary mould was destroyed by it. The sulphate of ammonia dissolves iron rapidly, and forms a double salt which is deleterious to such growths. I imagined any other metallic salt would do, and used ordinary chlorid of manganese prepared in the laboratory, which killed all such fungi rapidly, and no more have grown after standing eleven months in contact with organic matter.

I believe there are many ways in which this may be used. My wish was to find a substance suited for building fire-proof ships, and I believe this would do; at any rate the ships would be fire-proof, experience could alone tell if any other objection followed. It does not render the wood hard, heavy or brittle.

I believe it would be of the greatest advantage in mills, which now suffer so much from fire, diminishing or rather entirely removing the expense of insurance. It does not hurt colors; so that even colored goods might be dipped when kept long in one place, or when sent in vessels abroad. Possibly some delicate colors may be attacked, but this must be a rare case.

I am more desirous of seeing ships built of an incombustible material, the means of escape at sea being few, and confined to few; and whilst there is any hope of doing it easily, I scarcely think it proper for any one to neglect what information may exist on the subject.

II. Mineralogy and Geology.

1. *Randanite, a native hydrated Silica from Algiers;* by M. Salvetat, (Ann. de Ch. et de Phys., Nov., 1848, t. xxiv, p. 348.)—This hydrated silica exists abundantly near Algiers, and was taken for Kaolin. It is pulverulent and friable, forming an excessively light powder. It is infusible, but loses color and becomes grayish, contracting a little. It gives up water at 16° C., but still retains a portion at 100° C., losing the whole only at an intense heat. It was found to consist of 80 parts of gelatinous silica, 9 of water, 6·48 of insoluble silica, with 1·41 alumina, 0·55 oxyd of iron, 0·56 lime, 2·00 of potash, soda and loss, and *a trace* of magnesia. Of the water 4·04 per cent. escaped at 16° C., and 3·96 at 100° C., and 1 per cent. is combined with the alumina. Neglecting what is obviously foreign to the mineral, it has the formula $\dddot{Si}^2\dot{H}$ when simply dried at 16° C., and $\dddot{Si}^4\dot{H}$ when dried at 100° C.

The composition resembles that of a similar material from Ceyssat, and near Randan, in the Puy de Dome, analyzed by M. Fournet. This chemist obtained in his analysis, gelatinous silica 87·20, water, carbonic acid and organic matters 10·00, alumina and oxyd of iron 2·00, sand by decantation 0·80, with traces of lime, magnesia, &c.

Salvetat suggests the name *Randanite* for the mineral, in allusion to the locality, considering its composition as $\dddot{Si}^2\dot{H}$. Doveri has lately announced the formation of a substance having the composition $\dddot{Si}\dot{H}$, by the artificial drying of gelatinous silica. But the attempts of Salvetat to form Randanite artificially were not successful. A microscopic examination of the specimens from Ceyssat and Randan, has led Dufrenoy to attribute its origin to infusoria, and that of Algiers is probably due from the same source. The constancy in the composition of this infusorial silica is an interesting physiological fact.

2. *On Pistomesite and Mesitine;* by M. Breithaupt, (Pogg. Annalen, lxx, 146.)—Pistomesite resembles spathic iron. Crystallization rhombohedral; R : R=107° 18′. Density 3·412–3·417. According to M. Fritzsche, it consists of protoxyd of iron 33·92, magnesia 21·72, carbonic acid 43·62=99·26, giving the formula $\dot{Fe}\ddot{C}+\dot{Mg}\ddot{C}$.

Breithaupt on a new examination of the Mesitine, obtained for its composition, protoxyd of iron 24·18, magnesia 28·12, lime 1·30, carbonic acid 45·76, and hence deduces the formula $2\dot{Mg}\ddot{C}+\dot{Fe}\ddot{C}$.

3. *Analysis of Lardite from near Voigtsberg, in Saxony;* by M. Karsten, (Jour. für Prakt. Chem., xxxvii, 162.)—Lardite, which has been referred to Agalmatolite, is an anhydrous magnesian silicate, consisting according to Karsten's analysis, of silica 66·02, magnesia 31·94, protoxyd of iron 0·81, soda and potassa 0·75, loss by ignition 0·20, chlorid of sodium and sulphate of potash, *a trace* =99·72. It whitens before the blowpipe, and in a tube gives no trace of moisture but exhales a disagreeable odor, like many other magnesian minerals. In the exterior flame it becomes wax-yellow. It dissolves slowly but completely in borax, forming a glass which is pale yellow when hot, but becomes colorless on cooling. Density 2·795.

4. *Chemical Analysis of Glinkite;* by W. von Beck, (Verhandl. Min. Gesel. zu St. Petersburg, Jahr., 1847, p. 244.)—Glinkite comes from the District of Perm. It forms small veins in talc which is sometimes intersected by chlorite, and occurs only amorphous. The color is olive-green passing into a darker or lighter shade, and paler green by transmitted light. Luster nearly vitreous. H. = 6. G. = 3·479 at 14½° C. Fracture fine and flat conchoidal. Streak powder white. In nitric or muriatic acid it partly gelatinizes. Before the blowpipe it does not fuse, except on the edges of the thinnest splinters at a high heat.

	I.	II.	Mean.
Composition.—Silica,	38·817	39·6	39·208
Magnesia,	43·778	44·35	44·064
Protoxyd of iron,	17·141=99·736	17·75=101·70	17·445

This gives the formula $\dot{R}^3\dddot{Si}$, in which $\dot{R}=\dot{Mg}, \dot{Fe}$. It is the formula of Olivine.

5. *Neolite, a new mineral;* by M. Scheerer, (Œfvers. af. K. Vet. Ak. Fœrh., iv, 70.)—Neolite is a talc-like mineral from some old mines near Arendal, Norway, where it occurs as modern incrustations in fissures

and on detached stones. It is often crystalline, either in folia, or in concentric fibrous aggregations like Wavellite. It is greenish with a greasy luster, and a specific gravity 2·77 after long desiccation. Hardness, that of talc. The analyses vary much. In one, Scheerer obtained silica 52·28, alumina 7·33, magnesia 31·24, protoxyd of iron 3·79, protoxyd of manganese 0·89, lime 0·28, water 4·04=99·85. In another, silica 47·35, alumina 10·27, magnesia 24·73, protoxyd of iron 7·92, protoxyd of manganese 2·64, water 6·28=99·19.

6. *On Völknerite, a new mineral from the mines of Schischimsk;* by M. Hermann, (Jour. f. Prakt. Ch., xl, 11; Annuaire de Ch., 1848, p. 154.)—Völknerite occurs in white pearly laminæ on talc schist, and sometimes in hexagonal tables, with a perfect basal cleavage. Feel greasy. Density 2·04.

Composition $\dddot{Al}\,3\dot{H}+6(\dot{Mg},2\dot{H})$.

7. *Analysis of Pyrophyllite of Spaa;* by M. Rammelsberg, (Pogg. Annalen, lxviii, 505.)—The analysis afforded: silica 66·14, alumina 25·87, magnesia 1·49, lime 0·39, water 5·59=99·48—leading to the formula (neglecting the lime and magnesia) $5SiO^3\ 2Al^2\ O^3+2HO$.

8. *Analysis of Talc of Rhode Island and Steatite of Hungary;* by M. A. Delesse, (Rev. Sci. et Indust., xxv, 107.)—The Talc of Rhode Island occurs in large clear foliated masses. It has two optical axes intersecting at a small angle. Density =2·5657; after calcination =1·64. Hardness =1; after calcination =6, so that it scratches glass, although with some difficulty. It exfoliates when heated.

On analysis it afforded silica 61·75, magnesia 31·68, protoxyd of iron 1·70, water 4·83=99·96; and Delesse thence deduces the formula $2(4SiO^3+3Mg\,O)+3(Mg\,O,HO)$.

This author also examined a *steatite* from Nyntsch in Hungary, and obtained for its composition, silica 64·85, magnesia 28·53, protoxyd of iron 1·40, water 5·22=100·00, this result leading to the formula $5(SiO^3\ MgO)+2HO$.

9. *On a new Hydrosilicate of Alumina;* by MM. Damour and Salvetat, (Ann. de Ch. et de Ph., 3e ser., xxi, 376.)—This mineral occurs massive in nests in a brownish clay near Montmorillon (Vienna). It has a soapy feel, and a clear rose color, and becomes plastic in water. *Composition*, according to Damour, silica 50·04, alumina 20·16, sesquioxyd of iron 0·68, lime 1·46, potash 1·27, magnesia 0·23, water 26·00. It is hence allied to Halloysite.

10. *Philippsite and Gismondine;* by M. Marignac, (Ann. de Ch. et de Phys., 3e ser., xiv, 41.)—Marignac separates these species, which Kobell and Brooke had united. Under *Gismondine* he includes specimens having an octahedral form, and rarely mammillated, and faces not striated; and under Philippsite, those whose crystals have a rectangular prismatic form terminated by a 4-sided pyramid, with the faces striated in two directions oblique to one another. Density of Gismondine 2·265, of Philippsite 2·213.

11. *On the Composition of Heulandite;* by M. Damour, (Comptes Rendus, xxii, 926; Annuaire de Chim., 1847.)—Damour has detected in Heulandite a portion of soda and potash which simplifies the formula. His analysis gives: silica 59·64, alumina 16·33, lime 7·44, soda 1·16,

potash 0·74, water 14·33=99·64. Hence this mineral differs from stilbite only in the proportion of water, and it falls into the group of zeolites having the proportions

$$rO : Al^2 O^3 : Si O^3 :: 1 : 3 : 12.$$

The following table exhibits their relations,

	rO		$Al^2 O^3$		$Si O^3$	HO		
Stilbite,	1	:	3	:	12	6	in which	rO=CaO
Harmotome,	1	:	3	:	12	6	"	rO=BaO
Heulandite,	1	:	3	:	12	5	"	rO=(CaO, NaO, KO)
Epistilbite,	1	:	3	:	12	5	"	rO=(CaO, NaO)
Brewsterite ?	1	:	3	:	12	5	"	rO=(SrO, BaO)
Edelforsite,	1	:	3	:	12	4	"	rO=CaO

12. *On the identity of Osmelite and Pectolite*, (Annuaire de Chem., 1848, p. 166.)—An analysis by M. Adam indicates that osmelite of Breithaupt is identical with Kobell's pectolite. He obtained for it, silica 52·91, lime 32·96, protoxyd of manganese 1·44, soda 6·10, potash 2·79, alumina and oxyd of iron 0·54, water 4·01.

13. *On Disterrite, from the valley of Fassa in Tyrol;* by M. von Kobell, (Jour. f. Prakt. Ch., xli, 154; Annuaire de Ch., 1848, 173.)—Disterrite crystallizes in hexagonal prisms, cleaving parallel to the base, and has a pearly luster on the terminal faces, with a vitreous luster on the sides of the prism. H.=5 to 6½ (Breithaupt's scale). Density 3·042—3·051. *Composition*, silica 20·00, alumina 43·22, peroxyd of iron 3·60, magnesia 25·01, lime 4·00, potash 0·57, water 3·60.

14. *On Glaucophane;* by M. Hausmann, (Jour. f. Prakt. Ch., xxxiv, 238; Annuaire de Chimie, 1846, p. 271.)—Glaucophane comes from the island of the Cyclades, and resembles indicolite. It has a prismatic foliated structure, a clear blue color seen by refraction. Density 3·103—3·113. Powder feebly attracted by the needle. The mean result of two analyses is as follows:—silica 56·49, alumina 12·23, protoxyd of iron 10·91, protoxyd of manganese 0·50, magnesia 7·97, lime 2·25, soda with traces of potash 9·28=99·63. It is near Wichtyne from Finland in composition.

15. *On Chloritoid*,* (Jour. fur Prakt. Ch., xxxiv, 454.)—MM. Erdmand and Gerathewohl have obtained for Chloritoid or Chloritic spar the formula $\dot{F}e^3 \dddot{\mathbf{A}}l + 2\dddot{\mathbf{A}}l \dddot{S}i$ after the following analyses.

Silica,	24·40	24·931
Protoxyd of iron,	30·29	30·047
Alumina,	45·17=99·86, Ger.	45·016=99·994, Erd.

16. *On Humite.*—Humite, according to Marignac's investigations, is identical with Chondrodite.

17. *On Epidote*, (Jour. de Pharm. et de Chim., xiv, 3d ser., Sept., 1848, p. 214.)—M. Gerhardt here cites the analyses of M. Hermann (Journ. f. Prakt. Chem., xliii, 35 and 81,) of the different varieties of Epidote, including Zoisite and Pistacite of different localities, Bucklandite, and Orthite or ceriferous Epidote. Hermann deduces from his

* Mr. J. D. Whitney has found *Masonite* to agree with Bonsdorff's analysis of chloritoid, according to which this mineral contains 5 to 6 per cent. of water. His researches are published in the Proc. Bost. Nat. Hist. Soc., April, 1849, p. 100, and will be cited in our next number.

results and those of previous chemists, that they exemplify a new principle in chemistry, which he names *heteromerism*, which is the reverse of isomorphism, it implying a similarity of crystallization with a different proportion in the ingredients. Hermann obtains for the formulas of—

Zoisite,	$3[(2RO), (Si\,O^2)]+2[2(R^2\,O^3), 3(Si\,O^2)]$
Bucklandite,	$2[(2RO), (Si\,O^2)]+[2(R^2\,O^3), 3(Si\,O^2)]$
Orthite,	$3[(2RO), (Si\,O^2)]+[2(R^2\,O^3), 3(Si\,O^2)]$

He considers Pistacite as consisting of the Zoisite type and Bucklandite type united, the green Arendal variety containing, according to him, 2 atoms of Zoisite and 1 of Bucklandite ; and so on.

Gerhardt observes that M. Hermann "doubtless preoccupied with the idea that the oxyds represented by $R^2\,O^3$ cannot replace the oxyds RO in isomorphous substances, has entirely misunderstood the simplicity of relation actually existing between the varieties of epidote. If he had summed up the oxygen contained in all the oxyds and that of the silica, he would have found in all cases the simple relation of

$$1 : 1$$

In fact, in the several cases mentioned the actual relations are as follows, 2·94 : 3·03, 3·03 : 2·93, 3·01 : 3·04, 3·97 : 2·98, 2·91 : 2·87, 2·74 : 2·70, 2·74 : 2·69, 2·62 : 2·59, 2·56 : 2·55, 2·63 : 2·45, 2·05 : 2·12. All the epidotes have therefore the general formula*

$$Si^2\,O^4\,(M^4)$$

equal to $[Si^2\,O^2+2OM^2]$, "which comprises garnet, anorthite, olivine and a great number of other minerals." In epidote M^4 is represented by variable quantities of alumina and peroxyd of iron on one side, and lime, magnesia, protoxyd of iron, or of cerium on the other. Representing the former by $M\beta$ and the latter by M, the formulas of the prominent varieties are as follows :

Zoisite, ...	$Si^2\,O^4\,(M\beta^{2\cdot68}\,M^{1\cdot32})$
Pistacite, ...	$Si^2\,O^4\,(M\beta^{2\cdot60}\,M^{1\cdot40})$
Bucklandite, ...	$Si^2\,O^4\,(M\beta^{2\cdot56}\,M^{1\cdot44})$
Orthite, ...	$Si^2\,O^4\,(M\beta^{2}\quad M^{2})$

These formulas sustain the view of the isomorphism of these minerals.

18. *On Zygadite;* by M. BREITHAUPT, (Pogg. Ann., lxix, 429.)—Luster vitreous. Color red and yellowish white. Feebly transparent. Density =2·511. Form of crystal a rhombic prism, and in all instances observed, macles. M. Plattner has detected in it nothing but silica, alumina and lithia.

19. *Bodenite*, (Jour. f. Prakt. Chem., xliii, 207.)—This mineral [alluded to in this Journal, vol. ii, p. 415,] has been analyzed by M. Th. Kerndt with the following result.—Silica 26·12, alumina 10·33, protoxyd of iron 12·05, yttria 3·47, lime 6·32, magnesia 2·33, protoxyd of manganese 1·61, potash 1·21, soda 0·84, protoxyd of cerium 10·46, protoxyd of lanthanum 7·56, water 3·01=99·27 : from which he deduces the formula $Al^4\,O^3, Si^3\,O^3+9R^2\,O, 2Si^3\,O^3$.

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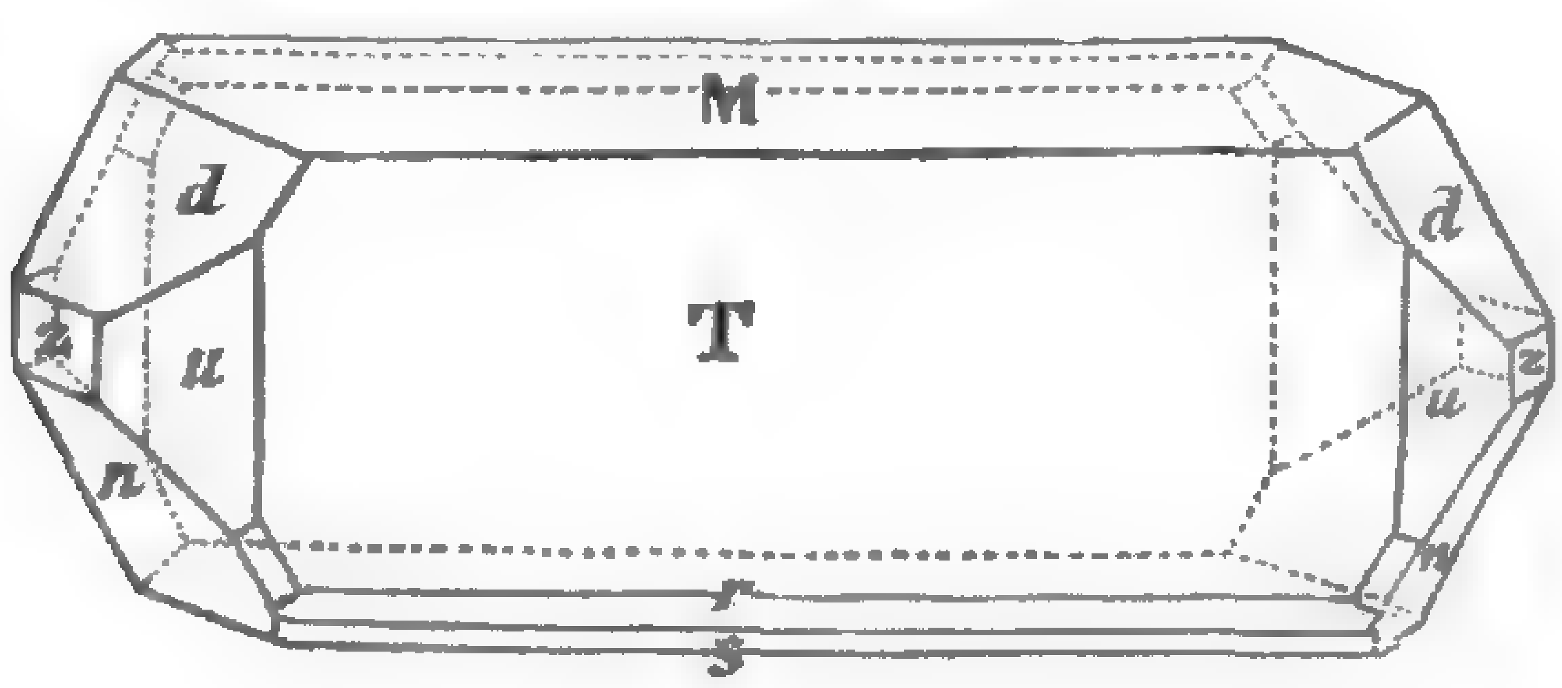
* In this formula, Gerhardt adopts his own notation, considering the oxyds OM^2, and silica $Si^2\,O^2$. The old notation is adopted in the preceding formulas.

20. *Muramontite, a new mineral;* by M. Kerndt, (Jour. f. Prakt. Chem., xliii, 207.)—Under this name the author designates a ceriferous mineral from near Marienberg in the Erzgebirge. It occurs in black amorphous grains, with a greenish reflection. Density 4·263 to 4·265. It consists of silica 31·09, alumina 2·23, glucina 5·51, yttria 37·14, protoxyd of iron 11·23, magnesia 0·42, protoxyd of manganese 0·90, lime 0·71, soda 0·65, potassa 0·17, protoxyd of lanthanum 3·53, protoxyd of cerium 5·54, water 0·82=99·94.

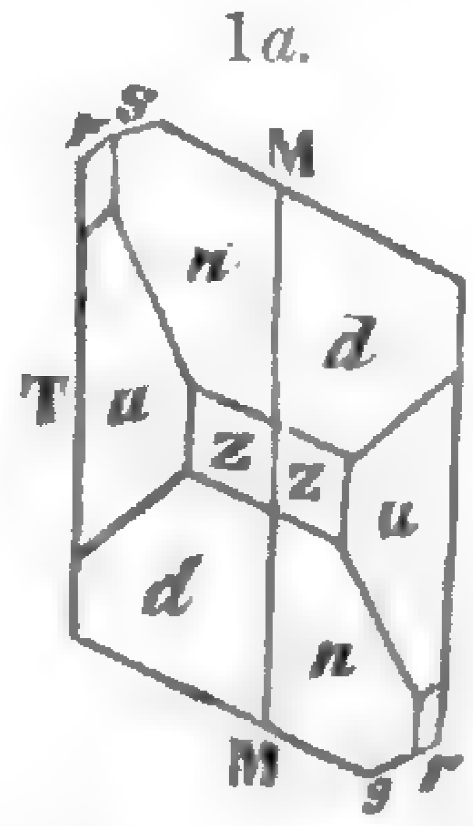
21. *Monazitoid, a new mineral from near Lake Ilmen;* by M. Hermann, (Jour. für Prakt. Ch., xl, 21; Annuaire de Ch., 1848, p. 146.)—Monazitoid is a variety of monazite, hardly distinguishable in external characters, consisting of oxyd of cerium 49·35, oxyd of lanthanum 21·30, lime 1·50, phosphoric acid 17·94, substance resembling tantalic acid 6·27, water 1·36, magnesia and protoxyd of iron, *a trace.* It has thence the formula, according to Hermann, 5(CeO, LnO) PhO^5, and differs from monazite in containing a tantalic substance in place of tin. Its density is 5·281.

22. *Crystallization of Uralorthite;* by N. von Kokscharov, (Verhandl. der Russ.-Kais. Min. Gesellsch. zu St. Petersburg, Jahr 1847.)—The author, in an elaborate memoir, points out close relations between the crystallization of Uralorthite, Allanite and Epidote, and shows them to be isomorphous. The following are two of his figures—from Plate iv.

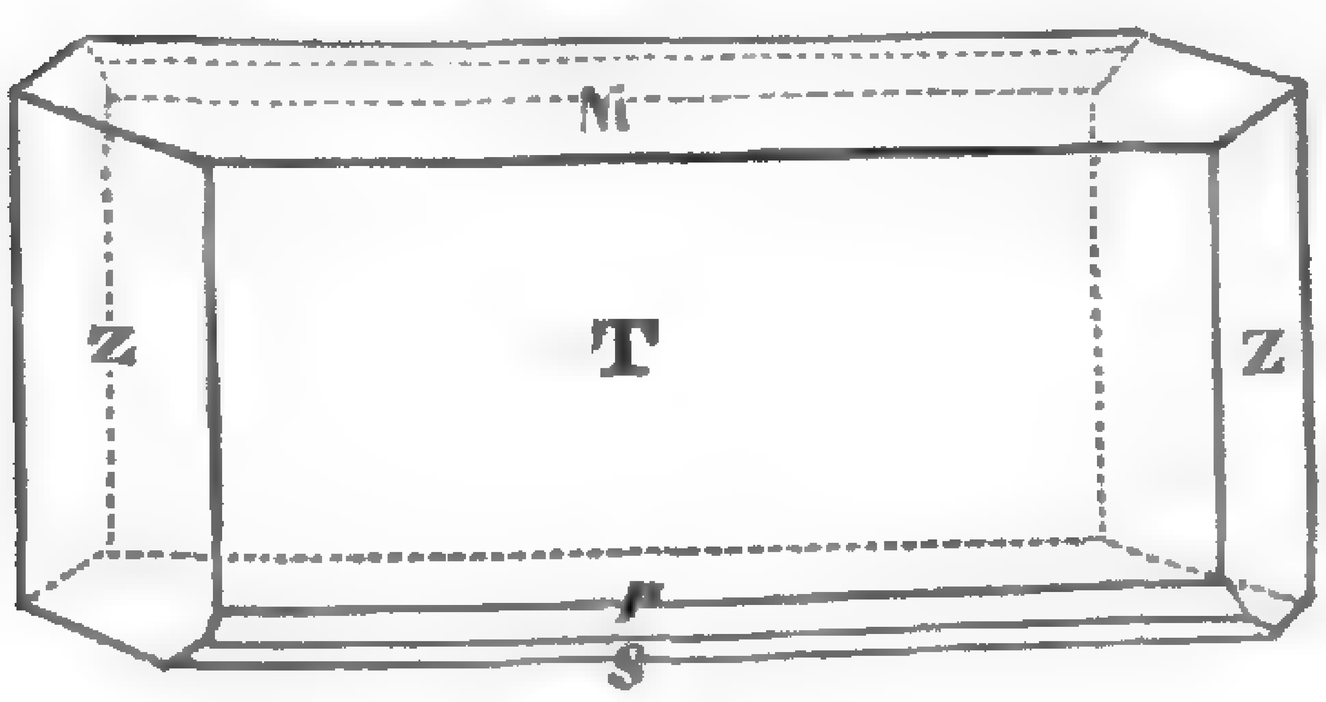
1.



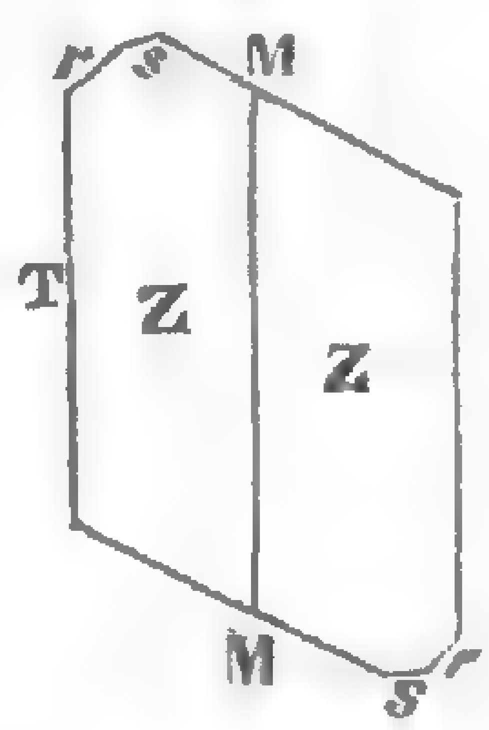
1*a*.



2.



2*a*.



The dimensions (placing *a* for the vertical axis, *b* for the clinodiagonal, and *c* for the orthodiagonal) are as follows:

Uralorthite,	$a:b:c = 1{\cdot}14918 : 1 : 0{\cdot}64510$	$\gamma=65°\ 5'$
Epidote,	$a:b:c = 1{\cdot}16050 : 1 : 0{\cdot}63653$	$\gamma=65°\ 34\frac{1}{2}'$

The description of figure 1, according to Naumann's system of notation, is as follows.

OP	$\infty P \infty$	$+P\infty$	$+\frac{1}{2}P\infty$	$+P$	$-P$	∞P	$\infty P2$
M	T	*r*	*s*	*n*	*d*	*z*	*u*

The following are some of the angles obtained for uralorthite; and in parallel columns the corresponding angles of epidote and allanite are given. The first three of uralorthite and the three measurements by the reflective goniometer, from which the dimensions were calculated.

	Uralorthite.	Epidote.	Allanite fr. *Heidinger.*	Orthite, *Scheerer.*
$M:d=$	127°40′	126°56¾′		
$M:T=$	114°55′	114 25½	116°	113°—116°
	65°05′	65 34½	64	
$M:r=$	116°20′	116 12½	115°	116°
$M:n=$	105° 1′	104 48½		
$T:r=$	128°45′	129 22	129°	130°48′
$T:z=$	125°25½′	124 57½		
$T:u=$	144°53½′	144 25		
$d:z=$	156°28′	156 45½	156¾°	

Bagrationite (Pogg. lxxiii, 182), also appears to be another variety. The measurements gave $M:T=114°\ 55{\cdot}2'$; $M:r=116°\ 35{\cdot}6'$; $M:n=105°\ 10{\cdot}5'$; $T:r=128°\ 29{\cdot}7'$; $T:z=125°\ 25'$.

The resemblance between the above minerals in composition is striking, as shown by M. Kokscharov, from a comparison of various analyses.

23. *Niobite.*—This name has been applied to the Columbite in which niobic acid is the predominant acid. Specimens from the east of Lake Ilmen have been found to agree in crystalline form with the American, as described by M. G. Rose. The mean specific gravity is 5·57.

24. *On the Yttrotantalite of Ytterby.*—M. H. Rose announces (Jour. f. Prakt. Ch., xlii, 143,) that the Ytterby yttrotantalite has the same composition, the same metallic acids, and the same density, as the tantalite of Finland.

25. *On Eukolite,* a new mineral; by M. Scheerer, (Ann. der Ph. und Ch., lxii, 561; Annuaire de Chem., 1848, p. 150.)—Eukolite appears to be a Wöhlerite, in which the greater part of the zirconium is replaced by sesquioxyd of iron. Scheerer obtained for its composition, silica 47·85, metallic acids and zirconia 14·05, sesquioxyd of iron 8·24, lime 12·06, protoxyd of cerium 2·98, soda 12·31, protoxyd of manganese 1·94, magnesia *a trace*, water 0·94.

26. *On Crystallized Pitchblende;* by M. Th. Scheerer, (ibid.)—The crystals of pitchblende are regular octahedrons with truncated angles. Density 6·71. Composition, green oxyd of uranium 76·6, oxyd of lead, metallic acids and silica 15·6, oxyd of manganese 1·0, water 4·1, loss and gangue 2·7. Scheerer does not state whether the metallic acids are essential constituents or derived from the gangue.

27. *On Euxenite from Tvedenstrand;* by M. Th. Scheerer, (ibid.)—Composition, titanic and metallic acids 53·64, yttria 28·97, protoxyd of uranium 7·58, ib. of cerium 2·91, ib. of iron, 2·60, water 4·04. Density 4·73, 4·76, 4·60. Approaches polycrase in crystalline form, crystallizing in rhomboidal prisms of about 140°, surmounted with a pyramid whose obtuse culminant edge is nearly 136°. The prism of samarskite is 135 to 136°; and the obtuse culminant edge of columbite is 150°.

28. *New Minerals;* by M. BREITHAUPT, (Pogg. Ann., lxix, 429.)—*Pliniane.*—This mineral has the composition and appearance of mispickel. Density $=6\cdot282$. It differs from that species in being oblique in its crystallization, pertaining to the monoclinate system.

Stannine of Cornwall. This species resembles somewhat a white opaque garnet. It has little luster, a pale yellowish color, and is transparent only upon the thinnest edges. It is compact and has a scaly fracture. Hardness nearly that of quartz. Density $=3\cdot545$. M. Plattner finds it to consist of silica and alumina 36·5 for 100 of oxyd of tin. It is infusible before the blowpipe.

29. *Telluric Bismuth from Brazil;* by M. A. DAMOUR, (Annales de Ch. et de Phys., 3e ser., xiii, 372.)—This ore occurs in leaves of the luster of polished steel, slightly flexible, very tender. According to two analyses it contains—

Bismuth,	79·15	78·40
Tellurium,	15·93	15·68
Sulphur,	3·15	4·58
Selenium,	1·48=99·71	=98·66

Adopting 1330·376 for the atomic number of Bismuth, as determined by Regnault and Rose, and 802·121 for the atomic weight of Tellurium, we have the formula $Bi^2S^3+3Bi^2Te$. The Schemnitz ore has the formula $Bi^2S^3+2Bi^2Te^3$; the Deutsch-Pilzen ore, $BiS+2Bi\,Te$.

30. *Analysis of Copper blende;* by C. F. PLATTNER, (Pogg. Ann., lxvii, 422.)—Copper blende of Haidinger is distinguished from Tennantite, by a red streak and less specific gravity. The Tennantite of Cornwall afforded Kudernatsch, copper 48·94, iron 3·57, sulphur 27·76, arsenic 19·10, silver *a trace*, quartz 0·08=99·45. Plattner has obtained for Copper Blende from Freiberg, copper 41·070, zinc 8·894, iron 2·219, lead 0·341, sulphur 28·111, arsenic 18·875, antimony and silver *traces* =99·510. Admitting that Cu^2S is isomorphous with $Zn\,S$ and FeS, they have the same formula, except the substitution of $Zn\,S$ in the latter for part of the Cu^2S. The formulas are—

Tennantite,	$Ar\,S^3+4(Fe, Cu^2)S$
Copper blende,	$Ar\,S^3+4(Fe, Zn, Cu^2)S$.

31. *Analysis of Phosphates of Copper from Nischne Tagilsk;* by M. R. HERMANN, (Jour. f. Prakt. Chem., xxxvii, 175.)

	Oxyd of copper.	Phosph. acid.	Water.
Libethenite,	65·89	28·60	$5\cdot50=PhO^5+4CuO+1\frac{1}{2}HO$
Dihydrite,	68·211	25·304	$6\cdot485=PhO^5+5CuO+2HO$
Phosphorocalcite,	67·15	24·55	8·20
Ehlite,	66·86	23·14	$10\cdot00=PhO^5+5CuO+3HO$
Tagilite,	61·29	26·44	$10\cdot77=PhO^5+4CuO+3HO$

Phosphorocalcite is stated to be equivalent to equal proportions of dihydrite and ehlite.

32. *On Mendipite;* by M. SCHNABEL, (Pogg. Ann., lxxi, 516.)—Composition, lead 85·69, chlorine 9·87, oxygen $4\cdot44=PbCl+2PbO$.

33. *On a Native Antimonite of Mercury;* by M. DOMEYKO, (Berzelius's Report on the Progress of Chemistry, 6th year; Annuaire de

Chimie, 1848, 145.)—This mineral is a red powder from the mercury mines of Chili. It consists of antimonious acid 21·2 to 23·8 oxyd of mercury, with peroxyd of iron, silica and water.

34. *Arsenical Nickel from Oelsnitz;* by M. H. WACKENRODER, (Arch. f. Pharm., xcvii, 288; Annuaire de Chem., 1847, 211.)—This mineral was found in the green sand, in a gangue looking like spathic iron. The fresh fracture has a lead gray color which soon changes to brownish gray, with spots of oxyd of nickel. An analysis obtained:—Nickel 20·937, arsenic 35·258, sulphur 8·903, lead 0·299, protoxyd of iron 8·26, protoxyd of manganese 1·023, lime 12·578=87·248, the loss being carbonic acid; carbonic acid and oxyd of iron and manganese belong to the gangue. The lead is undoubtedly an unessential ingredient and exists as a sulphuret. Omitting these, the author considers the species as having the formula $Ni\,S^2+2Ni\,Ar^2$, which would give for its composition nickel 32·700, arsenic 54·440, sulphur 11·860, the analysis affording (after separating the impurities) nickel 32·185, arsenic 54·198, sulphur 13·617.

35. *On an Arsenio-sulphuret of Nickel;* by MM. WACKENRODER and LUDWIG, (Jour. f. Prakt. Ch., xl, 318.)—This ore of nickel occurs massive with spathic iron in graywacke. Analysis afforded the formula $Ni\,S^2+2(Ni, As.)$

36. *On Polymerous isomorphism;* by M. NAUMANN, (Jour. f. Prakt. Ch., xxxix, 196, and xl, 1; Annuaire de Ch., 1848, 142.)—M. Naumann admits that Scheerer's theory explains well the relations of the serpentine of Snarum and chrysolite. But as regards cordierite (iolite) and aspasiolite, it is unsatisfactory; for the constitution of these two minerals requires rather the isomorphism of 1 equivalent of magnesia and 4 of water; and even admitting 5 of water to be isomorphous with 1 of magnesia, there is little discrepancy with the analytical results.

Naumann also shows that the minerals fahlunite, praseolite, chlorophyllite, esmarkite and bonsdorffite do not sustain Scheerer's theory; and to account for their forms, we must admit that they are derived from iolite.

37. *Analysis of California Gold*, (Ann. des Mines, tom. xiv, p. 67; Phil. Mag., May, 1849.)—M. RIVOT, mining engineer, has analyzed a specimen of California gold sent by Mr. Peabody to the Ecole des Mines. The specimen contained—small flattened grains, of a fine yellow color, and extremely small and smooth grains, attracted by the magnet, which appeared to be titaniferous iron. A rather large, yellow and irregularly rounded grain, weighing 0·628 grs., the density of which was only 14·60, was fused on a small cupel in a muffle, and gave a button of alloy, the density of which was 17·48.

The analysis of the grains of gold, performed on one gramme, gave the following results:

Gold,	90·70
Silver,	8·80
Iron,	0·38
	99·88

38. *On some newly discovered Substances from the African Guano Deposits;* by Thornton J. Herapath, Esq., (Quart. Jour. Chem. Soc., April, 1849.)—Some time in the latter part of the year 1845, a paper was read before this Society, by Mr. E. F. Teschemacher,* in which the author gives an account of the results of his analyses, including a variety of substances which had been found in the guano deposits and in their vicinity. Besides those there described, however, I have lately had the opportunity of examining another, which that gentleman does not appear to have taken any notice of. This substance, which was found occurring in large crystalline masses or nodules in a cargo of guano from the island of Ichaboe, on the western coast of Africa, was sent to my father's laboratory for examination by Mr. Ruxton of Swansea, in January, 1846, some of the parties to whom he had supplied the guano having complained to him of the presence of the crystals, imagining them to be an adulteration. These crystals, when purified from the adherent guano, were found to be perfectly transparent and homogeneous, but stained of a light yellowish-brown color by the humic acid and extractive matters of the guano. They were exceedingly frangible, and did not effloresce upon exposure to the air; they dissolved easily both in hot and cold water, and the solutions gave, with the soluble salts of silver, a bright yellow precipitate, which was almost entirely soluble in an excess of nitric acid. When boiled with a solution of potassa, pungent fumes of ammonia were given off, which gave a fugitive stain to moistened turmeric paper. Before the blowpipe, they intumesced, turned black, and gave off water and ammonia; by a further application of heat, the carbonaceous matters were burnt off, and the residue fused into a transparent colorless glass, which dissolved readily in boiling water, giving a solution which yielded a granular precipitate when tested with antimoniate of potash.

The specific gravity of these crystals, as determined by means of oil of turpentine, was about 1·6151. An attempt was made to ascertain the primary form of the crystal, but it was found impossible to do so from the rough irregular masses met with in the guano. By dissolving these, however, in boiling water, and filtering the solution and crystallizing, the salt was obtained in moderately large, colorless, prismatic crystals. Upon subjecting these to analysis, the following results were obtained: * * * * *

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	Mean.
$\dddot{P}$	..	..	..	..	34·291	34·360	..	..	34·325
$\dot{Na}$			..	..	..	..	16·010	15·494	15·752
NH_3	51·030	52·320	7·540	7·820	..	..	..	..	7·680
$\dot{H}$	..	..	..	..	..	..	..	..	42·243

which very closely corresponds with that of the ammonia-phosphate of soda, or microcosmic salt, the formula for which is

$$\dot{Na}, NH_3, \dddot{P}h + 10\dot{H},$$

or according to Graham,

$$Na\,O, NH_4\,O, PO_5, HO + 8HO.$$

* Mem. Chem. Soc., vol. iii, part 16, p. 13.

The original crystals contained the following constituents in 100 parts as:

Crystallized ammonia-phosphate of soda,	91·660
Organic matters, (urates, humates, &c.)	1·956
Phosphate of potash,	traces.
Chlorid of sodium,	0·520
Carbonate of lime,	0·280
Carbonate of magnesia,	traces.
Phosphate of lime,	2·100
Silica, sand, &c.	2·151
Water and loss,	1·332
	100·000

With regard to the manner of the formation of this salt, it is extremely difficult to comprehend how such a compound as the ammonia-phosphate of soda could be produced by the decomposition of a substance so remarkably deficient in the alkalies as guano. For unless we conceive that there was in this case a peculiar and special source of the soda, we must of necessity admit that it was obtained from the decomposition of the chlorid of sodium of the sea-water by the phosphate of ammonia of the guano—the resulting chlorid of ammonium being either volatilized at the high temperature of those climates, or, from its extreme solubility, dissolved out by the rain-water and carried into the sea or the lower strata of the guano deposits. We well know that chlorid of sodium is capable of being decomposed by phosphate of ammonia at a high temperature. May not this decomposition, therefore, also take place when the salts are in solution? I think it very probable.

This being the first instance in which the ammonia-phosphate of soda has been met with as a natural production, I propose to class it amongst our minerals under the name of "*Stercorite.*"* I should have preferred to have given it that of Guanite, as being more indicative of its origin, but this has been already applied by Mr. Teschemacher to the ammonio-magnesian phosphate, another product of the decomposition of guano.

I have also examined another salt which was met with in the same cargo of guano as the preceding, to which it bore a very close resemblance, both in physical and chemical properties. Like it, it was frangible, crystalline, and readily soluble in water, and gave off ammoniacal fumes when heated to redness or when treated with caustic potash; it also gave a yellow precipitate with nitrate of silver; but it differed from it in efflorescing upon exposure to the air, and in not giving a precipitate with antimoniate of potash.

The primary form of the crystal, as nearly as could be determined from the few imperfect specimens in my possession, was an oblique rhomboidal prism, with a dihedral summit. Upon redissolving these in water and recrystallizing by spontaneous evaporation, long acicular crystals were obtained, which, when dried between pieces of bibulous paper and subjected to analysis, afforded the following results:

* From the Latin "*Stercoro,*" to dung or manure land.

I. 2·131 grains of the crystals, when heated to redness, lost 1·034 grs. in weight of water and ammonia.

II. 1·940 grains gave 6·039 grs. of ammonio-chlorid of platinum =0·465 grs. of ammonia.

III. 3·500 grains gave 10·539 grs. of phosphate of lead, which gave 11·786 grs. of sulphate of lead =1·854 grs. of phosphoric acid.

Or, in 100 parts:

	I.	II.	III.	
Water,	48·521 (Water and Ammonia)	....	....	23·058
Ammonia,		23·980	....	23·980
Phosphoric acid,	....	....	52·962	52·962

numbers which are very nearly equivalent to 1 atom of ammonia, 1 atom of phosphoric acid, and 1½ atoms of water. It may therefore be considered as the neutral *phosphate of ammonia*. The excess of water was doubtless caused by the moisture which remained between the interstices of the crystals. It was therefore the same salt as that which had been previously examined by Mr. Teschemacher, but which he was prevented from analyzing quantitatively on account of the smallness of the quantity in his possession.

In conclusion, I should perhaps observe that the guano from which the above substances were obtained was exceedingly moist, and possessed a strong ammoniacal smell.

39. *On the probable extent of the Flora of the Coal-Formation in Britain;* by Dr. Hooker, (from a Memoir on the Vegetation of the Carboniferous Period, in Jameson's Jour., vol. xlvi, 1848–49.)—No fewer than 300 species of plants have been enumerated as belonging to the Coal Flora of Great Britain; but, whether this gives any approximation either to what was the amount of species at one period, or even to all those which contribute to form the coal, it is impossible to say. It need hardly be observed, that a collection of the fragments imbedded in our most recent deposits is no index to the general mass of existing vegetation, nor are the remains necessarily those of the commonest plants, or even of such as would *à priori* be judged the best suited for becoming fossilized. That hitherto unknown species do exist in an available state for the botanist cannot be doubted; they are of frequent occurrence; but that these are not so numerous as might be expected from the enormous magnitude of a coal-field, is evident from the great uniformity that prevails throughout the formation. It may indeed be a query, whether the number of species still to be discovered will equal in amount that of the so-called species, which, being founded on imperfect specimens, will ultimately prove to belong to previously described forms.

It cannot be disputed that the vegetation of the carboniferous period, whether confined to the coal-veins or not, was highly luxuriant. The enormous bulk of carbon accumulated, and the prevalence of ferns in all the fields, and the great size to which so many soft-tissued plants attained, all prove this fact. A luxuriant vegetation is, however, no index to a varied one; and, as many of our modern woods, and even great areas of tropical forests, consist of but a few species greatly multiplied, so may the forests of the carboniferous period have been composed of but a few *Sigillariæ* and *Lepidodendrons*, sheltering an under growth of a limited number of kinds of fern,* for a very limited number of them (comparatively speaking), if as protean as some of their allies are in our day, would embrace all the known species of the Fossil Flora.

In the temperate latitudes particularly, a recent Flora marked by a preponderance of ferns, is almost universally deficient in species or other orders ; as is thus shewn. 1. Where one species prevails over a considerable area, as the bracken (*Pteris aquilina*) does in parts of Britain, and the *P. esculenta* in Van Diemens Land and New Zealand, it generally monopolizes the soil, choking plants of a larger growth on the one hand, and admitting no undergrowth of smaller species on the other. 2. A luxuriant vegetation of many species of ferns, continued through a great many degrees of latitude or longitude, especially in the temperate regions of the globe, generally indicates a uniformity of temperature throughout that area, and a paucity of species of flowering plants. A comparison of the vegetation of Tasmania and New Zealand illustrates this. The former of these islands, barely 200 miles long, contains four times as many species of flowering plants as New Zealand, whose total length is 900 miles. On the other hand, this latter country possesses more than four times as many kinds of fern as Tasmania, and they are so uniformly distributed over its area, that almost all those which are found at the southern extremity of the island, prevail also at the northern. The West Indian and Pacific Islands again present a flora, remarkably rich in ferns, and, in both these instances, we have very many of the species uniformly spread over an enormous surface, in the one instance, from the windward Islands to Mexico ; and, in the other, from New Zealand to the Society and Sandwich Islands. Take, on the other hand, the campos of Brazil, the sandy flats of Southern Africa, and the somewhat similar plains of Australia, and sterile though they appear at first sight, they will be found to abound in many kinds of flowering plants ; but unaccompanied with ferns.

This prevalence of ferns has been long adduced in proof of the climate of the carboniferous period being temperate, equable, and humid ; and so, no doubt, it was ; but I am not aware that it has been hitherto regarded as probable evidence of the paucity of other plants, and the general poverty of the whole flora which characterized that formation. If, however, the laws of existing vegetation are to be considered as having had equal force at that time when the fossil one flourished, we must conclude that the predominance of ferns in general, and of certain species of Pecopteris (a fern apparently allied to our *Pteris*), over a great area, together with the remarkable similarity of the English fossils with those of North America, are all indications that the flora of that period was poor in number of species.

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* This preponderance of ferns over flowering plants is common to many tropical islands, and not confined to the smaller of them, as St. Helena and the Society group. In extratropical islands, too, as New Zealand, I have collected as many as thirty-six kinds of fern in an area not exceeding a few acres ; they gave a most luxuriant aspect to the vegetation, which presented scarcely a dozen flowering plants and trees besides. An equal area in the neighborhood of Sidney (in about the same latitude), would have yielded upwards of 100 flowering plants, and but two or three ferns.

Let it not be supposed that this prevalence of an order, which, in point of complexity of structure, is low in the system of plants, is a fact favorable to the hypothesis that the vegetation of which it appears to form a large part, was less highly developed than what succeeded it. We know too little of the structure of the ferns of that day, to pronounce them either more or less complete than their allies of the present time; while of *Lycopodiaceæ*, it may be safely asserted, that they were of a form and stature far more noble, and in structure more complicated, than any plants of that order now existing. (*Vide* vol. ii, Part 2, of *Memoirs of the Geological Survey of Great Britain.*)

40. *The Himalayan Alpine Land;* by B. H. Hodgson, Esq., (Jameson's Jour., vol. xlvi, p. 189, 1848–49.)—The vast limitary range of snows to the north of India, has been known in all ages by names derived entirely from Sanscrit, the Greeks and Romans neither coining fresh appellations nor even translating the sense of the Indian ones into their own languages, but adopting almost unaltered the Sanscrit names they found. These are Hemáchal, Hema-achal, *snowy mountain;* Hemádri, Hema-adri, the same; Hemálaya, Hema-alaya, *place of snow;* Hemódaya, Hema-údaya, *source of snow;* (as Suryódaya, *source of sun or East.*) From the last term the Greek Œmodus is deduced without alteration. The following tables, shewing the relative height of the great Andean and Himalayan peaks, and the connection of the latter with the physical geography of northern India, may prove interesting, since no one but myself I believe is in a position to note the connection of the snowy peaks with the distribution of waters as regards the eastern half of this magnificent theatre of nature's vastest display.

Andean Peaks.	Feet.	Himalayan Peaks.	Feet.
Sorato,	25,400	Nanda Devi,	25,749
Illimani,	24,350	Dhavala giri,	27,060
Desya cassada,	19,570	Gosain than,	24,700
Descabeçada,	21,100	Kanchan Jhinga,	24,000
Chimborazo,	21,441	Cholo,	26,000

HIMALAYAN PEAKS.

Names.	Relations.
No known peak,	Basin of the Indus, Alpine Paunjab.
Nanda Devi (above Rohilkhand),	Alpine Gangetic basin, East end. Alpine Karnalic basin, West end.
Dhavalagiri (above Gorakpoor),	Alpine Karnalic basin, East end. Alpine basin of Gandac, West end. Naraini.
Gosainthan vel Dayabhang (above the valley of Nepal),	Alpine basin of Gandac, East end. Trisul. Alpine basin of Cosi, West end, Sún Cosi.
Khanchan Jhinga (above Sikim),	Alpine Basin of Cosi, East end, Tamvar. Alpine basin of Tishta, West end, Bomchu.
Cholo (above Bhutan),	Alpine basin of Tista, East end, Painomchu. Alpine basin of Monas, West end, Baréli.

The latter of the above tables shews with distinctness the connection that exists between the greatest elevations of the snowy range and the aquatic system of the Sub-Himalayas, so that the great snow peaks are really entitled to be considered *divortiæ aquarum* on the Indian side of the snows, whatever may be the case on the Tibetan side: and, it is observable that at those points where the transnivean origin of our river necessitates a partial reference of our aquatic system to extra Indian limits, there no such towering snowy peak seems to demark the alpine Sub-Himalayan basin as in cases where our aqueous system is altogether our own and Cisnivean. Thus we have no peak to define the basin of the Indus on its western *or* eastern margin. At least I know of none, though Pargyúl may in part be considered a water-shed, and so, at the other end of the chain, may Chumalari. Both peaks, however, are detached and stand on the plain of Tibet. Cholo is near to Chumalari and not detached. Of the innumerable rivers of these regions the only ones with ascertained transnivean sources are the Indus, Sutlege, Karnáli, Saupu, and Arún, whereof the four first take their rise at Gangri, the great water-shed of the plain of Tibet, close to Lake Mepang vel Manasrovar, and the fifth or Arun from the northern slope of Hemáchal in the district of Tingri. These five rivers are, as might be expected, the largest of the whole, both the Karnali and Arun exceeding the Ganges or Jumna within the mountains, and being nearly equal the one to the other. Gangri is probably the Kailas of the Hindus, whence diverge to the four quarters of the compass the four great rivers of Bhárat des. I have said above that only five of our rivers have trans-Himalayan sources. It is however probable, though unascertained, that the Painomchú and Monas arise beyond the snows, and are identical respectively with the Naivel Pá-chu and the Mon-chú of Klaproth. Chú vel Tchú means river, so that in the one case we have an absolute identity of names, and nearly so in the other (Pá-Pai, the root).

Klaproth's determination to make the Sanpu something else than the Brahmputra, has led him to overlook the several large streams descending into Bhutan and Assam. Had he been aware that his Shokbaja is Sho vel Bhutan, and his Mon vel Moun the Cis-Himalayans generally, he must have been more accessible to recent evidence against his theory.*

With regard to the heights of the Himalayan peaks, of the five given, the two first are Webb's and Herbert's, the third Colebrook's, and the fourth and fifth Waugh's, communicated verbally, the results of his recent operations not having yet been completely worked out. The peak called by me Cholo, Captain W. supposes to be Chumalari; but the natives say otherwise. Captain W.'s positions for triangulation† were at 85 miles distance. Captain Herbert justly observes that unequalled and vast as is the elevation of the giants of Hemachal, no adequate conception of the vast mountain mass can be formed by merely adverting to them. The best way is to contemplate the whole extent and general elevation of the snowy region spreading over some 1800

* Memoirs relatifs à l'Asie 3,370—417, and Map.
† Tanglo and Singchal in Sikim, 10 miles apart.

to 2000 miles, with a breadth or depth of 20 miles, peaks above 5 miles high, distributed throughout *its whole extent*, and passes similarly extended, *yet seldom or never* falling *below* 15,000 *feet;* and all this though we admit Humboldt's somewhat theoretic negation of the general opinion, that Hemachal, and not, as he contends, Kuenlun, is the chain which divides Asia from end to end!

III. Zoology.

1. *Synopsis of the Genera of Gammaracea;* by James D. Dana.—The tribe of Amphipoda among Crustacea includes the subtribes Gammaracea and Hyperiacea. The former of these subtribes consists of six groups or families.

Fam. 1. Orchestidæ. Saltatoriæ. Palpus mandibularis obsoletus. Corpus compressum, epimeris latis. Styli caudales duo postici breviores.

Fam. 2. Gammaridæ. Saltatoriæ vel natatoriæ. Mandibulæ palpigeræ. Corpus sæpius compressum. Antennæ flagello confectæ, non pediformes. Styli caudales duo postici sive longi sive breves.

Fam. 3. Corophidæ. Gressoriæ. Corpus plus minusve depressum, lineare, abdomine recto, normali, epimeris angustissimis vel obsoletis. Mandibula palpigera. Antennæ pediformes.

Fam. 4. Icilidæ. Corpus depressum, latum, abdomine normali, inflexo, pedibus latè expansis instar Araneæ. Antennæ non pediformes.

Fam. 5. Cheluridæ. Corpus vix compressum. Abdomen abnormale, segmentis duobus tribusve coalitis et irregularibus; stylis caudalibus sex, dissimilibus. Antennæ breves pediformes.

Fam. 6. Dulichidæ. Isopodis affines. Corpus depressum, lineare. Antennæ pediformes. Abdomen abnormale, 5-articulatum, stylis duobus. Antennæ pediformes. Pedes tertii quartique breves, sex sequentes elongati, Caprelliformes.

In the following synopsis, the synonymy is included only so far as it is not contained in the work on Crustacea by Milne Edwards (Paris, tome iii, 1840); copious notes also are added. The number of new genera introduced since 1840 is quite large, and a few are instituted from the collections by the writer in the Exploring Expedition.*

We add a word on a single point in the distinctions of genera. The size of the hands among the Orchestidæ and Gammaridæ has often been deemed to some extent an important generic character. But it is now well known that the gradations in the same group are imperceptible, and farther, females may have minute and hardly prehensile feet, while in males of the same species the corresponding hands are quite large. On this ground, Fr. Müller has lately denied the propriety of separating the Orchestiæ, and Talitri (Archiv für Naturg., 1848, p. 53). There is however a wide difference between the species having a styliform joint terminating the *second pair* of legs and those with a hand however minute or obsolescent. The only safe course appears to the writer to consist in drawing the line between *species having a finger or claw however small or large, closing upon the fifth joint,* and those *species having an extended finger or claw not closing up.* Kröyer's *Anonyx*, according to his descrip-

* The Crustacea of the Exploring Expedition under Captain Wilkes will form a volume of text in 4to, accompanied with figures of all the species in a folio atlas. Brief descriptions will from time to time appear in the Proceedings of the American Academy of Arts and Sciences of Boston, part of which, relating to the Entomostraca and including upwards of 150 species, has already been published. The number of new species of Amphipoda in the collections exceeds eighty.

tion, has the 4 anterior feet non-prehensile; but in his figures, these feet are subprehensile though minute, and they resemble in this, many *Amphitoe, Orchestiæ*, and *Allorchestes*. The two *anterior* feet of the Talitri vary widely, from an obsolescent hand to a large strong prehensile form. Here as elsewhere in nature, there is no saltus in the gradations to aid us in generic groupings.

The larger part of the new genera recently added, have been instituted by Kröyer from species obtained in high northern latitudes. It is remarkable that the form in this tribe should be so greatly varied in the colder seas, and confined to so few genera in tropical latitudes.

Fam. I. ORCHESTIDÆ.

1. Pedes secundi non subcheliformes. Antennæ superiores basi inferiorum breviores. — *Talitrus* (Latreille).
2. Pedes primi secundique subcheliformes. Antennæ superiores basi inferiorum breviores. Maxillipedes ad apicem obtusi. — *Orchestia* (Leach).
3. Pedes primi secundique subcheliformes. Antennæ superiores breviores, basi inferiorum longiores. Maxillipedes ad apicem unguiculati. — *Allorchestes* (Dana.*)

Fam. II. GAMMARIDÆ.

Sub-fam. I. Lysianassinæ.

Antennæ superiores ad basin crassæ. Epimera grandia. Pedes sex postici non prehensiles.

I. Pedes subcheliformes nulli, secundis interdum exceptis.

a. *Pedes quinti sexti septimique directione similes.*

1. Antennæ superiores appendiculatæ. — *Lysianassa* (M. Edw.).
2. Antennæ superiores non appendiculatæ. — *Phlias* (Guérin).

b. *Pedes quinti tertii quartique directione similes.*

1. Antennæ sup. appendiculatæ. Palpus mandibularis 1-articulatus. — *Stegocephalus*† (Kröyer).

II. Pedes primi subcheliformes, secundi non subcheliformes; reliqui non prehensiles.

1. Antennæ sup. appendiculatæ. — *Opis*‡ (Kröyer).
2. Antennæ sup. non appendiculatæ. Pedes secundi vergiformes; tertii quartique brevissimi. — *Uristes* (Dana).

III. Pedes primi secundique subcheliformes, reliqui non prehensiles.

1. Antennæ sup. appendiculatæ. — *Anonyx*§ (Kröyer).
2. Antennæ sup. non appendiculatæ. — *Stenia* (Dana).

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* The species of this genus have the aspect of many Amphitoe, and have probably been hitherto referred to that genus. They have the very short posterior stylets of the Orchestiæ, and resemble them in habit and in the absence of a palpus to the mandible; while they differ in having the superior antennæ *longest* and in the stout spine or claw terminating the maxillipeds. The writer has dissected the mouth of nearly a dozen species of Allorchestes.

† Kröyer's Naturhistorisk Tidsskrift, (Copenhagen,) iv, 150, 1842. "Caput *oculis*, ut videtur, destitutum." "Antennæ breves (capitis altitudine non longiores)." "Pedes quinti paris pedibus tertii quartique paris structurâ et directione similes."

‡ Tids., iv. 149. "Pedes primi paris chelis armati portentosæ magnitudine. Reliqua cum genere *Anonyce* fermè conveniunt."

§ Tids., ii, 256 and iv, 164. This genus is united with Lysianassa by Milne Edwards. Any species wholly without hands are properly *Lysianassæ;* those with only two anterior hands, however minute or imperfect, belong to *Opis*.

IV. Pedes tertii quartique subcheliformes.

1. Antennæ sup. appendiculatæ. Pedes tertii quartique validi, articulo quarto dilatato instar palmæ, ungue conico, aculeato. *Pontoporeia** (Kröyer).

SUBFAM. II. GAMMARINÆ.

Antennæ superiores ad basin tenues. Epimera sive grandia sive angusta. Pedes 6 postici non prehensiles.

I. Pedes subcheliformes nulli, secundis parvulis interdum exceptis.

1. Antennæ superiores appendiculatæ. *Alibrotus* (M. Edw.).
2. Antennæ sup. non appendiculatæ. *Acanthonotus* (Owen).

II. Pedes primi subcheliformes, secundi non subcheliformes, reliqui non prehensiles.

1. Antennæ sup. appendiculatæ. *Leptochirus*† (Zaddach).

III. Pedes primi secundique subcheliformes, reliqui non prehensiles.

A. *Antennæ secundæ subtus primas insitæ.*

* Digiti toti uni-articulati.

a. *Pedes sex postici similes.*

1. Antennæ sup. appendiculatæ. *Gammarus*‡ (Fabr.).
2. Antennæ sup. non appendiculatæ. *Amphithöe*§ (Leach).

* Tids. iv, 152. "Pedes primi et secundi paris perbreves, robusti; illi manu latá instructi ungue vero breviore; hi manu carentes ungueque præditi rudimentari. Pedes tertii quartique paris longiores, validi, subcheliformes, articulo quarto dilatato palmam efficiente, ungue armati conico, aculeato. Pedes quinti et sexti paris recurvi, articulo primo parum modo dilatato ungue armati perpusillo. Pedes septimi paris recurvi, articulo primo permagno, clypeiformi; articulo sexto vel ungue rudimentari. Epimera magna."

† Syn. Crust. Pruss. Prodromus, 1844. This genus is stated to be allied to Amphithoe.

‡ From the genus Gammarus, Leach separates:—

MÆRA (Edinb. Encyc., vii, 403; Trans. Linn. Soc., xi, 359.) Manus secundæ valde inæquæ, majore bene cheliformi.

MELITA (Edinb. Encyc., vii, 403.) Digitus pedum secundi paris in latus manûs claudens.

The *Amathia* of Rathke (Fauna der Krym, Mem. Acad. Imp. St. Petersburg, iii, 1837, p. 291, and Beit. zur Fauna Norwegens, Act. Leop., xx Bd.) includes those Gammari which have the superior antennæ shortest—apparently an unimportant distinction.

§ Amphithöe includes the *Dexamine* and *Pherusa* of Leach. *Eusirus* of Kröyer (Tids., N. R., i, 501,) is somewhat peculiar in the form of the hands, but the gradations among the species are such that the character is not sufficient even for a subgenus.

Kröyer's *Microcheles* (Tids., N. R., vol. ii,) is also near Amphithöe. The principal point of difference mentioned is the absence of the molar prominence from the mandible. The *small hands* to which the name alludes is common to many Amphithöes, especially females.

The *Iphimedia* of Rathke (Beit. zur Fauna Norwegens, p. 85; Act. Leop., Bd. xx) appears to differ little from Amphithöe. The superior antennæ are shorter than the inferior, and this characterizes generally the species from the higher latitudes. *Acanthosoma* of Owen (Ross's 2d voyage to the north in 1829–1833, Append., p. xci) has the same characters. The description of Iphimedia by Rathke is as follows—p. 89. "Antennæ superiores inferioribus breviores; illarum pedunculus e tribus, harum e quatuor articulis, compositus: omnium flagellum tenue, multiarticulatum. Pedes secundi paris manibus simplicibus, primi paris, illis minores, chelis instructi, quarum pollex ex uno tantum articulo constat. Reliqui pedes iis Gammarorum similes. Pedes spurii in duos ramos plus minusve complanatos divisi."

b. *Pedes sex postici non similes.*

1. Pedes quinti recurvati, inversi, ungue rudimentari. Antennæ sup. non appendiculatæ. — *Photis** (Kröyer).
2. Pedes septimi longissimi, tenues, fere filiformes. Antennæ sup. non appendiculatæ. Frons in rostrum producta. — *Œdicerus*† (Kröyer).

† Duo quatuorve digiti bi-articulati.

1. Pedes primi digitum bi-articulati. Antennæ sup. non appendiculatæ. — *Leucothöe* (Leach).
2. Pedes secundi digitum bi-articulati. — *Erichthonius* (M. Edw.).
3. Pedes primi secundique digitum bi-articulati. Antennæ tenues, sup. appendiculatæ. — *Pardalisca*‡ (Kröyer).

B. *Antennæ secundæ post primas insitæ, fronte in rostrum productâ.*

1. Digiti uni-articulati. Pedes 6 postici similes. Antennæ anticæ appendiculatæ. — *Ischyroceras* (Kröyer).

IV. Pedes tertii quartique prehensiles ; sequentes non prehensiles.

A. *Antennæ secundæ subtus primas insitæ.*

1. Manus tertiæ quartæque simplicissimæ, pollice instructæ. Digiti uni-articulati. Antennæ sup. appendiculatæ. — *Lepidactylis*§ (Say).
2. Manus tertiæ quartæque articulis tertio quartoque instructæ, et digiti articulis sequentibus coalitis. Corpus subdepressum. Antennæ sup. appendiculatæ. — *Protomedeia*‖ (Kröyer).
3. Manus tertiæ quartæque articulo tertio instructæ, et digiti articulis sequentibus junctis, articulo ultimo longissimo, gracillimo. Antennæ graciles. Epimera magna. — *Ampelisca*¶ (Kröyer).
4. Manus tertiæ quartæque articulo quarto instructæ, et digiti articulis quinto sextoque. Corpus subdepressum. Antennæ sup. appendiculatæ ; inf. subpediformes. Pedes primi secundique subcheliformes. — *Aora*** (Kröyer).

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* Tids., iv, 155. "Corpus sat altum, compressum. Antennæ subpediformes flagello appendiculari destitutæ." "Epimera permagna: quinque paria anteriora ad marginem inferiorem setis sat longis instructa; quintum eadem est ac quartum altitudine, postice profundius excisum."

† Tids., iv, 155. "Frons in rostrum producta, plus minus acutum obtusumve, semper vero nodo pellucente, ovali, flavo rubescente, turgidum. Oculi nulli?" "Pedes primi et secundi paris manu armati subcheliformi permagna. Pedes tertii, quartique paris validi, ungue instructi lato, laminari; quod quoque usu venit quinto sextoque pari, quorum articulus primus dilatatus non est." "Epimera mediocris magnitudinis."

‡ Tids., iv, 153. "Caput crassiusculum, subtumidum. Epimera exiguæ magnitudinis." "Pedes tertii quartique paris ungue sublaminari, posticè subtiliter serrulato. Pedes reliqui elongati, sat debiles, femoribus subangustis."

§ Jour. Acad. Nat. Sci. of Philadelphia, i, 380. Superior antennæ appendiculate, shorter than the inferior pair.

‖ Tids., iv, 154. "Antennæ inferiores pediformes, pedunculo longissimo, flagellum ter ad minus longitudine superante. Pedes secundi paris parvi, manu non instructi subcheliformi." "Epimera sat brevia."

¶ Tids., iv, 154. "Pedes primi secundique paris nulla instructi manu subcheliformi." "Pedes quinti sextique paris articulis modo compositi quinque, quorum ultimus ad finem marginis posterioris ungue armatus est rudimentari, recurvo, immobili (vel parum mobili). Septimum pedum par ungue laminari, lato, natatorio (?)" "Oculi simplices (?)" "Epimera magna." "Sextum pedum abdominalium par natatorium. Reliqua ut in genere Amphithöe."

** Tids., N. R., i, 328, 1845. "Quintum pedum par brevissimum, robustum; sextum par septimumque quinto multo longiora sed graciliora." "Pedes abdominales quarti, quinti et sexti paris saltatorii."

B. *Antennæ secundæ post primas insitæ, fronte in rostrum productâ.*

1. Manus tertiæ quartæque articulis tertio quartoque instructæ, et digiti articulis sequentibus coalitis. Antennæ anticæ appendiculatæ, breves. Pedes primi secundique subcheliformes. *Phoxus** (Kröyer).

SUBFAM. III. ISÆINÆ.

Pedes sex quatuorve postici subprehensiles.

A. *Antennæ secundæ subtus primas insitæ.*

1. *Gammaro* similis. Pedes decem postici similes. Antennæ sup. appendiculatæ. *Isæa* (M. Edw.).
2. Pedes tertii sexti septimique crassè cheliformes; secundi minores; primi quarti quinti minimi. Digiti toti uni-articulati. *Anisopus* (Templeton).

B. *Antennæ secundæ post primas insitæ, fronte in rostrum productâ.*

1. Pedes decem postici subcheliformes, similes. *Laphystius*† (Kröyer).

FAM. III. COROPHIDÆ.

a. *Digiti duo 2-articulati.*

1. Antennæ totæ flagellis confectæ. Caput et segmentum proximum in unum coalita. Pedes quarti, quinti, sextique obsoleti? *Cerapodina* (M. Edw.).
2. Antennæ flagellis carentes. *Cerapus* (Say).

b. *Digiti nulli 2-articulati.*

* Antennæ inferiores flagellis carentes.

1. Pedes secundi non subcheliformes. *Corophium* (Lat.).
2. Pedes primi secundique subcheliformes. *Podocerus*‡ (Leach).

† Antennæ quatuor flagellis gracilibus confectæ.

1. Pedes primi secundique subcheliformes. Antennæ superiores appendiculatæ. *Unciola*§ (Say).
2. Pedes primi secundique subcheliformes. Antennæ superiores non appendiculatæ. *Atylus* (Leach).

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* Tids., iv, 150. "Sextum pedum par ceteris multo longius." "Epimera permagna."

† Tids., iv, 156. "Antennæ sat breves, subulatæ, validæ." "Pes primi paris gracillimus, manu lineari; ungue elongato; pes secundi paris brevis, validus, manu quadrata, ungue sublaminari apice setoso. Reliqui decem pedes validi, subcheliformes, eadem ferme longitudine. Epimera mediocris magnitudinis; quartum par in acumen inferne productum."

‡ The Siphonœcetes of Kröyer (Voy. Scand., etc., 1838–1840, pl. 20, fig. 1; Tids., N. R., i, 481, 1845) differs from Podocerus only in having the posterior legs longer than the four preceding. In his description he says, p. 491:—

"Pedes thoracici primi et 2di paris validissimi, manu instructi subcheliformi. Pedes 3tii et 4ti paris articulo primo latissimo, laminari; articulo quarto obcordato, laminari, manum præbente, cujus unguis efficitur articulo quinto subconico articuloque sexto aciculari. Pedes 5ti 6tique paris minutissimi, sed robusti, recurvati, articulo primo clavato, ungue furcato. Pedes 7mi paris graciles, recurvati, articulo primo laminari, ungue minutissimo, furcato. Pedes abdominales 1mi, 2di et 3tii paris natatorii breves validissimi, parte basali latissima, rhomboidali; pedes 4ti, 5tique paris saltatorii, pes abdominalis sexti paris natatorius unica instructus lamina terminali."

§ Glauconome of Kröyer (ibid, pl. 19, fig. 1; Tids., N. R., i, 491, 1845) has the hands and antennæ of Unciola. The following is the description, p. 501:—

"*Antennæ* subpediformes; superiores flagello ornatæ appendiculari perparvo. *Oculi* minuti, parum distincti. *Mandibulæ* apex in duos fissus ramos qui dentibus

‡ Antennæ longæ, flagello crasso rigidoque, obsoletè articulato.

Antennæ styliformes, rectæ. Pedes filiformes, non prehensiles, sex postici prælongi.	*Clydonia* (Dana).

Fam. IV. Icilidæ.

1. Pedes postici sublamellati.	*Pterygocera* (Lat.).
2. Pedes toti vergiformes, nulli prehensiles.	*Icilius* (Dana).

Fam. V. Cheluridæ.

Abdomen ad extremitatem crassè styliforme, (segmentis quarto quinto sextoque in articulum styliformem coalitis).	*Chelura** (Philippi).

Fam. VI. Dulichidæ.

Caprelliformes. Abdomen 5-articulatum. Segmenta thoracis sextum septimumque coalita.	*Dulichia*† (Kröyer).

2. *On the Pancreatic Juice;* by M. Bernard,‡ (L'Institut, No. 791, Feb. 28, 1849.)—Alimentary substances have been arranged by some recent chemists in four groups:—substances soluble by themselves and consequently absorbed directly by the veins and the digestive tube; amylaceous substances converted into sugar; fibrinous matters requiring a special fermentation in order to become soluble; and fatty substances, evidently designed to pass into the chyle and giving it its most decided characters. The recent researches of MM. Bouchardat and Sandras, Mialhe, Bareswill and Bernard himself, have placed beyond doubt the existence of a ferment fitted to change fecula to sugar in some of the liquids which mixed with the aliment. They have shown that the gastric juice has for its primary object the digestion of azotized substances. It remained still to discover the agent operating in the formation of chyle properly so called. M. Bernard argues on the following grounds, suggested by experiments, that this remarkable function belongs to the pancreatic juice.

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sunt armati conicis; tuberculus molaris dentibus confertissimis instructus. *Labium superius* breve, depressum latissimum, margine anteriori medio inciso; *labium inferius* quatuor compositum laminis setosis. *Laminæ maxillares* pedum maxillarium dentibus armatæ validis; unguis palpi apice setosus. *Pes primi paris* robustissimus, manu subcheliformi; pes *secundi* paris gracilior, manu carens subcheliformi, pedes 3tii, 4tique paris pergraciles; pedes 5ti, 6ti, 7mique paris graciles femoribus parum dilatatis. Pedes abdominales 1mi 2di et 3tii paris natatorii, breves sed robustissimi; 4ti, 5tique paris saltatorii, validi; 6ti paris fere rudimentares, natatorii. Epimera minima fere evanescentia."

* Philippi, Archiv fur Naturg., 1839. Also on Chelura terebrans, G. J. Allman, Ann. and Mag. Nat. Hist., xix, 361, June, 1847.

† Kröyer, Tids., N. R., i, 512, 1845, and Voy. Scand., etc., pl. 22, fig. 1, 1*a*–1*n*. "Corpus valde elongatum gracili. Antennæ longissimæ (imprimis superiores) subpediformes; superiores flagello instructæ appendiculari. Oculi prominentissimi, acuminati. Pedes 1mi paris compressi, manu (articulo 4to) magna, ungueque biarticulato instructi (qui unguis articulo 5to 6toque junctis efficitur). Pedes 2di paris manu instructi subcheliformi (quæ apud mares maxima est). Pedes 3tii 4tique paris minimi, fere filiformes, invicem ejusdem fermè longitudine et forma. Pedes 5ti 6ti 7mique paris elongati, lineares (femore non dilatato) prehensiles. Sextus thoracis annulus cum septimo coalitus ut difficilius distinguantur. Epimera nulla vel prorsus rudimentaria. Abdomen quinque modo compositum annulis et quinque præditum pedum paribus, quorum tria anteriora natatoria, duo posteriora saltatoria sunt."

‡ See a notice of a previous memoir, in this Journal, vol. vi, p. 276, 1848.

(1.) The pancreatic juice, when pure and recently formed, emulsionates fats or oils with the greatest facility; the emulsion remains for a long time and the fatty bodies soon undergo a fermentation which separates the acids they contain.

(2.) The chyle begins to be collected in the chyliferous ducts about that part of the intestinal tube where the pancreatic juice is mixed with the alimentary matters.

(3.) When the pancreas are affected, the fatty substances contained in the aliment pass without change into the dejections.

The memoir of M. Bernard has been reported upon favorably by MM. Magendie, Milne Edwards and Dumas, a commission of the Academy of Sciences of Paris.

3. *A description of the characters and habits of Troglodytes gorilla;* by THOMAS S. SAVAGE, M.D., corresponding member of the Boston Society of Natural History; and of the Osteology of the same, by JEFFRIES WYMAN, M.D., Hersey Professor of Anatomy in Harvard University, Boston, 1847, (extracted from the Boston Journal of Natural History.)—We have here another species added to the list of anthropoid animals from the banks of the Gaboon river in Africa, an animal however somewhat inferior in its organization to its well known congener and compatriot the Chimpanzée (*T. niger* of Geoff.) For the first recognition of gorilla (Engé-ena of the natives of Gaboon) as a new species, the scientific world is indebted to Dr. Thomas S. Savage, for many years a missionary resident at Cape Palmas, W. Africa, where he has devoted the best energies of his life to the advancement of the religion of Christ, and has always made it consistent with his duties to lend a helping hand to the cause of science.

Dr. Savage, in April, 1847, first saw two crania which he recognized as distinct from the Chimpanzée, and subsequently obtained two others more perfect as well as other portions of the skeleton. These with such information as he could collect from the natives, the living animal being unknown to the white population, were forwarded to Boston and are the subject of the present memoir, the section on the external characters and habits being by Dr. Savage, the description of the crania and bones, the specific characters derived from them, and general remarks, by Dr. Wyman, and published in November, 1847, in the Boston Journal of Natural History. In Feb., 1848, Prof. Owen of the Royal College of Surgeons, received three other crania of the same species, which he described under the name of *T. Savageii*, in the Proceedings of the Zoological Society of London, New Series, No. 1. As Prof. Owen has added no new specific characters, *T. Savageii* (Owen) becomes merely a synonym with *T. Gorilla* (Savage).

The first memoir of Drs. Savage and Wyman show that the Engé-enas were far more athletic, in all probability, having a height of about six feet, and far more terrible and ferocious than the shy and harmless chimpanzée. Such a belief with regard to their habits exists among the natives, who regard the chimpanzées as possessed of the spirit of a Coastman, and the engé-enas of the more savage spirit of a Bushman. The cranium of the male measured from the plane of the occiput is two inches longer than an ordinary sized human head, and nearly three-quarters of an inch broader across the zygomatic arches. The scapula and humerus are of gigantic size and are indicative of the immense strength of the arms, which are in relation not only to the arboreal life, but, if the narratives of the natives be correct, to the immense bulk of its body.

The following are the more important of the specific characters enumerated by Dr. Wyman, by which the Engé-ena is distinguished from the Enché-eco or chimpanzée.

1. By its greater size.

2. By the existence of large occipital and interparietal crests in the males.

3. By the great strength and arched form of the zygomatic arches.

5. By the form of the anterior and posterior nasal orifices.

6. By the existence of an emargination on the posterior edge of the hard palate.

7. The incisive alveoli do not project beyond the line of the rest of the face as in the chimpanzée and orangs.

8. The ulna is much shorter than the humerus.

9. The distance between the nasal orifice and the incisive alveoli is less than in the chimpanzée.

This valuable memoir is illustrated by four quarto plates.

IV. Miscellaneous Intelligence.

1. *Telegraphic Operations of the Coast Survey.—Velocity of the Galvanic wave*, (from the Proc. Am. Philos. Soc. Philad., vol. v, p. 74.) —Dr. Patterson, in the name of Prof. A. D. Bache, laid before the Society, an abstract of a report, made by Mr. Sears C. Walker, of the results of the telegraphic operations of the U. S. Coast Survey, made by him on the 23d January last, between Washington and Philadelphia, New York and Cambridge, Mass. A letter from Prof. Bache to Dr. Patterson, accompanying the report, was read by Prof. Kendall.

Washington, March 1, 1849.

Dear Sir,—Will you please communicate to the American Philosophical Society a brief abstract of a Report made to me on the 21st ultimo, of the results of the telegraph operations of the U. S. Coast Survey, made on the 23d of January last, between Washington, Philadelphia, New York and Cambridge, Mass., by Mr. Sears C. Walker, assistant, having charge of the telegraph operations.

The object in view was to test the practical working of the method of imprinting the dates of star transits on a graduated clock register. The three astronomical stations, selected for the occasion, were the Philadelphia Observatory, under the direction of Prof. Kendall; the New York City station, in the private residence of Dr. L. M. Rutherford, under Prof. E. Loomis; and the Harvard Observatory, Cambridge, under Prof. Wm. Cranch Bond.

In conformity with the plan of his Report of December 15, 1849, duplicate records were kept at the Washington Northern Telegraph office, by Mr. Walker and myself.

The astronomical clock was located at Philadelphia, and rated for several days by Prof. Kendall. It contained two tilt-hammer *electrotomes*, one invented by Mr. J. J. Speed, Jr., of Ithaca, N. Y., in 1847 attached to the minute wheel, and giving its signals every two and a half minutes. The other (used for the occasion) was on the plan invented by Dr. Locke, in 1848, and attached to the escapement-wheel. The automatic clock register was graduated to two seconds, usually occupying an inch of paper of the Morse's registering fillet.

Mr. Walker reports, that a comparison of sixty records, made by the two registers at Washington, shows that the probable error of the mechanical operation of printing and reading off, is only about fifteen-thousandths of a second.

This confirms the estimate of accuracy of the work made by him in his report of Dec. 15th last, viz., of a hundredth of a second for the case of an automatic register of single seconds, with an inch of paper to each.

It further appears, from the Report, that when the star-signals were given at Philadelphia, so that the clock and signal-waves had the same local origin, all the registers at all the stations, marked alike, within such limits as were indicated by the probable error just mentioned.

When, however, the star-signals were given at New York, small, but appreciable, differences were noticed in the respective readings of the apparent date of the same event as recorded at the different stations. This discrepancy was still greater for the case of the Cambridge star-signals, the graduating clock always remaining at Philadelphia.

The following table contains the mean excess of the readings of the date of each event in the time of the Philadelphia automatic clock at each station, over that of each of the others, with the number of single results, and the probable accidental error from the source already referred to. The stations compared are denoted by their initials. Those marked *W*, are for the mean of the two records made at Washington. A further revision of these quantities may somewhat change their amounts.

Two kinds of readings were made, viz., *break circuit* signal readings on a *break circuit clock scale*, and *make circuit* signal readings, on a *make circuit clock scale.*

The excess indicated by the mean of the two series of readings for the two scales, with the number of results and probable error of each, are reported as follows. The times A, B, C and D, respectively denote the time of passage of the galvanic wave between W and P, P and N, N and C, C and W.

For reasons connected with the analytical theory of longitudes, by telegraph operations, as published in Mr. Walker's report of Nov. 10, 1847, and in the recent report of the 21st ultimo, the mean of the two series is the most plausible value that can be derived from the printed record. The residual quantities do not appear to be explicable by any admissible value of relative times of operations, of the spiral spring and receiving magnet, armature. Neither do they appear to be explained by any reasonable hypothesis of relative changes of apparent dates from changes of permanent magnetism, as it is called, by change of locality of signal station. The analytical theory of this subject was given by Mr. Walker, Dec. 28, 1847, in his report on the telegraph operations of 1847.

These several sources of error are nearly all eliminated by the manner of forming the residuals of these tables, and being in their nature periodical, disappear in the average of all the results. It may also be remarked, that the outward and inward armature times of the magnets of the local registers, are relatively annulled by their having the same value for the clock and signal electrotomes.

According to Mr. Walker's report, these residual quantities, from change of relative place of origin of the clock and signal waves, may all be explained by the hypothesis that the time of propagation of the galvanic wave from the place of the clock or star signal stations, to that of the receiving register, though small, is not quite insensible. A solution of the eighteen equations of condition formed on this hypothesis, by Mr. Walker, give, for the velocity of the propagation of the galvanic wave, through the compound circuit, eighteen thousand eight hundred miles per second, with a probable *accidental* error, as stated by him, of about one thousand miles. The statistics are too incomplete to warrant any discrimination between the times of propagation of the wave through the different kinds of media, viz., the wires, the batteries, (three in number,) and the ground. After applying the values of the wave-times by this hypothesis, and with this velocity in the different portions of the whole circuit of one thousand and fifty miles, no sensible discrepancy remains, the residual terms being not greater than the probable errors, from the comparison of the two Washington registers. All the readings now harmonize as well as if all the clock and star signals, and all the printed records, had been made in the same place.

The result is one of much interest to the progress of science, and of special importance in the longitude operations of the coast survey.

The value apparently attributable to wave time, is too great to be neglected in telegraph operations for longitudes intended to be used as data in connection with geodetical measurements. A more extensive series of operations, with more complete mechanical arrangements, will be undertaken in the course of the coming season.

Very truly yours, A. D. Bache.

Dr. R. M. Patterson, Pres. Am. Philos. Society.

Table of Relative Distances.

No.	Star Signal Station.	Receiving Station Compared.	Wave Time.	Relative miles traversed by Clock and Signal Waves.
1	Philadelphia	P–W	0	0
2		P–C	0	0
3		P–N	0	0
4		W–C	0	0
5		W–N	0	0
6		N–C	0	0
7	Cambridge	P–W	A+B+C–D	150
8		P–C	2B+2C	900
9		P–N	2B	400
10		W–C	–A+B+C+D	750
11		W–N	–A+B–C+D	250
12		N–C	2C	500
13	New York	P–W	0	0
14		P–C	2B	400
15		P–N	2B	400
16		W–C	2B	400
17		W–N	2B	400
18		N–C	0	0

Conditional Equations.

No.	Conditional equations, $0=ax+n$,	Weight. W.	Wa.	Wn.	Residual Error, $ax+n=\varepsilon$	Probable Error. ε'	$W\varepsilon\varepsilon$
	s			s	s	s	s
1	0=0 − 0·0029	17	0	− 0·0493	− 0·003	±0·006	0·00015
2	=0 − ·0015	10	0	− ·0150	− 0·002	7	4
3	=0 + ·0038	8	0	+ ·0304	+0·004	7	13
4	=0 + ·0075	12	0	+ ·0900	+0·007	6	59
5	=0 − ·0047	10	0	− ·0470	− 0·005	7	25
6	=0 + ·0070	5	0	+ ·0350	+0·007	10	2
7	=1·5×x − ·0117	21	31·5	− ·2457	− 0·003	4	19
8	=9·0×x − ·0453	17	153	− ·7701	+0·005	5	42
9	=4·0×x − ·0115	10	40	− ·1150	+0·011	7	121
10	=7·5×x − ·0386	24	180	− ·9264	+0·003	4	22
11	=2·5×x − ·0144	16	40	− ·2304	+0·000	5	0
12	=5·0×x − ·0442	12	60	− ·5304	− 0·016	6	307
13	=0· + ·0007	9	0	+ ·0063	+0·001	8	1
14	=4·0×x − ·0192	6	24	− ·1152	+0·003	7	5
15	=4·0×x − ·0314	7	28	− ·2198	− 0·008	8	45
16	=4·0×x − ·0225	8	32	− ·1800	+0·000	7	0
17	=4·0×x − ·0300	10	40	− ·3000	− 0·008	7	64
18	=0· + ·0158	6	0	+ ·0948	− 0·014	0·008	118
		208	628·5	+3·5374	− 0·018		0·00862
					±0·100	±0·119	

REMARKS. x=Wave Time for 100 miles. $x=0^s·005629±0^s·000302$. $E=±0^s·00435$, $\frac{10·5}{x}$=18690 miles ±1000 =miles of wave per second. $\Sigma Wnn=0^s·12547$, $\Sigma W\varepsilon\varepsilon=0^s·00862$.

2. *New Planet*, (N. Y. Jour. of Com., June 11, 1849.)—A new planet was discovered by Signor Gasparis, at Naples, April 12, 1849. It resembles a star of the 9th or 10th magnitude, and its place was near a star on Steinheil's Celestial Chart, in R. A. 12^h 9^m 49^s and S. Decl. 7° 0′ 9″, and numbered 23,098 in Lalande's Catalogue Reduced. The motion of the planet was retrograde, and towards the equator.

3. *The American Association for the Promotion of Science.*—Agreeable to an invitation from the Corporation of Harvard University, the next meeting of this Association will be holden at Cambridge, commencing on Tuesday, August the 14th. The officers for the ensuing year are as follows.

President.—Prof. JOSEPH HENRY, of Washington.

Treasurer.—Dr. ELWYN, of Philadelphia.

Local Committee for Boston.

Mr. JOHN A. LOWELL,
Dr. JACOB BIGELOW,
Hon. NATHAN APPLETON,
Hon. NATHAN HALE,
Dr. GEORGE B. EMERSON,
Prof. H. D. ROGERS,
Dr. A. A. GOULD.

Local Committee for Cambridge.

Prof. L. AGASSIZ,
Prof. B. PEIRCE,
Lieut. C. H. DAVIS, U.S.N.,
Prof. E. N. HORSFORD,
Prof. ASA GRAY.

JEFFRIES WYMAN, *Secretary.*

Arrangements will be made for the accommodation of the members of the Association, both as regards board and lodging, in Cambridge.

A meeting of unusual interest is expected. This is the second since the change in the character of the Association, by which all branches of science are included. The wide range of its subjects, calls together all who would promote the progress of science in any of its departments; and no place more abounds in attractions, of a scientific, literary or social character than the one chosen for the sessions.

4. *C. G. Page on Galvanic Light*, in a letter to the Editors, dated Washington, D. C., June 13, 1849.—I regret that my letter requesting the suppression of the notice of experiments upon galvanic light, did not reach you in season. The experiment has no other value than a repetition of those made by Prof. Grove, to prove the identity of galvanic with common light in respect to polarization. Dr. Lardner in the course of his lectures in Washington some years since, stated upon the authority of Arago, that galvanic light could not be polarized, and a friend of mine translating for me a communication of De la Rive, gave a similar rendering upon this subject. Upon recurring to the original notice in the Comptes Rendus, I find that the error was committed in translating the French *polarizè*, polarizable instead of polarized, which materially alters the case.

OBITUARY.

5. Julius T. Ducatel.—It is with pain that we have to record, since the issue of our last number, the demise of our old friend and contributor to this Journal, Prof. Ducatel of Baltimore, who expired at his residence, April 23d. We pay a sadly willing tribute to the memory of this man of science, in inscribing here some particulars of his life and character which have been communicated to us by one of his daily acquaintances.

Julius Timoleon Ducatel was born at Baltimore, June 6th, 1796; and was therefore at the time of his death nearly 53 years old. He was the oldest son of the late Eome Ducatel, who a Frenchman by birth, was for a long time the principal pharmaceutist of Baltimore.

Educated at Saint Mary's College, a seminary of learning under the auspices of members of the Order of S. Sulpitius in the Roman Catholic Church, young Ducatel gave evidences of extraordinary facility for acquisition and retention; a faculty characteristic through life.

After his school-discipline was completed, he attached himself for a while to the business of his father's establishment; and subsequently, at the close of the war in 1815, he visited Havana with a view to a mercantile settlement there.

But such pursuits were not congenial either to his physical temperament or his intellectual activity. His propensity was always to be making advances in knowledge; and if he was precluded at any time from acquiring new facts, to devote himself to systematizing and generalizing those already in possession. With these traits, West Indian commerce was hardly likely to thrive in his hands: so he returned home in 1816, after a little more than twelve months' absence, and again took part in the Pharmacy-establishment.

By this time, verging on manhood, the bent of his talents was so decided that the parental wishes which hitherto seemed to find gratification in the prospect of the old house being perpetuated, opposed no farther obstacle to the manifest destiny of the young man; and he was sent to Paris, then as now the focus of the arts and sciences, to complete his education. There, with the appliances which the wealth of his father, chiefly acquired in the exercise of a meritorious profession and honorable skill, freely allowed, he had full opportunity for increasing his stores of learning; and however he may have mixed in the gay societies of the capital, those who knew him best in after life found cause to admire the extent of his graver acquisitions treasured up since then.

There, he made acquaintances whose correspondence was maintained for more than thirty years, and until death rendered it longer impossible; and the names of Brongniart, Brochant, and Gay-Lussac among them, attest the favorable impressions which the young man of five and twenty made upon those whose scientific fame already shook the world.

His stay in the capital of France and his travels through that kingdom, through Switzerland and Italy, covered a period of nearly four years, and having left America in 1818, he returned in 1822. At that time, geology was far from being the systematic science that it is now; but it may be safely said that he brought back with him a knowledge of its as yet somewhat vague groupings, and an acute and accurate appreciation of mineral characteristics, founded not only upon the study of cabinet specimens, but upon extensive and careful observations *in situ*, second to that of none of his American cotemporaries.

Not long after his return, in 1824, he assumed new relations by his marriage with a lady, the least of whose commendations was, that she was a beauty and an heiress. But the fortunes of his family, which had already stood the shock of some unfortunate commercial speculations, were still more seriously impaired by the reverses of 1825–6; and the epoch of his domestic happiness may also be taken to mark a new period, when it became necessary that his talents and learning should be applied in some degree for his own benefit.

His first engagement was as Professor of Natural Philosophy in the Mechanics' Institute of Baltimore; his next as Professor of Chemistry and Geology in the Faculty of Arts and Sciences in the University of Maryland. To both these chairs he manifestly brought extraordinary resources; and, adding to the reputation of a savant that of an agreeable and successful lecturer, he was at length, upon the decease of the lamented Professor De Butts, in 1830, elected with great unanimity to fill the chair of Chemistry in the Medical Department of the University. Here he had a wider scope for his talents; and he is still gratefully remembered by many who enjoyed the benefit of his public teachings, and still more for that abundant accessibility and cheerful interest which he allowed and manifested in the apparatus room to his students. During several years of this period, he also edited awhile alone and awhile in conjunction with C. H. Calvert, Esq., well known by his taste and attainments in German literature especially, a weekly journal, the Baltimore Times, whose subsequent cessation appears to have been caused by the calling away of the editors to other engagements.

In 1832, upon a resolution of the legislature of Maryland in behalf of a new map of the state, he was appointed in conjunction with J. H. Alexander, Esq., to make the necessary preliminary reconnoissance of the subject and the territory. The report of these gentlemen was republished in this Journal, 1st Series, vol. xxvii, p. 1, seqq. Progress was made in this survey; though it was unfortunately hampered by a spirit of well meant but injudicious economy. Prof. Ducatel pursued his researches as geologist (without assistants however) until 1841, when the embarrassments of the state treasury were held to be sufficient reason for suspending any farther appropriation.

This step, however justified by policy in other regards, was in so far unhappy that it deprived the state of results which were upon the point of attainment and the individual of the opportunity of generalizing and assembling the fruits of several years' observation into a shape worthy of science and of himself: for the annual reports, as they themselves testify, were in no wise looked upon by their writer as completing his task for the particular districts of whose examination they respectively treated. They were but popular announcements of particulars of interest especially to the denizens of the respective localities; and regard seems to have been paid in their very style to the exclusion of technicalities whose introduction among the multitude of topics, though it would have thrown over them a scientific garb, would have defeated the proper industrial aim of the report. Yet as they are, they serve to characterize the cautious yet profound spirit of investigation in their author: facts are simply and unpretendingly stated; and the inferences from them when necessary to be drawn are given without any of that theoretical dogmatism which is sometimes met with and which is so much calculated to mislead the reader and ultimately discredit the writer. It is to be hoped that ere long some one will undertake the subject afresh and, bringing up Maryland abreast with Virginia and New Jersey, again enable that state to be among the foremost in the practical applications of geology for which the chemical discoveries and advances in the last seven years have given so much wider scope than was possible in 1833.

During these engagements, Ducatel was also appointed to the Chair of Chemistry, Mineralogy and Geology in St. John's College, Annapolis; a post which in 1838 or 1839 he resigned, as well as his Chair in the University, in order to devote himself more exclusively to his geological examinations. Such devotion although for the best interest of that work, was perhaps not so well for the interest of the individual; since it was the resignation of an *état* in behalf of a temporary employment, and in fact so it proved when a few years afterwards the geological survey was stopped unfinished, and the Professor found himself looking for employment instead of employment unsought pressing itself upon him. If details of this kind are mentioned here, it is with the view of warning others in similar circumstances,—not of course to encourage a selfish disregard of public duties which they may have assumed, but against any implicit and possibly inconvenient reliance upon the measures and consideration of governments which are proverbially ungrateful.

In 1843, Ducatel accompanied his friend Nicollet in an expedition to explore the geology of the Upper Mississippi, and clear up some important points in the theory of volcanic action supposed to have occurred in that region. The premature death of that distinguished man of science prevented the full effect of the coöperation which was designed.

In 1846, he visited the Lake Superior region upon a reconnoissance in behalf of some parties who were proposing industrial developments there: but its only fruit was an interesting series of lectures which he delivered after his return in the winter of that year.

These journies were in so far disastrous in that an accident (he narrowly escaped death on the spot) occurring to him during the first, and a severe illness brought upon an enfeebled frame by exposure during the last, laid the foundation of the physical disorders from which he never afterwards recovered. For some years, his maladies appear to have affected, except at some brief intervals, his capacity for application and exertion; and to have superinduced an unnatural apathy and premature old age. He died of congestion on the lungs; and was interred, as he had always desired, privately in the presence of his family and of a few intimate friends.

As an author, Professor Ducatel but rarely appeared before the world. His principal work, a Manual of Toxicology, was well received and would have been more widely and beneficially known but for a fire which almost cotemporaneous with its publication destroyed all the copies on hand. He laughingly said it was an ill omen and he feared a worse disaster with another edition. His editorial connection with the Baltimore Times has been already mentioned. At a later period, he contributed regularly for some time the scientific articles for the American Farmer and for another journal of wide circulation, the Sporting Magazine.

Enough has been said to shew the character of Ducatel as a scientific man. If his associations are referred to, it is only to shew how he had been appreciated. Always the foremost in every social enterprise where learning and *savoir faire* were required in his native city, the American Philosophical Society of Philadelphia, the Royal Geological Society of Paris, the Georgofili of Florence, and others numbered him among their members.

In another aspect, his temperament rendered him singularly useful in science. No one was more liberal in imparting either what he knew or what he had; the facts he had observed and the specimens he had collected were always accessible and frequently gifts to those he thought would use them well. Those who have themselves commenced the pursuits of science under difficulties will best appreciate and honor such a trait.

His traits as a man were of the same generous and winning character. They will not be dwelt on here; not from fear lest friendly partiality might transcend the severe limits of biographical justice, but that they do not comport with the aim of this notice. The silence of those who knew and loved him is more eloquent than lines of beauty or pages of tenderness. A.

V. Bibliography.

1. *Report in relation to Sugar and Hydrometers:* on researches made under the superintendence of Professor A. D. Bache, by Prof. R. S. McCulloch. Revised edition, published by order of the Senate of the U. S. (Ex. Doc., No. 50, 30th Congress, 1st Session.) Washington, 1848, p. 653.—This voluminous and elaborate report is divided into two parts, as its title indicates, the subjects being entirely distinct and yet quite germane. The first part of the sugar report was issued in 1845–6, and is now reprinted by order of the Senate in connection with the subsequent and more extended research of Prof. McCulloch. To sketch even the scope of these reports would take us quite beyond the limits of a book-notice.

The labors encountered by Prof. McC. and his assistants in these researches, at home and abroad, are evidently very great, and it appears that no care has been spared to probe the several subjects of investigation thoroughly. The method of analysis for saccharine fluids adopted by McCulloch, is that of circular polarization originally indicated by M. Biot. The reasons for this preference are given and comparative results by the ordinary chemical methods. In an extended series of researches like these, embracing nearly two hundred analyses of molasses and sugars, the method of polarization undoubtedly possesses great advantages in every respect, but it may be doubted whether it can replace the chemical methods in ordinary cases, with perhaps imperfect apparatus and an insufficient experience in the use of the instrument and the application of the formulas.

We receive Mr. McCulloch's reports with great satisfaction as substantial and important additions to our previous knowledge, and an additional proof of the wisdom of Congress in consigning special subjects of this sort, involving profound scientific principles, to competent hands for investigation and report, as the only just and enlightened basis of their legislation.

In hydrometers for determining the value of distilled spirits, the results adopted by Prof. McCulloch are entirely in accordance with the opinions and practice of scientific men and of the more intelligent manufacturers, viz., that the centesimal system of notation is the only proper one, founded on a well conducted set of comparisons of actual weights and densities. The report contains ample details on this subject, and tables of results of numerous careful experiments or known mixtures of absolute alcohol and pure water. The results of these sufficient trials will undoubtedly be the adoption, by the revenue laws, of an uniform standard instrument which is much called for by the notorious differences now acknowledged to exist in the methods followed in various parts of the country.

2. *Mohr, Redwood and Proctor's Pharmacy.**—We had scarcely finished a glance at the beautiful London edition of Mohr and Red-

* Practical Pharmacy: the Arrangements, Apparatus and Manipulations of the Pharmaceutical Shop and Laboratory, by Francis Mohr, Ph. D., and Theophilus Redwood, Edited, with extensive additions, by William Proctor, Jr., Prof. of Pharmacy in the Philad. College of Pharmacy. Illustrated by 500 engravings on wood. Philad.: Lea & Blanchard. 1849. pp. 576.

wood's pharmacy, before Prof. Proctor's improved edition of this fine technical treatise was laid on our table by Messrs. Lea & Blanchard. This work is one which will at once find its place in every laboratory and pharmaceutical shop, and is well calculated to recommend new and improved methods of manipulation to both chemists and pharmaceutists. In the absence of highly appointed laboratories and of pharmaceutical instruction which is so general in this country, such works as the present are particularly valuable. The beautiful and abundant wood-cuts which adorn almost every page of the book, render the descriptions of apparatus perfectly plain, and its reconstruction easy even by the tyro. Prof. Proctor has long been known to pharmaceutical readers in this country as the author of numerous and important researches in the Materia Medica, and his additions to the present edition of Mohr and Redwood are frequent and valuable.

3. *Chemical Analysis, Qualitative and Quantitative;* by Henry M. Noad, with numerous additions by Campbell Morfit, with illustrations. Philadelphia: Lindsay & Blackiston. 1840. 12mo, pp. 567.—This well "got up" book is undoubtedly an important addition to the resources of the chemical student, and we believe we hazard little in saying that *England* has produced nothing better. In saying this we do not feel bound to except the late English translation of Rose, by Dr. Normandy, published without the knowledge of its distinguished author, from the *French* edition of 1843; and this too while it is well known to all chemists that Rose is and has been for two years engaged constantly in the preparation of a new and greatly improved edition of his treatise on analysis. Those who are familiar with Rose and Berzelius, will freely acknowledge that all other treatises on analytical chemistry are very largely indebted to these cardinal authors for their most valuable portions.

From this remark we do not except the treatise above named, and it is certainly in itself no poor recommendation of such a work, that its authorities are the best in the literature of chemistry. The difficulty in such cases however, is not that the authorities are good, but that it is not always easy to distinguish the author from the compiler. In general we have to object to this and similar treatises, that they are not always full enough on some important points while they are usually redundant in others. This fault is obvious to experts and with them will do no harm, but to the learner is often troublesome. We frankly confess however, that we have been very favorably disappointed by this book of Mr. Noad's, having contracted a very different opinion of his Lectures of Chemistry, published some years ago.

Mr. Morfit, the American editor, claims our thanks, not only for this edition of Noad, judiciously annotative, but also for his late work on "*Chemical and Pharmaceutical Manipulations*" by the same publishers and in the same size and style as the edition of Noad.

The "Manipulations" is adorned with over four hundred beautiful wood-cuts illustrative of its descriptive portions, and is a really valuable addition to our chemical literature, and should be in the library of all chemical students and manipulators.

4. *The Fossil Footmarks of the United States and the Animals that made them;* by Edward Hitchcock, D.D., LL.D., President of Am-

herst College, and Professor of Natural Theology and Geology, (from the Transactions of the American Academy of Arts and Sciences, 2d ser., vol. iii, Boston, 1848.)—This elaborate memoir extends to 128 pages quarto, and is illustrated by 24 plates, together with a large table, giving a general view of the distinctive characters of the species. The learned author has pursued the course usual in palæontology, of distinguishing the genera and species *of the animals* indicated by the fossil remains and naming them accordingly. Although the remains are but footmarks, they point out, under the guidance of the unerring principles of comparative anatomy, the habits of the several animals, the classes to which they pertain, and the peculiarities, to some extent, of the species. These characters have been seized, and upon them the descriptions and names are based. Fifty-one species are included in the memoir, 12 of which are of quadrupeds, 4 probably of lizards, 2 chelonian, 6 batrachian, 2 annelids or molluscs, 34 bipeds, 3 doubtful; and of the bipeds 8 were thick-toed tridactylous birds, 16 were narrow toed tridactylous or tetradactylous birds, 2 were batrachian, and the remaining 8 either birds or reptiles and probably the latter. We have to defer to our next number a farther account of the genera and species.

5. *Additional observations on a new living species of Hippopotamus of Western Africa;* by S. G. Morton, M.D., Penn. and Edinb., Vice President Acad. Nat. Sci. Philadelphia, (from the Journal of the Acad. Nat. Sci. of Philadelphia, vol. i, 2d series,) 12 pp. 4to, with 3 plates. Philadelphia, 1849.—This new species of Hippopotamus was first described by Dr. Morton in the Proceedings of the Academy for February, 1844, and there named *H. minor.** As this name was previously used by Cuvier for a fossil species, it is now changed to *Hippopotamus* (Tetraprotodon) *Liberiensis.* The animal is slow and heavy in its motions and weighs 400 to 700 pounds. It lives on the river St. Paul's, a stream that rises in the mountains of Guinea and passing through the Dey country and Liberia, empties into the Atlantic to the north of Cape Messurado. The description of the animal by Dr. Morton, is drawn from the two skulls in his possession, the only specimens which have hitherto been brought from the African coast.

6. *On the nature of Limbs.* A discourse delivered on Friday, Feb. 9th, at an evening meeting of the Royal Institution of Great Britain. By Richard Owen, F.R.S. London, 1849.—This discourse consists of two portions; in the first of which is demonstrated the "unity of composition" of the limbs of vertebrated animals, their various forms being in accordance with their diversified uses. The paddle of the whale, the short but powerful arm of the mole, the wing of the bat, the fore-leg of the horse and the arm of man, being but modifications of the same typical limb. In all, there exists a shoulder, an arm, a fore-arm and hand; the latter may be provided with its five fingers, as in man and many animals, or it may have a single finger, as in the horse and the apteryx. If the limb form simply an organ of support and of locomotion, then the hand exists in the simple condition of the "fore-foot" of the horse; but if it be prehensory or tactile, it approaches more or less in its conformation, the hand of man. These are views

* See this Journal, xlvii, p. 406, where wood-cuts are given.

however, about which most anatomists have been for a long time agreed, and they have become to a certain extent popular.

In the second portion of the discourse the author grapples with a far more abstruse and difficult subject. Since the publication of the speculations of Gœthe, Oken, Carus in Germany, and of St. Hilaire in France, many attempts have been made to perfect the idea of the philosophical "signification" of the parts of the skeleton. In evidence of the difficulties which beset such investigations, and of the undigested state in which many points still remain, it is only necessary to bear in mind that the two ablest living naturalists have arrived at conclusions widely different. Of their comparative merits however, it is not now proposed to speak. Mr. Owen's views of the "signification of limbs," as set forth in the discourse, are reproduced from his late treatise on the Archetype and Homologies of the Vertebrated skeleton, and this last has its basis on the labors of the German anatomists. One cannot but be struck with the resemblance of Owen's "*Archetypus*" to the "*Schema vom Nerven skelet*" of Carus,* the latter obviously in a very crude embryonic condition; the former giving evidence of more complete development, and provided with appendages of which we do not recognize even the germs in the latter. Mr. Owen, with other transcendental anatomists, regards the whole skeleton as a series of vertebræ, more or less modified, each vertebra consisting of its *centrum* or *body*, an upper or *mural arch* protecting the brain or spinal marrow, and a lower or *hæmal arch* protecting the great blood vessels and the organs of organic life. The lower arch is composed of ribs, their cartilages and sternum, which in the nomenclature of Mr. Owen, are respectively *pleuropophyses*, *hæmapophyses* and *hæmal spine*. In many fishes and reptiles, and in all birds, each inferior arch corresponding with the thorax is provided with a small appendage of bone, which in birds is attached to the middle of the rib, and in reptiles to the point of union of the rib with its cartilage; this Mr. O. calls the *diverging appendage*. Two of these diverging appendages in the Lepidosiren protrude through the muscles, and invested with the common integument constitute its single-rayed pectoral and abdominal fin. From the single-rayed appendages to the acknowledged "arms" and "legs," there are many transitional forms. He therefore regards arms and legs as appendages to ribs and not as modified ribs, as maintained by some anatomists of the transcendental school. The rib to which the arm is attached, consists in the higher vertebrate classes, of the scapula, clavicle and coracoid, one or both of the latter directly attached to the first segment of the sternum, but having no connection with the spinal column; now as every inferior arch corresponds with some centrum, with the "body" of some vertebra, the question at once arises, to what vertebra is the scapula a rib. Mr. Owen reasoning by exclusion, regards it as the true and lawful rib of the occipital vertebra of the cranium. In the skeleton of the crocodile, every vertebra from the atlas to the last lumbar, inclusive, is provided with its inferior arch, or a portion of one, and so are the three anterior vertebræ of the cranium; the occipital being the only one which is destitute of it; if therefore the

* See Carus, von den Ur-theilan, des Knochen- und Schalengerüstes, Tab. IV, fig. 1.

scapula be a rib, it belongs to the occiput, and this view he finds supported by the fact that in most fishes and some reptiles the scapula is directly articulated with the occiput, and this he regards its normal position, and in accordance with this view, avows his conviction, "that in their relation to the vertebrate archetype, the human hands and arms are parts of the head; diverging appendages of the costal or hæmal arch of the occipital segment of the skull."—(Discourse, p. 70.)

Many of the views entertained by Mr. Owen with regard to the homologies of the vertebrate skeleton are original with him, as is also the view just referred to, with regard to the relationship of the anterior extremity to the occiput. Coming from so eminent a naturalist, they should command respectful consideration, but are nevertheless not to be admitted as scientific truths unless resting upon the only sure foundation of knowledge, "observation on the order of nature." It must be remembered that other naturalists have given an entirely different interpretation to the parts in question, and it will, we think, be readily admitted, that a public teacher will not be entitled to consider himself beyond the reach of question, when before a learned audience he indulges in poetical applications of a science, when he avows that he does not regard the "conceivable modifications of the vertebrate archetype as being exhausted by any of the forms that now inhabit the earth, or that are known to have existed here at any former period," and does not think "the inference as to the possibility of the vertebrate type being the basis of the organization of some of the inhabitants of other planets," a "hazardous" one.—Discourse, p. 83.

7. ***Report on the Geological Survey of Canada, for the year* 1847–48;** by W. E. Logan. 165 pp. 8vo. Montreal, 1849.—This report presents an account by Mr. Logan, of the rocks and minerals along the country south of the St. Lawrence, from Montreal and Lake Champlain to the river Chaudière, and the results of analyses by Mr. T. S. Hunt of several rocks and mineral waters. The general review of the region examined exhibits careful research, and a full knowledge of what is scientifically and practically useful; and it is greatly to the benefit of geological science that the survey has fallen into the hands of Mr. Logan. After many minute and valuable details, describing the rocks, sandstones, limestones, calcareo-chloritic beds, serpentine with intruded trap, he observes as follows:—

"The facts detailed respecting the structure of the Green Mountains in their Canadian prolongation, would appear to make the plumbaginous sandstones and titaniferous red slates of the Seraphine range in the Seigniory of St. Hyacinthe, which are within a mile and a half of the Trenton limestone of that vicinity, equivalent to those of Granby; and these rocks, with their chromiferous calcareo-chloritic bands, to the dolomites and chloritic quartzose rocks of Kingsey, Shipton and Sutton; these again to the serpentine and quartz rocks of Potton, from which it would follow that the whole of the Green Mountain rocks, including those containing the auriferous quartz veins, belong to the Hudson river group, with the possible addition of part of the Shawangunk conglomerates. The fossils of the succeeding micaceo-calcareous formation of Memphramagog Lake and the St. Francis and Famine Rivers would seem to indicate that it is probably of an age not anterior to the Niagara limestone, or at most the Clinton group beneath, or to use more definite terms, that it is of the upper Silurian series, of which the Clinton group appears at present to be considered the American base; and this sequence would accord with that displayed in the great Appalachian trough, in its nearest approach to the Green Mountain range in the valley of the Hudson. A calcareous formation very fully supplied with upper Silurian remains, has already been mentioned in prior reports, as met with in Gaspé at intervals from the very extremity of that district to Matapedia Lake, a distance of about 150 miles. The geographical character of the intermediate 220 miles, the great similarity in the metamorphic condition of the Notre Dame and Green Mountains, and the continuous run of the recognized rocks of the Hudson River group, from Lake Champlain along the south bank of the St. Lawrence to Cape Rosier, render it probable that the upper Silurian localities will be found to have a nearly direct continuous outcrop connexion; and as the micaceo-calcareous rocks of Memphramagog have I believe been traced thence by Prof. Adams, the state geologist of Vermont, along the eastern flank of the Green Mountains, to the southern boundary of the state near Halifax, whence they proceed into Massachusetts, it seems probable that the upper Silurian group will thus be found continuous perhaps upwards of 700 miles. In Gaspé an arenaceous formation succeeds the upper Silurian, the conditions of which appear to resemble those of the Chemung and Portage group of New York, probably including the old red sandstone; and as this formation in Gaspé is found to possess a thickness of 7000 feet, and in its Western American development does not die away before reaching the banks of the Mississippi, it is not unreasonable to expect that they should follow the upper Silurian zone, in its southwestern course from the eastern extremity of Gaspé, and display a conspicuous figure, either in a metamorphic or unaltered condition, between it and the carboniferous areas of Eastern America, to one of which New Brunswick belongs, while another is met with in the state of Rhode Island, and in a metamorphic condition in Massachusetts. Whether the mica slates southeast of the micaceo-calcareous rocks on the line of section, be part of the Gaspé sandstones in an altered state, can until further investigation, be only conjectural."

On the following pages, the author remarks upon the beds of magnetic and specular oxyds of iron—bog iron and iron ocher—chromic iron, discovered on the 26th lot in the seventh range of Bolton—bog manganese or wad—copper ore—gold and the various rocks of economical importance. The gold of the Chaudière valley was obtained on the banks of a small stream called the Touffe des Pins, a tributary emptying into the right bank of the Chaudière about fifty-eight miles from Quebec. It occurs in the seigniory of Rigaud Vaudreuil, the property of the heirs of the late C. E. Chaussegros de Léry, Esq. The largest pieces collected by Mr. C. de Léry, one of the present proprietors, weigh 1068, 1056 and 744 grains. About 75 lbs. of gravel, washed in the presence of Mr. Logan, produced about two grains of gold to a bushel. A notice of this gold is given in the 6th volume of this Journal, 1848, p. 274, 275.

The results of the analyses of mineral waters by Mr. Hunt, may appear in another number of this Journal.

8. *The Book of the World*, being an account of All Republics, Empires, Kingdoms and Nations, in reference to their Geography, Statistics, Commerce, &c., together with a brief Historical Outline of their Rise, Progress and Present Condition, &c., by RICHARD S. FISHER, M.D., 2 vols. 8vo, 614 and 706 pp. New York, 1849.—This work, as the preface states, is "intended to supply a standard of general reference and a source to which the merchant and scholar may look for the most recent and best authenticated account of the world in its several parts." The first volume, after six pages devoted to general remarks upon the world, is occupied with an account of America, 332 pages of which relate to the United States. The most recent travellers have been consulted with reference to Oregon, California and other parts of Western America. Extensive statistical tables of population, commerce, navigation, navy, army, churches, canals and railroads, &c., are appended to this part of the work. The second volume comprises the countries of the Eastern Continent and Pacific and Antarctic Oceans. The work is illustrated with a chart of the mountains and rivers of the globe; a chart of the national flags of all nations; a chart of the United States, and a chart of the world.

9. *Chemical Technology, or Chemistry applied to the Arts and Manufactures;* by Dr. F. KNAPP, Prof. Univ. Giessen. Translated and edited, with numerous notes and additions, by Dr. EDMUND RONALDO and Dr. THOMAS RICHARDSON. First American edition, with notes and additions, by Prof. WALTER R. JOHNSON. 2 vols. 8vo. Lea & Blanchard: Philadelphia, 1849.—The second volume of this work has just appeared, and is illustrated with 246 engravings on wood, in the first style of the art. The great beauty and fullness of the illustrations, and the general style of printing, recommend the work on the first glance at its pages. This volume treats of glass, alum and vitriol, pottery, brick making, lime, mortar, gypsum, magnesia, and barytes; and all the various modes and means of manufacture and use are detailed, with chemical analyses and a general scientific as well as practical view of the subject. As a specimen of the detail:—to glass 134 pages are devoted, treating of glass and its properties—composition of different kinds—materials and implements for manufacture—manufacture of the different kinds, with minute details and modes of working for the various styles of articles—moulds for pressing glass, and grinding—optical glasses—colored glass—manufacture of smalt—artificial gems—enamel—incrustations, gilding, silvering, &c.—glass spinning, etching, &c.—soluble glass. The other topics are taken up in a similar manner.

10. *Twelve Lectures on Comparative Embryology, delivered before the Lowell Institute in Boston, December and January*, 1848–9; by LOUIS AGASSIZ, Prof. Zool. and Geol. in the Lawrence Scientific School, Cambridge University. 104 pp. 8vo. Boston: Henry Flanders & Co., 1849.—These lectures were reported phonographically, by Mr. James W. Stone, A.M., and we understand, from good authority, that they are faithfully and correctly given. Professor Agassiz for a long time has made this subject his special study, and the science is indebted to him for many important discoveries. Embryology, or the science of egg or animal development, opens to the student the innermost recesses of

the arcana of Life, and develops the unity and harmony of nature from its very foundation. The object of the Lectures is to demonstrate that a natural method of classifying the animal kingdom, may be attained by a comparison of the changes which are passed through by different animals in the course of their development from the egg to the perfect state; the change they undergo being considered as a scale to appreciate the relative position of the species.—The subject does not admit of condensation into a few pages, and requires numerous figures for its illustration, and we therefore merely announce the work in this our Bibliography. It is a work of vast learning, and profound philosophical research, and should be read and studied by all who are interested in the laws of Life and the history of animals.

11. *Twelve Lectures on Comparative Physiology, delivered before the Lowell Institute in Boston, January and February*, 1849; by JEFFRIES WYMAN, M.D. 8vo. Boston: Henry Flanders & Co., 1849.—We are indebted for this publication to the accomplished phonographic reporter of Prof. Agassiz's lectures, and their accuracy it is stated, may be equally relied upon. Professor Wyman presents in his series of lectures, a general review of the properties of Living Beings—of Locomotion and the Skeleton—Muscular action—Digestion, Absorption, Circulation and Respiration—Nervous system—and the senses, touch, taste, smell, hearing and vision. The author ranges through the animal kingdom in his illustrations, with a facility which could be accomplished only by a thorough knowledge of natural science in its various departments, and presents his views with clearness and precision. The work is an excellent compend of Comparative Physiology, such a one as the student needs; and the learned reader will value it for many original views and much recent information.

12. *Pioneer History, being a brief account of the first examinations of the Ohio Valley and the early settlement of the Northwest Territory, chiefly from original manuscripts, &c.*; by S. P. HILDRETH of Marietta, Ohio. Cincinnati, 1848, pp. 525, 8vo.—Although this work is not devoted to science, its learned and excellent author has done so much for its cause, as is manifest in many volumes of this Journal, that we are not willing to deny ourselves the pleasure of mentioning in our pages this interesting and instructive history of the settlement of a very important part of the United States.

Sixty years have hardly elapsed since the first permanent settlement was made on the banks of the Ohio below the confluence at Pittsburgh of its two constituent rivers, the Monongahela and Alleghany. Now the state of Ohio alone contains two millions of inhabitants, and is one of the most flourishing and progressive states in the Union; and six or seven other powerful states lying still to the west have already extended the chain so far, that a link or two more will carry it to the Pacific Ocean.

Dr. Hildreth was an early pioneer in Ohio—not an actor in the sanguinary conflicts with the aborigines, nor a sufferer in the periods of severe privations of almost every kind, of which starvation—proceeding to great suffering if not to actual death—was the chief. He was however early enough on the ground to draw much valuable information from several of the first adventurers who were still living, and he has fully availed himself of many other original sources of information in private journals, correspondence, the records of the Ohio Company, &c. He has rescued from oblivion many biographical notices, connected with events of deep and thrilling interest, and through his pages many individuals may trace out their own family history. To them and to all persons interested in the history of the West, this work of Dr. Hildreth is invaluable, nor can it be read by any American without a feeling of deep sympathy for the sufferings of the early settlers, and admiration of their heroism—as well as social and personal virtues. Even the writer of this notice can remember the disastrous battles of Harmar and St. Clair, and the decisive victory of Wayne—nor has the bruit of savage massacre which floated on every western gale yet died away. We do not know of any American history, except that of the valley of Wyoming by Mr. Charles Miner, which equals in painful interest this recent work of Dr. Hildreth. Both are replete with stories of tragical conflicts and almost unparalleled sufferings—strongly set forth by men of high intelligence and worth—and our only consolation in perusing such painful narratives is, that both the valleys of the Ohio and of the Susquehannah are now smiling in peace, comfort and plenty, while the grass grows and the plough traces its furrows over the graves of the slaughtered pioneers and through soil once wet with their blood.

13. *The Earth and Man: Lectures on Comparative Physical Geography in its relation to the History of Mankind;* by Arnold Guyot, Prof. Phys. Geog. and Hist., Neufchatel, Switzerland. Translated from the French by C. C. Felton, Prof. Harvard Univ. 310 pp. 12mo. Boston, 1849.—A copy of this volume reached us at too late an hour for an extended notice. The work is one of high merit, exhibiting a wide range of knowledge, great research, and a philosophical spirit of investigation. Its perusal will well repay the most learned in such subjects, and give new views to all, of man's relation to the globe he inhabits.

14. *Système Silurien du Centre de la Bohême;* by Joachim Barrande. In 3 volumes, 4to. The first two for Palæontology, the third Geology. Pr. 100 fl. C. M.—This work has been recently announced as in course of publication, and subscriptions are solicited, which may be addressed to W. Haidinger, Wien (Vienna). It will contain 130 to 140 plates, illustrating one thousand species. The work is mentioned to us as an exceedingly important contribution to science, and of peculiar value to American geologists on account of the wide extent of the Silurian strata in the United States.

15. *Third Annual Report of the Board of Regents of the Smithsonian Institution to the Senate and House of Representatives, showing the Operations, Expenditures and conditions of the Institution during the year* 1848. 64 pp. 8vo. Washington, 1849.—This Report states among its many facts of interest, that the Institution has been the means of starting an important literary enterprise. Mr. Henry Stevens, who has been engaged for a number of years as agent in this country of the British Museum and other European libraries, has commenced the preparation of a bibliographical work comprising a description of all books relative to, or published in, America prior to the year 1700, and

indicating not only the contents and value of the books, but also the principal libraries in this and other countries where they are to be found. Mr. Stevens has already commenced his investigations in foreign libraries. This gentleman is well known to be fully competent for the task, though so arduous and difficult in its nature.

16. *Manual of Mineralogy or the Natural History of the Mineral Kingdom;* by James Nicol, F.R.S.E., F.G.S., Assist. Sec. Geol. Soc. London.—576 pp. 12mo. *Edinburgh.* 1849.—This manual of mineralogy is a thorough, accurate work, well worked up to the period of its publication. It is very full in analyses and sufficiently so in notices of localities. Naumann's system of crystallography and crystallographic notation are adopted throughout, and under each species, the system of crystallization with the notation of the common forms are mentioned; but few angles are given and figures are but sparingly introduced. The classification is a mixed system approaching in its general features that of Mohs. It is as follows—

I Order. Oxydized Stones. *Families:* Quartz, Feldspar, Scapolite, Haloid stones, Zeolite, Mica, Hornblende, Clays, Garnet, Gems, Metallic stones.

II Order. Saline Stones. *Families:* Calc spar, Fluor spar, Heavy spar, Gypsum, Rock salt.

III Order. Saline Ores. *Families:* Sparry Iron ores, Copper salts, Lead salts.

IV Order. Oxydized Ores. *Families:* Iron ores, Tinstone, Manganese ores, Red Copper ores, White Antimony ores.

V Order. Native Metals.

VI Order. Sulphureted Metals. *Families:* Iron pyrites, Galena, Grey Antimony ore, Grey Copper ore, Blende, Ruby-blende.

VII Order. Inflammables. *Families:* Sulphur, Diamond, Coal, Mineral Resins, Combustible salts.

Isaac Lea: Observations on the genus Unio, together with descriptions of new species in the families Naiades, Colimacea, Lymnacea, Melaniana, and Peristomiana, with numerous plates. Vol. iv. *Philadelphia.*

Sears C. Walker: Ephemeris of the Planet Neptune, from the data of the Lalande Observations of May 8 and 10, 1795, and for the oppositions of 1846, 1847, 1848, and 1849, computed for the Smithsonian Institution. Appendix I to vol. II, of the Smithsonian Contributions to Knowledge, 32 pp. 4to. *Washington,* 1849.

Fourteenth Report of the Chester Co. Cabinet of Natural Science, March 17, 1849, 8 pp. 8vo. *West Chester, Penn.,* 1849.

Dr. Ed. Schweizer: Praktische Anleitung zur Ausführung quantitativer chemischer Analysen, mit einem Vorworte von Prof. Dr. Löwig. Mit vielen in den Text eingedruckten Holzschnitten. 10 Bogen. 8 broch.

W. Sartorius von Waltershausen: Atlas der Ætna. *Göttingen.*

V. Streffleur: Die Entstehung der Kontinente und Gebirge unter dem Einflusse der Notazion nebst einer Uebersicht der Geschichte des Europäischen Bodens in geognostisch-orographischer Beziehung; mit einem kolorirten Atlasse. *Vienna.*

Dr. A. Schnizlein and Albert Frickhinger: Vegetations-Verhaltnisse der Jura und Keuperformation in dem Flussgebieten der Wornitz uud Altmühl; mit einer geognostisch-topographischen Karte des Bezirkes. *Nördlingen,* 1848.

H. G. Bronn: Lethæa Geognostica. Dritte Auflage. Erste bis dritte Lieferung, Tafel I–XL. Preis fl. 10, 12 kr. R. 6. 11 sgr.

J. J. Kaup and Dr. H. G. Bronn: Abhandlungen über die gavial-artigen Reptilien der Lias formation. Mit 4 lithographirten Tafeln in 9 Blättern und 1 Vignette. Preis fl. 5. R. 3. 5 sgr. Nachtrag hierzu von Dr. H. G. Bronn, mit 2 liththog. Taf. Preis fl. 3. R. 1. 22½ sgr.

Proceedings Boston Soc. Nat. History. NOVEMBER, 1848. p. 81. Closing of straits on east end of Long Island Sound, and a change to fresh water ponds with fresh water animals; *Dr. Cabot.*—p. 83. Shells of the U. S. Exploring Expedition (6 species of Littorina, 1 of Stilifer, 1 of Solarium); *A. A. Gould.*—DECEMBER. p. 85. On the ovarian egg; *Desor.*—p. 87. On the muscular arrangement in Catostomus; *Mr. Ayres.*—p. 89. Shells of the U. S. Exploring Expedition (3 of Turbo, 8 of Trochus); *A. A. Gould.* On fresh water in Dune Sands and Sand Spits; *E. C. Cabot.*—p. 96. On Arkansite, Schorlomite and Ozarkite of Shepard; *J. D. Whitney.*—JANUARY, 1849. p. 99. On certain dendritic delineations; *Mr. Teschemacher.*—p. 100. On Chloritoid and Masonite; *J. D. Whitney.*—p. 102. On the black Oxyd of Copper of Copper Harbor, Lake Superior; *J. D. Whitney.*—p. 103. On fresh water in dune sands; *E. C. Cabot* and *Mr. Ayres.*—p. 108. Shells of the U. S. Exploring Expedition (8 species of Trochus); *A. A. Gould.*—p. 108. On the distribution of animal life about the shoals of Nantucket; *Desor.*—FEBRUARY. p. 111. Geological position of the Mastodon giganteus.

Proceedings of the American Phil. Soc. Philad.—Vol. v, No. 42. Jan., March, 1849.—p. 51. Markings by Telegraphic Clock; *John Locke.*—p. 54. On the U. S. Coast Survey.—p. 74. Telegraphic Astronomical Clock, and velocity of galvanic wave (see this volume, page 142).

Annales des Sciences Naturelles, Paris, JULY, 1848.—On Annelida (family "Hermelliens"); *A. de Quatrefages.*—New Paguri; *Milne Edwards.*—Review of the genus Cinchona; *H. A. Weddell.*—On Anatomic Phyllotaxy or Researches on the Organic causes of the different distributions of leaves; *Th. Lestiboudois.*—AUGUST. On Corals; *M. Edwards* and *Jules Haime.*—On the hours of waking and singing of some birds during the months of May and June, 1846; *D. de la Malle.*—Anatomic Phyllotaxy, continued; *Th. Lestiboudois.* New exotic cellular plants; *C. Montagne.*—SEPTEMBER. On the Gasteropoda Phlebenterata; *A. de Quatrefages.*—On Coleoptera of the Genus Eurhinus (Curculionidæ); *E. Blanchard.*—Sur le non-vomissement du Cheval; *M. Flourens.*—Embryogeny of the Annelida; *A. de Quatrefages.*—New exotic Cellular plants, continued; *C. Montagne.*—Anatomical Phyllotaxy, continued; *Th. Lestiboudois.*—On the Family Salvadoraceæ; *J. E. Planchon.*—OCTOBER. Embryogeny of the Annelida, continued; *A. de Quatrefages.*—Vertebrata of Algiers, viewed in relation to zoological geography and domestication; *P. Gervais.*—On Corals; *M. Edwards* and *Jules Haime,* (4th mem. Monographie des Astræidæ).—Changes in the flora of Central Europe during the tertiary period; *V. Raulin.*—On the Embryos which have been described as Polycotyledonous; *M. Duchartre.*—On the Ovula of the Euphrasia officinalis; *G. Dickie.*—On the Ulmaceæ as a tribe of the Urticeæ; *J. E. Planchon.*

Appendix.—At a late hour we have received the following letter from Mr. Isaac Lea, (dated Philadelphia, June 17,) on footprints in Pennsylvania in rocks below the coal; a farther notice is necessarily deferred to our next number.

"I am sure it will greatly interest you to learn that it has been my good fortune to have discovered "fossil footmarks" of a *reptilian quadruped* in the series below any heretofore observed. In a late visit to the southern coal field of Pennsylvania, while making some geological investigations, I found six distinct double impressions in regular progression, in the old red sandstone. These were accompanied by numerous "ripple marks" and "pits of rain drops" over the whole exposed surface of the rock. The lowest heretofore observed I believe are of the *Chirotherium*, described by Dr. King in the coal formation, near Greensburg, Pa., and those mentioned by Dr. Logan, in the same formation of Nova Scotia.

"The name I have proposed for this reptile is *Sauropus primævus.*"

The next No. of this Journal will be published on the first of Sept.

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

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Our British correspondents are requested to forward all communications and parcels to Mr. T. Delf, Putnam's American Agent, 142 Strand, London, who will forward all works of which notice may be desired in this Journal. It is also desired that all persons who may have works in progress, will send a notice of them, that they may be inserted among the accounts of new publications.

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April, 1849.

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J. P. NORTON,

Professor of Agricultural Chemistry.

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A college education is not required of those who become students under this department.

The Professors are always accessible to those who wish to consult them on matters relating to their several departments; and will undertake such analyses and investigations as may be entrusted to them. Letters of inquiry will be promptly attended to.

Analytical Laboratory, Yale College, New Haven, September, 1849.

THE

AMERICAN

JOURNAL OF SCIENCE AND ARTS.

[SECOND SERIES.]

Art. XII.—*Notice of Dr. Hooker's Flora Antarctica;** by Prof. Asa Gray.

The Botany of Capt. Ross's Antarctic voyage of Exploration was announced to be published in two departments, viz., the Australian and New Zealand portion, which is still delayed, and the *Antarctic Flora*, which is now before us. The concluding fasciculus of this elaborate and highly beautiful work,—second in importance and in perfection of illustration, to no other Flora which has appeared in our time,—was issued a little more than a year ago; since which the indefatigable author has been gathering new *laurels* (literally new Rhododendrons by the dozen) upon the Himalayas, and is probably at this time exploring, with undiminished ardor, the luxuriant and entirely novel vegetation of Borneo. The patronage of the British government to the publication was bestowed in the form of a handsome grant from the Treasury, which has enabled the publishers to bring out the numerous plates in the highest style of the art, and to afford even the colored copies at a very moderate price indeed.

The materials elaborated in the *Flora Antarctica* consist not only of the full collections made during this voyage, by Dr. Hooker himself, and by the officers of the expedition, from the

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* *The Botany of the Antarctic voyage of H. M. Discovery ships Erebus and Terror* in the years 1839–1843, under the command of Capt. Sir James Clark Ross, &c. By Joseph Dalton Hooker, M.D., R.N., F.R.S., &c., Botanist to the Expedition. Published under the authority of the Lords Commissioners of the Admiralty. London. Reeves, Brothers, 1845–7. Two vols. 4to, with 198 plates.

Commander downward,* but of nearly all previous Antarctic collections; among which were "the still unpublished herbaria formed by Sir Joseph Banks, Forster, and Solander in Cook's voyage, and Menzies in that of Vancouver." We may add that the collections made in the recent French Antarctic voyages, even the yet unpublished portions, were liberally shared with Dr. Hooker, for the purpose of giving greater completeness to the present work.

The first part of the Flora Antarctica is devoted to the botany of the few small islands which lie to the south of New Zealand, of which Lord Auckland's group and Campbell's island are the most important. No account of the botany of these islands had as yet been published. Their flora, as might be expected, proves to be closely related to that of New Zealand, "and does not partake of any of those features which characterize Australian vegetation."

The second part of the work treats of the botany of the other antarctic regions, exclusive of the Islands above mentioned; principally of Tierra del Fuego, the Falkland Islands, and Kerguelen's Land; the latter, from the characteristics of its vegetation, being associated with Fuegia, from which it is separated by 140 degrees of longitude, rather than with Lord Auckland's group, which is about 50 degrees nearer in geographical position. The introduction to this portion, like the whole work, abounds with interesting and very acute observations upon the laws which govern the geographical distribution of plants, especially as connected with physical geography and geology. We gather some extracts of this kind, as possessing more general interest to the readers of the Journal, than those disquisitions which relate to strictly botanical questions.

"A certain affinity in botanical productions has often been traced in widely severed countries, and Professor Forbes† has lately brought geological causes to bear immediately upon this

* Dr. Hooker remarks that there were few officers of either ship who did not contribute something to the collection of plants; and that the Commander, "whose private cabin was unreservedly placed at his disposal during the whole time the expedition was afloat, took a pleasure in promoting the interests of the collections at all times, and himself gathered many of the plants here described."

† "Professor E. Forbes has connected the similarity, long known to exist between the floras of the west of Ireland and Portugal, with certain geological characteristics belonging to both these now remote, but perhaps once united countries. * * Uniformity of surface is generally accompanied by a similarity of vegetation throughout an extended region. When such a surface becomes divided, we are apt to conclude that the isolation of the lesser portion preceded the migration of plants from the larger; in short, that the identity of the Norfolk and Suffolk flora with that of Holland, must be due to the former having been peopled with plants by the latter subsequently to the German Ocean having assumed its present position; and not that the two together formed an equally well clothed and extended plain, reaching, as Humboldt believes, from North Brabant to the steppes of Asia; its western portion having afterwards been insulated by the influx of the North Sea."

subject. In reference to this curious topic I would adduce, as corroborative perhaps of his speculations, the general geographical arrangement of these islands, whose botany I am about to describe as that of one country. They stretch from Fuegia on the west to Kerguelen's Land on the east, between the parallels of 45 and 46° of south latitude. Throughout this portion of the world the land exhibits a manifest tendency eastward, from the extreme south of the American continent; for there are no fewer than five detached groups of islands between Fuegia and Kerguelen's Land, but none between the latter island and the longitude of Lord Auckland's group, nor between this last again and the western shores of Fuegia and Patagonia. * *

"Tierra del Fuego and the neighboring southern extremity of the American continent appear to be the region of whose botanical peculiarities all the other Antarctic islands, except those in the vicinity of New Zealand, more or less evidently partake. It presents a Flora characterizing isolated groups of islands, extending for 5000 miles to the eastward of its own position; some of these detached spots are much closer to the African and Australian continents, whose vegetation they do not assume, than to the American; and they are all situated in latitudes and under circumstances eminently unfavorable to the migration of species, save that their position relatively to Fuegia is in the same direction as that of the violent and prevailing westerly winds."*

While Fuegia is to a considerable extent forest-clad, especially the western portions, the characteristic trees being the Deciduous Antarctic Beech with the Evergreen Beech, the Falkland Islands, though mainly lying more northward, produce no tree whatever.

"The botanical and other characters of the Falklands are allied to the Atlantic coast of Patagonia, opposite to the strait

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* "The prevalence of certain winds in favoring the migration of plants must not be overlooked, though too much stress has been laid by some writers on their influence. An element that will carry particles of dust for hundreds of miles through the upper regions of the air, must be a powerful agent in disseminating the sporules of the lower orders of plants; so much so indeed, that I should unhesitatingly deny the necessity of a double creation, to account for the same species of moss or lichen inhabiting any two spots on the globe, however widely apart. That currents of air are not efficacious in wafting the seeds of the higher orders is proved by the absence in the British Isles of many common European plants; though, when once introduced by other means, they increase rapidly. We further see that the tide of vegetation (like the population) has, in the intertropical Pacific islands set in a direction contrary to the prevailing winds, namely from the Asiatic and not from the American shores; and again, that the botany of the North Atlantic islands, the Azores, Madeira, and the Canaries, though these groups are situated in the westerly winds, contain a large proportion of European species. The violence of the perennial westerly gales to the southward of 45°, is proverbial among sea-faring men: such winds carried H. M. S. Chanticleer from Cape Horn to the Cape of Good Hope, a distance of 4000 miles, in twenty-seven days, and have enabled an oceanic fowl, the Cape Pigeon, to maintain its position close to a ship during the whole of that distance; but still I am not inclined to attribute the prevalence of the Fuegian flora over so vast an area to their influence, when exerted against many other opposing agents."

of Magalhaens, from whence they are only three hundred miles distant. The most evident causes of the absence of trees in the Falkland Islands are the dislocation or removal of that group from the main land; their comparatively plane surface, every where exposed to the violence of westerly gales; and more especially to the rapid evaporation and sudden changes in temperature, and in other meteorological phenomena. The southerly and westerly winds are violent, cold, and often accompanied by heavy snow-storms; the easterly and northerly arrive saturated with warmer sea vapors, which, quickly condensing over the already chilled surface of the soil, form fogs and mists that intercept the sun's rays; while the northwesterly winds are singularly dry and parching, from the influence of the Patagonian plains over which they blow. Such sudden alternations from heat to cold, and from damp to dry, are particularly inimical to luxuriant vegetation, and no foliage but perhaps the coriaceous growth of Australia could endure them. * *

"In January, 1843, I landed upon a small islet, close to the main portion of Palmer's Land, in latitude 64° 12′ S. and longitude 57° W. It appeared to be the 'Ultima Thule' of southern vegetation; the soil hard frozen, except on the very surface, where it was thawed by a sun-heat which raised the temperature to 46°, while the sea was encumbered with pack-ice and bergs. No flowering plants were to be seen, and only eighteen belonging to the orders *Lichens*, *Musci* and *Algæ*. Beyond this latitude, I believe there is no terrestrial vegetation."

We add a portion of the remarks upon Kerguelen's Land, which, though lying within the 50th degree of latitude, appears well to deserve its synonyme of the "Isle of Desolation."

"The island presents a black and rugged mass of sterile mountains, rising by parallel steps one above another in alternate slopes and precipices, terminating in frightful, naked and frowning cliffs which dip perpendicularly into the sea. The snows lying upon these slopes between the black cliffs gave a most singularly striped appearance to the whole country, each band indicating a flow of volcanic matter; for the island is covered with craters whose vents have given issue to stream upon stream of molten rock. These are all worn along the coasts into abrupt escarpements, rendering a landing impracticable except at the heads of the sinuous bays. One bluff headland to the north of the island is a precipice seven hundred feet high, and exposes such numerous sections of horizontal deposits of red, black, and gray volcanic matter that it is difficult to count them, though overlaying one another with perfect regularity and uniformity. Sterile as Kerguelen's Land now is, it was not always so. Vast beds of coal are covered by hundreds of consecutive layers of igneous and other rocks, piled to a height of 1000 feet and upwards upon what was once a luxuriant forest. Throughout many of the lava-streams are found prostrate trunks of fossil trees of no mean girth, and the incinerated remains of recent ones, which had been swallowed up simultaneously with the fossil; and these occur in strata of various ages, so that it seems impossible to reckon the period of time that must have elapsed between the origin, growth, and destruction of the successive forests now buried in one hill. A section of such a hill would display coal beds and shale resting upon a blue basalt, at the level of the sea, covered again with whinstone, whereon are deposited successive layers of volcanic sand, baked clay-stones, porphyries, and long lines of basaltic cliffs, formed of perpendicular prisms, regularly sloped like those of Staffa or the Giants Causeway, and along which the traveller may walk even for a mile without ascending or descending fifty feet. To calculate the time required for the original formation following silicification of one such forest, and to multiply that by the number of different superincumbent strata, containing remains similar to those displayed at the north end of Kerguelen's Land, would give a startling number of years, during which periods the island must have deserved a better name than that of 'Desolation.' And if to this be added the time necessary for the deposit of the arenaceous beds containing the impressions of *Fuci*, of the clays afterwards hardened by fire, and of the prismatic cliffs, which, with the arenaceous, indicate that the land was alternately submerged and exposed as often as those successive formations occur, such a sum would bespeak an antiquity for the flora of this isolated speck on the surface of our globe far beyond our powers of calculation."

This island, the remotest of any from a continent, in the most inhospitable climate, now yields only eighteen flowering plants; but one of these is a very important one, namely the *Kerguelen's Land Cabbage*, which the readers of Capt. Cook's voyage will not fail to remember. It appears that Mr. Anderson, the surgeon and naturalist of Cook's first voyage, and who successfully used this plant to check the scurvy which was making such ravages among the crew, on his return, drew up an account of the remarkable plants he collected, which is still preserved in the Banksian Library; and that to this he applied the name of *Pringlea*, in honor of Sir John Pringle who wrote a work on the scurvy. In now completing and giving to the world the botanical account of this plant, Dr. Hooker has most properly adopted this name, adding, at Mr. Brown's suggestion, the specific appellation of *antiscorbutica*. He thus discourses upon the plant.—

"The contemplation of a vegetable very unlike any other in botanical affinity and in general appearance, so eminently fitted for the food of man, and yet inhabiting one of the most desolated and inhospitable spots on the surface of the globe, must equally fill the mind of the scientific enquirer and common observer with wonder. The very fact of Kerguelen's Land being possessed of such a singularly luxuriant botanical feature, confers on that small island an importance far beyond what its volcanic origin or its dimensions would seem to claim; whilst the certainty that so conspicuous a plant can never have been overlooked in any larger continent, but that it was created in all probability near where it now grows, leads the mind back to the epoch far anterior to the present, when the vegetation of the Island of Desolation may have presented a fertility of which this is perhaps the only remaining trace. Many tons of coal and vast stores of now silicified wood, (which I have mentioned in the introduction to this Part,) are locked up in or buried under those successive geological formations which have many times destroyed the forests of this island, and as often themselves supported a luxuriant vegetation. The fires that desolated Kerguelen's Land are long ago extinct, nor does the island show any signs of the recent exertion of those powers, that have at one time raised parts of it from the beds of the ocean with those submarine Algæ which once carpeted its shores but which now are some hundred feet above the present level of the sea. The *Pringlea*, in short, seems to have led an uninterrupted and tranquil life for many ages; but however loth we may be to concede to any one vegetable production an antiquity greater than another, or to this island a position to other lands wholly different from what it now presents, the most casual inspection of the ground where the plant now grows, will force one of the two following conclusions upon the mind; either that it was created after the extinction of the now buried and forever lost vegetation, over whose remains it abounds, or that it spread over the island from another and a neighboring region where it was undisturbed during the devastation of this, but of whose existence no indication remains.

"The *Pringlea* is exceedingly abundant over all parts of the island, ascending the hills up to 1400 feet, but only attaining its usual large size close to the sea, where it is invariably the first plant to greet the voyager like the *Cochlearia* or scurvy grass upon the northern coasts. Its long rhizomata, often three or four feet long, lie along the ground; they are sometimes two inches in diameter, full of spongy and fibrous substances intermixed, of a half woody texture, and with the flavor of horse-radish, and bear at the extremity large heads of leaves, sometimes eighteen inches across, so like those of the common cabbage that, if growing in a garden with their namesakes in England, they would not excite any particular attention; the outer leaves are coarse, loosely placed and spreading, the inner form a dense white heart, that tastes like mustard and cress, but is much coarser. The whole abounds with essential oil of a pale yellow color, highly pungent, and confined in vessels that run parallel with the veins of the leaf, and which are very conspicuous on making a transverse section of the head. During the whole stay of the Erebus and Terror in Christmas Harbor, daily use was made of this vegetable, either cooked by itself or broiled with the ships' beef, pork, or pea-soup. The essential oil gives a peculiar flavor which the majority of the officers and the crew did not dislike, and which rendered the herb even more wholesome than the common cabbage; for it never caused heart-burn, or any of the unpleasant symptoms which that plant sometimes produces. Invaluable as it is in its native place, it is very doubtful whether it will ever prove equally so in other situations. It is of such slow growth that it probably could not be cultivated to advantage. * * * * Growing spontaneously and in so great abundance where it does, it is likely to prove, for ages to come, an inestimable blessing to ships touching at this far distant isle, whilst its luxuriance amid surrounding desolation, its singular form and appearance striking even the casual observer, and the feelings of loneliness and utter isolation from the rest of the world that must more or less oppress every voyager at first landing on its dreary and inhospitable locality, are circumstances likely to render the Kerguelen's Land cabbage—cabbage though it be—a cherished object in the recollection of the mariner; one never to be effaced by the brighter or luscious products of a tropical vegetation."

Dr. Hooker's account of the *Balsam-bog* (Bolax glebaria) of the Falkland, as originally printed in the *Icones Plantarum*, was extracted for this Journal on a former occasion. (Vol. iii, 2d ser., 121.)

Nothing can be more interesting to the vegetable physiologist, than his complete and most able account of the anatomical structure and parasitism of *Myzodendron*, a Fuegian genus of woody parasites of the Mistleto family, illustrated by a series of incomparable figures, which have won for the youthful author an enviable reputation for his talents in that department of investigation. These plates (102 to 107, 107 *bis*, and 107 *ter*) are the great glory of the work. Want of room alone prevents our noticing Dr. Hooker's excursus on the potato, and his interesting account of the Antarctic beeches, the two principal species of which have been imported into England by this expedition, where they promise to succeed well. But we must by no means omit the famous Tussock grass (Dactylis cæspitosa) of the Falkland Islands, which, successfully raised from seeds, bids fair to thrive in Great Britain. It would be well to try it on our own shores, but we can scarcely expect it to live in our extreme climate. The summers of the foggy coast of Maine would doubtless agree with it; but it would hardly withstand the winter even of New Jersey, where probably the summer is too dry.

"It was not until the recent colonization of the Falklands by the British, that attention was particularly directed to the

Tussock, in consequence of accounts forwarded to the colonial office by Governor Moody, and to the Admiralty by the Antarctic Expedition. The peculiar mode of growth of *Dactylis cæspitosa* enables it to thrive in pure sand, and near the sea, where it has the benefit of an atmosphere loaded with moisture, of soil enriched by decaying sea-weeds, of manure, which is composed in the Falkland Islands of an abundant supply of animal matter in the form of guano, and of the excrements of various birds, who deposit their eggs, rear their young, and find a habitation amid the groves of tussock. Its general locality is on the edges of those peat bogs which approach the shore, where it contributes considerably to the formation of peat. Though not universal along the coast of these islands, the quantity is still prodigious, for it is always a gregarious grass, extending in patches sometimes for nearly a mile, but seldom seen except within the influence of the sea air. This predilection for the ocean does not arise from an incapacity to grow and thrive except close to the salt water, but because other plants, not suited to the seashore, already cover the ground in more inland localities, and prevail over it: I have seen the tussock on inaccessible cliffs in the interior, having been brought there by the birds and afterwards manured by them; and, when cultivated, it thrives both in the Falklands and in England, far from the sea. I know of no grass likely to yield nearly so great an amount of nourishment as the Tussock when thoroughly established; in proof of which, I quote my friend Governor Moody's printed report, for the truth of which I can vouch, both from my own experience and from his having kindly given me ample means for judging of the correctness of his interesting and useful observations, when drawing up the report from which the following extract was made. 'During several long rides into the country I have always found the Tussock flourishing most vigorously in spots exposed to the sea, and on soil unfit for any other plant, viz.: the rankest peat-bog, black or red. It is wonderful to observe the beaten foot-paths of the wild cattle and horses, marked like a foot track across the fields of England, extending for miles over barren moor-land, but always terminating in some point or peninsula covered with this favorite fodder; amid which one is almost certain to meet with solitary old bulls, or perhaps a herd of cattle; very likely, a troop of wild horses, just trotting off as they scent the coming stranger from afar. To cultivate the Tussock grass, I should recommend that its seeds be sown in patches, just below the surface of the earth and at distances of about two feet apart; it must afterwards be weeded out, for it grows very luxuriantly, frequently attaining a height of six or seven feet. It should not be grazed, but cut or reaped in bundles. If cut, it quickly shoots again: but is injured much by grazing; for all animals, especially pigs, tear it up to get at the sweet nutty-flavored roots. I have not tried how it would be relished if made into hay, but cattle will eat the thatch off the roof of a house in winter; their preference to Tussock grass being so great that they scent it a considerable distance and use every effort to get at it. Some bundles which had been stacked in the yard at the back of the government house, were quickly detected, and the cattle in the village made every night repeated attempts to reach them, which occasioned great trouble to the sentry on duty.' Since the above was written, the Tussock has been used abundantly when made into hay, being preferred by the cattle even to the green state of any of the other excellent grasses in the Falklands. Governor Moody informs me that in his garden it grows rapidly and improves by cutting. There is, however, one drawback to the value of the Tussock; it is a perennial grass, of slow growth, and some disappointment has been experienced in England from this cause. Each Tussock consists of many hundreds of culms, springing up together from a mass of roots, which have required a long series of years to attain their great and productive size. Our cultivated specimens in the royal gardens of Kew, now nearly three years old, are in a fair way of becoming good Tussocks, for the quantity of stems from each root, the produce of one seed, is incalculably more than any other grass throws up; but this ball, now scarcely six inches across and not two in height, must have grown to six or eight feet high, with a diameter of three or four feet; instead of forty culms, there must be four hundred; and the leaves, now three feet long, must attain seven, ere the Tussock of England can compete with its parent in the Falklands. Though, however, the stoles (if I may so call the matted roots of this grass) in the most vigorous and native specimens attain the height of seven feet, it is certain they are very productive before they have reached two or three. By this time the leaves have gained their great size, the bases of the culms are nearly as broad as the thumb, and when pulled out young, they yield an inch or two of a soft, white, and sweet substance, of the flavor of a nut, and so nutritious, that two American sealers, who deserted a vessel in an unfrequented part of the Falklands, subsisted on little else for fourteen months. There are few plants which from perfect obscurity have become objects of such interest as this grass. The Tussock in its native state seems of almost no service in the animal economy. A little insect, and the only one that I observed, depends on it for sustenance; a bird, no bigger than the sparrow, robs it of its seeds; a few sea-fowl build among the shelter of its leaves; penguins and petrel seek hiding places among its roots, because they are soft and easily penetrated, and the sea-lions cower beneath its luxuriant foliage; still, except the insect, I know no animal or plant whose extinction could follow the absence of this, the largest vegetable production in the Falklands, which does not even support a parasitical fungus. These same sea-birds breed or burrow where no Tussock grows; rocks elsewhere suit the sea-lion's habits equally well; and the sparrow, which subsists on other food eleven months of the year, could surely make a shift without this for the twelfth. Certain it is that the Tussock might yet be unknown and unprized amongst plants, if cattle had not been introduced to its locality by man: who thus became, first the injurer, and then the protector and propagator of the existence of this noble grass; for the herbivorous quadrupeds which he carried to the Falklands and left there, were surely extirpating the Tussock, when man returned, and by protecting, perpetuating, and transporting it to other countries, he has wisely dispersed it. It appears singular that so striking a grass should abound where there is no native herbivorous animal to profit by its luxuriance; but it is no less certain that had not civilization interfered, the Tussock might have waved its green leaves undisturbed over the waters of the stormy Antarctic Ocean, forever perhaps, or until some fish, fowl, or seal, should be so far tempted by the luxuriance of its foliage as to trangress the laws of nature, and to adapt its organs to the digestion and enjoyment of this long neglected gift of a bounteous Providence."

But we must not pass by the interesting account of the two gigantic races of sea-weed in the southern ocean, *Lessonia* and *Macrosystis*. It is to the description of *Lessonia fucescens*, of the Falklands, &c., that the subjoined remarks are appended.

"This and the following are truly wonderful *Algæ*, whether seen in the water or on the beach; for they are arborescent, dichotomously branched trees, with the branches pendulous and again divided into sprays, from which hang linear leaves 1–3 feet long. The trunks are usually about 5–10 feet long, as thick as the human thigh, rather contracted at the very base, and again diminishing upwards. The individual plants are attached in groups or solitary, but gregarious, like the pine or oak, extending over a considerable surface, so as to form a miniature forest, which is entirely submerged during high-water or even half-tide, but whose topmost branches project above the surface at the ebb. To sail in a boat over these groves on a fine day, affords the naturalist a delightful recreation; for he may there witness, in the Antarctic regions, and below the surface of the ocean, as busy a scene as is presented by the coral reefs of the tropics. The leaves of the *Lessonia* are crowded with *Sertulariæ* and *Mollusca*, or encrusted with *Flustræ*; on the trunks parasitic *Algæ* abound, together with Chitons, Patellæ, and other shells; at the bases, and among the tangled roots, swarm thousands of Crustacea and Radiata, whilst fish of several species dart amongst the leaves and branches. But it is on the sunken rocks of the outer coasts that this genus chiefly prevails, and from thence thousands of these trees are flung ashore by the waves, and with the *Macrosystis* and *D'Urvillea*, form along the beach continued masses of vegetable rejectamenta, miles in extent, some yards broad, and three feet in depth; the upper edge of this belt of putrefying matter is well in shore, whilst the outer or seaboard edge dips into the water, and receives the accumulating wreck from the sub-marine forests throughout its whole length. Amongst these masses the best *Algæ* of the Falklands are found, though if the weather be mild, the stench, which resembles putrid cabbage, is so strong as to be almost insufferable. The ignorant observer at once takes the trunks of *Lessonia* thus washed up for pieces of drift-wood, and on one occasion, no persuasion could prevent the captain of a brig from employing his boat and boat's crew, during two bitterly cold days, in collecting this incombustible weed for fuel."

"The ramification of all the species of *Lessonia* is dichotomous; each plant in a young state consists of a few rooting and clasping fibres, giving off a single stem (or petiole) and frond. This frond splits at the base, and as the growth proceeds, the fissure extends vertically upwards, till the original frond is bisected; each of the two parts is now a complete frond, altogether similar to the primary one, and provided with a petiole of its own: these again divide, and the process is repeated. Hence the rapid growth of this genus, and hence the origin of the flattened form of ramuli and elliptic core which is placed in the long axis of these ramuli and across the axis of the terete stem. It was not observed whether any relation existed between the number of branches on the whole frond and of concentric rings in the trunk. The latter are probably the indices of the number of times that a subdivision of the laminæ has accrued, supposing that all split at about the same epoch, rather than a register of the years the vegetable has existed; as the following account of the anatomy of this species will show.

"A branched portion of the plant, terminated by four laminæ, necessarily presents subdivisions of three periods of growth: 1st, the petioles of the four laminæ; 2d, the two ramuli from which the four are given off; 3d, the one branch which gives off the two latter: these were successively examined.

"1. The base of the laminæ or petiole is exceedingly compressed, and composed of a mass of cellular tissue of different textures, all, however, very gelatinous, and modifications of the three layers forming the leaf; there are 1st, the superficial tissue (or cortex) consisting of small cells, closely packed, and full of chromule, gradually opening out into, 2d, an intermediate tissue of much larger cells more loosely placed, with little or no contained chromule, separated by much gelatine; and 3d, an elliptical core placed in the long axis of the petiole, composed of still smaller cells, separated by broader masses of gelatine, which latter is permeated by canals, full, as are the small cells, of chromule."

"2. Each ramulus, from which proceed the two petioles, whose structure we have just described, presents no very important difference from them; the core no longer stretches across it, however, but the whole petiole within the superficial portion is augmented by a newly developed though indistinct zone of cellular tissue, thus deposited between the superficial (or cortical) and intermediate tissue. At this period the cortex is somewhat broader, and the intermediate tissue has become through the absorption of the gelatine, much more conspicuous; the cells being longer and the spaces between them narrower; little or no change is perceptible in the core itself.

"3. The branch is very materially different from either of the above, for what was hitherto the petiole is now enclosed (all but its cortex) in a very broad zone of cellular tissue, whose cells are large and thin towards the old tissue, elongated and of a different shape, so as to show the line of separation between the two periods of growth.

"From this time forward the normal mode of growth followed by the stem, exhibits an additional layer or zone of cellular tissue for every subdivision of the frond, (shown at A 1, where six are interposed between the cortex and core.) It is not probable, however, that this numerical relation can be always evident, or that the number of subdivisions of the frond will indicate the rings of growth in a large stem. This uncertainty arises from the branches being frequently broken off; added to which, the growth of the sea-weed is very rapid, and there being no period of rest, irregular zones may be expected, or their absence from those branches of the plant whose leaves are injured.

"I have stated the growth of the *Lessonia* to be very rapid; this is proved by the zones of a five-ridged stem being progressively broader towards the circumference. The probability, too, of one being added for every time the laminæ divide, and the fact that the process of subdivision is continued in geometrical progression, all favor the opinion that these Algæ attain their enormous bulk in a very few months. The vast masses washed up on the outer eastern shores of the East Falkland Island, and the rapidity with which they decay, are additional proofs of a singularly rapid development.

"The analogy between the mode of growth exhibited by this genus and an exogenous tree, is, though incomplete, very obvious; both increase by layers deposited outside one another, within a cortical substance, and both contain an axis of tissue different from that forming the greater part of the trunk: here, however, there are no traces of medullary rays. We conclude this subject with the observation, that the periodical increment of the trunk being dependent on, or coincident with, the formation of the laminæ, these appear to perform the office of the leaves in the higher order of plants; and that the *Lessonia* is also in this respect analogous to an Exogenous plant, deprived of its woody tissue, for it is a stem composed of layer upon layer of cellular tissue, deposited round an axis, which, like the pith, when once formed, is afterwards but slightly modified."

The ten described species of the gigantic *Macrosystis*, Dr. Hooker's own observations have enabled him to reduce to one; remarking that few botanists in Europe have ever seen even a tolerable suite of specimens from one single plant of this Alga, such as give a fair idea of the differences between the various leaves and bladders along some 300 feet of stem, with the submerged fructifying fronds from the root. The general interest of the following account must be our apology, if one is needed, for so lengthened a series of extracts.

"It is seldom that the history of *an Alga* is likely to afford interest or amusement to the general reader, unless it be a positively valuable plant in an economic point of view. Like the Sargasso-weed of the Tropics, however, the *Macrosystis* is so conspicuous, and from its wandering habits, often occurs so unexpectedly, that the attention of our earliest voyagers has been directed to it, and we are consequently led back by our enquiries into its first discovery, to the annals of those perils and privations which have ever marked the progress of discovery and enterprise in the stormy seas of the south. 'Nihil vilior Alga,' is a saying more trite than true, and one which a seaman can never use; for these weeds often prove his unerring guide towards land, as they surely are to the direction of the currents; or become of more importance still in the case of the present plant; for it is, where growing, not only the infallible sign of sunken rocks, but every rock that can prove dangerous to a ship is conspicuously buoyed by its slender stem and green fronds, and we may safely affirm that without its presence many channels would be impracticable, and numerous harbors in the south closed to our adventurous mariners.

"The first notice of the *Macrosystis*, with which we are acquainted, is of so early a date as the middle of the 16th century, and occurs in a copy of sailing directions for mariners, with the title 'A Ruttier from the river of Plate to the Streight of Majelana,' and forms part of 'A special note concerning the currents of the sea between the Cape of Buena Esperanza and the coast of Brazilia, given by a French pilot before Sir John Yorke, Knt., before Sebastian Cabote, which pilot had frequented the shores of Brazilia eighteen voyages.' (Hakluyt, ed. 2, vol. iv, p. 219).

In describing the above mentioned route, after passing Cape Sta. Martha, the trusty pilot's direction to the mariner is to 'goe S. W. by W. until he be in 40 degrees, where he shall find great store of weedes which come from the coast;' and again, in pursuing the voyage after entering the Straits, 'if you see beds of weede, take heed of them and keep off from them.' Now, both the position assigned to the great masses of floating weed and the value of those which are attached in denoting hidden dangers, are conclusive as applying to the *Macrosystis*. These directions bear no date; but the discovery of the Strait of Magalhaens was in 1520, and the death of Sebastian Cabote took place in 1556, so that we have sufficient proof that this attracted the attention of the earliest Antarctic voyagers in the longitudes of Cape Horn; though it may have been noticed previously on the southern extreme of Africa or the China seas. Nor can we wonder that the attention of our forefathers should have been so early called to it, when even now it is of the first importance that the look-out man should use his utmost vigilance to detect, and promptitude to report, this weed on approaching any of the straits and bays of the shores of Tierra del Fuego and similar latitudes. In the latest voyages that have been published, those of Capt. Foster, King, and Fitzroy, we find a constant watch for the 'Kelp' to have been kept, and caution used to avoid the 'moored' pieces, together with instructions how to distingushed them from those which are floating.

" So remarkable a plant was not likely to escape the notice of Cook, and especially of the illustrious companions of that navigator's first voyage, and we accordingly find in his narrative repeated allusion to it. It engaged the attention of Banks when entering the Straits of LeMaire in 1769, and frequently afterwards in the cooler latitudes of the Southern ocean. To him we owe the first account of its gigantic dimensions. Captain Cook says, on the authority of Banks and Solander, who called it *Fucus giganteus*, that the stems attain a length of 120 feet. That these dimensions are considerably under the mark, there is little doubt; though the report that specimens have been measured upwards of 1000 feet, is perhaps as much of an exaggeration. Still it must be remembered that, provided the water be smooth and of sufficient extent, there are no impediments to the almost indefinite elongation of the upper part of a plant which never branches, or whose growth is independent of all below it, even of the root. Specimens measuring between 100 and 200 feet are common in the open ocean, and these are always broken off at the lower end, either from the division of the frond by sea-animals, through whose agency the plant increases and the floating island it forms dilates, or from the impossibility of securing the whole mass from the motion of the vessel or the swell of the sea, in latitudes where no boat can be lowered. Again, D'Urville, upon whose observations in natural history the utmost reliance may be placed, states it to grow in eight, ten, and even fifteen brasses of water, from which depth it ascends obliquely and floats along the surface nearly as far; this gives a length of 200 feet. In the Falkland Islands, Cape Horn, and Kerguelen's Land, where all the harbors are so belted with its masses that a boat can hardly be forced through it, it generally rises from eight to twelve fathoms water, and the fronds extend upwards of one hundred feet upon the surface. We seldom, however, had opportunities of measuring the largest specimens, though washed up entire on the shore; for on the outer coasts of the Falkland Islands, where the beach is lined for miles with entangled cables of *Macrosystis*, much thicker than the human body, and twined of innumerable strands of stems coiled together by the rolling action of the surf, no one succeeded in unravelling from the mass any one piece upwards of seventy or eighty feet long; as well might we attempt to ascertain the length of hemp fibre by unlaying a cable. In Kerguelen's Land, the length of some pieces, which grew in the middle of Christmas Harbor, was estimated at more than three hundred feet; but by far the largest seen during the Antarctic Expedition, were amongst the first of any extraordinary length which the ships encountered, and they were not particularly noticed, from the belief that the report of upwards of 1000 feet length was true; or, at any rate, that better opportunities of testing its truth would arise in the course of a three years' voyage, than the first week of our explorations could afford. These occurred in a strait between two of the Crozet Islands, where, very far from either shore, in what is believed to be forty fathoms water, somewhat isolated stems of *Macrosystis* rose at an angle of 45° from the bottom, and streamed along the surface for a distance certainly equal to several times the length of the "Erebus;"— data, which, if correct, (and we believe them so) give the total length of the stems as about 700 feet.

"That isolated patches of weed should rise through such a volume of water is not incompatible with the statements we have elsewhere made, that eight or ten fathoms is the utmost depth at which, judging by our experience, submerged sea-weed vegetates in the Southern temperate and Antarctic Ocean. These exceptional cases are probably due to the present plant having attained such a size in its birth-place near shore, as to weigh its strong moorings and deposit itself in deeper water, where an increase of the roots would unite the original base to other rocks, and thus gain a footing that defies the power of the elements.

"We have stated that the elongation of the *Macrosystis* may be indefinite; but this is only true partially and in the case of detached patches; for the stem of the attached plant does not gain bulk or tenacity, after a certain period; whilst the growing dimensions of the floating portion are increasing the difference between the specific gravity of the vegetable and the element it inhabits, and consequently augmenting the strain upon the slender stem by which it is attached. At some period or other, the resistance is overcome and the floating part detached from the submerged; though at what epoch this may take place, or whether it be coincident with other phases in the life of the plant, is beyond our conjecture.

"The fact that fructification is produced only on the submerged young bladderless and small frond, within a few inches of the very root, is highly remarkable. What then is the function of the floating mass of the plant? to one of whose thousand leaves, each four to six feet long, the fructifying bears an inconceivably small proportion. Were this a phænogamic plant, we should recognize, in such foliaceous expansions, organs which fulfil a respiratory and digestive office and are subservient and necessary to the development of the more important parts of the vegetable; but in this case such a mutual dependency is not so easily traced. As in *Lessonia* the multiplication of the leaves is intimately connected with the development in diameter of the stem, so in *Mácrosystis* the development of fructifying fronds may take place only at the root of the barren ones, on whose previous existence they may be dependent for their origin. These are, however, questions which propose themselves to us in the closet only, when the prospect of solving them is gone by; and when they but add to the thousand regrets over lost opportunities, the remembrance of which weighs so heavily on the mind of every naturalist, that the brightest prospects of discovery in the fair future can never obliterate them."

The general remarks of our author upon the distribution, economy and functions of the Antarctic Diatomaceæ are so just and so full of scientific interest, that we deem it our duty to afford them a wider circulation among our American readers, very few of whom, probably, will ever see them in the original work.

That the Diatomaceæ belong to the vegetable, and not to the animal kingdom, has of late years seemed altogether the most probable opinion; and this idea has recently been unequivocally confirmed by Mr. Thwaites, who has most successfully investigated this tribe in England, and who has had the good fortune to discover several species congregating, in the manner of the Zygnemata, a fact which leaves no doubt of their vegetable nature.

That *Volvox*, also, is a vegetable, would hardly be doubted, except for its active movements, which, being at some period common to the spores of every tribe of Algæ, cease to furnish a criterion. We learn that Prof. Braun of Carlsruhe, has recently studied the development of Volvox, and has clearly demonstrated their vegetable nature. Following the high authority of Ehrenberg, Dr. Hooker had supposed the Diatomaceæ to pertain to the animal kingdom, and consequently had supposed all vegetation to cease at a much lower latitude than these productions attain. He collected them, however, on every available occasion during the voyage, and on his return transmitted them to Prof. Ehrenberg, whose determination of the genera and species is introduced into the Flora Antarctica, where they find a place as a distinct order of plants. The circumstances under which they occur, and the modes in which they were collected and preserved for examination are thus described.

"The waters and the ice of the South Polar Ocean were alike found to abound with microscopic vegetables belonging to this order. Though much too small to be discernible by the naked eye, they occurred in such countless myriads as to stain the berg and the pack-ice, wherever they were washed by the swell of the sea; and when enclosed in the congealing surface of the water, they imparted to the brash and pancake ice a pale ochreous color. In the open sea northward of the Frozen zone, this order, though no doubt almost universally present, generally eludes the search of the naturalist; except when its species are congregated amongst that mucous scum, which is sometimes seen floating on the waves, and of whose real nature we are ignorant; or when the colored contents of the marine animals who feed on these Algæ are examined. To the south, however, of the belt of ice which encircles the globe, between the parallels of 50° and 70° S., and in the waters comprised between that belt and the highest latitude ever attained by man, this vegetation is very conspicuous, from the contrast between its color and the white snow and ice in which it is imbedded. Insomuch that, in the 80th degree all the surface ice carried along by the currents, the sides of every berg, and the base of the great Victoria Barrier itself, within reach of the swells, were tinged brown, as if the polar waters were charged with oxyd of iron.

"As the majority of these plants consist of very simple vegetable cells, enclosed in indestructible silex (as other Algæ are in carbonate of lime), it is obvious that the death and decomposition of such multitudes must form sedimentary deposits, proportionate in their extent to the length and exposure of the coast against which they are washed, in thickness, to the power of such agents as the winds, currents, and sea, which sweeps them more energetically to certain positions, and in purity, to the depth of the water and the nature of the bottom. Hence we detected their remains along every ice-bound shore, in the depth of the adjacent ocean, between eighty and one hundred fathoms. Off Victoria Barrier (a perpendicular wall of ice, between one and two hundred feet above the level of the sea) the bottom of the ocean was covered with a stratum of pure white or green mud, composed principally of the siliceous cells of Diatomaceæ. These, on being put into water, rendered it cloudy, like milk, and took many hours to subside. * * *

"Scattered on the surface of the ocean, the Antarctic Diatomaceæ were seen connected in filaments, or resolved into the simple frustutes of which they are composed. When entire, they showed no signs of motion or irritability. The grumous or granular contents of the cells were yellow under the microscope; but in most the same species assumed an orange-brown, or burnt sienna color, the intensity of which depended on the denseness with which they were packed together.

"The various means employed for selecting the species varied according to circumstances, as the following enumeration of the processes pursued will show. 1. Sea water was filtered through closely woven bibulous paper (filter paper), which latter was folded, dried, and carefully put away. If a certain measure of water be always thus treated, an approximate knowledge of the abundance and scarcity of the various species and genera occurring at different positions may be gained. 2. The scum of the ocean almost invariably contains many species entangled in its mass; it was preserved in small vials, well secured. 3. A tow-net of fine muslin, used when the vessels' rate does not exceed two or three knots, secures many kinds, which may be washed off the muslin and collected on filter paper. 4. The stomachs of *Salpæ* and other (especially of the naked) mollusca invariably contain Diatomaceæ, sometimes several species. These *Salpæ* were washed up in masses on the pack-ice, and in decay they left the snow covered with animal matter, impregnated as it was, with Diatomaceæ: the *reliquiæ* were preserved in spirits. 5. The dirt and soil of the *Penguin rookeries* and especially their guano abound in Diatomaceæ, perhaps originally swallowed by salpæ and cuttle fish, which themselves become the prey of the penguins. 6. Ice encloses Diatomaceæ: they are deposited on the already formed ice by the waves, or frozen into its substance during calm weather, where the upper stratum of water rapidly congeals. Ice so formed generally breaks up by the swell of the sea into thin angular masses, which become orbicular by attrition, whence the name pancake ice. The pancake ice was often seen a few hours after a calm, covering leagues of ocean, and uniformly stained brown from the attendance of these plants. It was taken in buckets, and when removed from the water appeared perfectly pure and colorless. On melting, however, it deposited a pale red, cloudy precipitate, excessively light, consisting wholly of Diatomaceæ. This precipitate was bottled on the spot, and proved more rich in species than any of the other collections. The specimens were also the best preserved: for Prof. Ehrenberg observes that some thus obtained appeared as if still alive, though collected three years previous to his examination, and subject to many vicissitudes of climate. The snow sometimes falls on the surface of the still ocean water and does not freeze, but floats a honey-like substance, often called brash ice: treated in the same way as the pancake ice it yielded an abundant harvest. 7. The mud and other soundings from the bottom of the ocean, when brought up on the arming of the deep sea lead, or by the chlam or dredge, generally contain the siliceous skeletons or coatings of many species, with the markings on their surface retained. The soundings were invariably in greenish mud, into which the lead sometimes sunk for two feet. At times this mud seemed almost wholly composed of Diatomaceous remains. 8. The fresh and salt waters and muddy estuaries of the Falkland Islands, and similar localities, present us with species, recurring under circumstances altogether similar to what accompany their allies in Europe.

"The universal existence of such an invisible vegetation as that of the Antarctic ocean is a truly wonderful fact, and the more from its not being accompanied by plants of a high order. During the years we spent there, I had been accustomed to regard the phenomena of life as differing totally from what obtains throughout all other latitudes: for every thing living appeared to be of animal origin. The ocean swarmed with mollusca, and particularly entomostracous crustacea, small whales and porpoises, the sea abounded with penguins and seals, and the air with birds: the animal kingdom was ever present, the larger creatures preying upon the smaller, and these again on smaller still; all seemed carnivorous. The herbivorous were not recognized, because feeding on a microscopic herbage, of whose true nature I had formed an erroneous impression. It is therefore with no little satisfaction that I now class the Diatomaceæ with plants, probably maintaining in the south polar ocean that balance between the animal and vegetable kingdoms which prevails over the surface of our globe. Nor is the substance and nutrition of the animal kingdom the only function these minute productions may perform; they may also be the purifiers of the vitiated atmosphere, and thus execute, in the antarctic latitudes, the office of our trees and grass turf in the temperate regions, and the broad leaves of the palm, &c., in the tropics. * * * *

"I shall now notice the most remarkable feature in the distribution of these organisms. They possess more than ordinary interest, many of the species being distributed from pole to pole: while these, or others are preserved in a fossil state, in strata of great antiquity. There is probably no latitude between Spitzbergen and Victoria Land where some of the species of either country do not exist. * * * * The siliceous coats of species only known living in the waters of the south polar ocean have, during past ages, contributed to the formation of rocks; and thus they outlive several successive creations of organized beings. The Phonolite stones of the Rhine, and the Tripoli stone contain species identical with what are now contributing to form a sedimentary deposit (and perhaps at some future period a bed of rock), extending in one continuous stratum for four hundred measured miles. I allude to the shores of the Victoria Barrier; along whose coast the soundings examined were invariably charged with Diatomaceous remains, constituting a bank which stretches 200 miles north from the base of Victoria Barrier, while the average depth of water above it is 300 fathoms, or 1800 feet.

"Again, some of the antarctic species have been detected floating in the atmosphere which overhangs the wide ocean between Africa and America. * * *

"The existence of the remains of many species of this order (and amongst them some antarctic ones) in the volcanic ashes, pumice, and scoria of active and extinct volcanoes (those of the Mediterranean sea and Ascension Island for instance) is a fact bearing immediately upon the present subject. Mt. Erebus a volcano 12,400 feet high, of the first class in dimensions and energetic action, rises at once from the ocean in the 78th degree of south latitude, and abreast of the Diatomaceæ bank, which reposes in part on its base. Hence, it may not appear preposterous to conclude that, as Vesuvius receives the waters of the Mediterranean, with its fish, to eject them by its crater, so the subterranean and subaqueous forces which maintain Mount Erebus in activity, may occasionally receive organic matter from this bank, and disgorge it, together with those volcanic products, ashes and pumice."

In the descriptive portion, it should be mentioned that Dr. Hooker, although himself no mean proficient in Cryptogamic botany, especially in Muscology, has received the valuable assistance of some of the best Cryptogamists of the age in the elaboration of the large part of this work which is devoted to these lower orders; Mr. Wilson having been associated with him in the preparation of the Mosses; the late Dr. Taylor, in that of the Hepaticæ and the Lichenes; Mr. Berkeley in the Fungi; and Professor Harvey in the Algæ. Making due allowance for all this important aid, we are more and more surprised at the amount of the results here embodied and the thoroughness with which they have been elaborated; the labor, enough as it would seem for a life-time, having been performed in the course of a few short years. May he long continue, in the new scientific undertakings in which he is at present so zealously engaged, to add new lustre to the honored name he bears.

Art. XIII.—*On the Quantitative Separation and Estimation of Phosphoric Acid;* by H. Rosè.*

The second No. of the Annalen der Physik und Chemie for 1849, contains an elaborate and most valuable memoir by H. Rosè on the quantitative separation and estimation of phosphoric acid. As this memoir furnishes the complete solution of one of the most difficult problems in analytical chemistry, we here offer a brief abstract of its contents. Some of the facts in relation to the action of the alkaline carbonates upon the phosphates of lime and magnesia will of course be familiar to many readers; still it may not be improper to mention them as the whole subject is discussed in the original memoir.

1. Phosphoric acid existing in a solution uncombined with bases is best determined by adding a weighed portion of oxyd of lead, (freshly ignited,) evaporating to dryness, and igniting. No bases must be present and no acids which cannot be completely expelled from the oxyd of lead by heat. The application of this method is independent of the particular modification in which the phosphoric acid may exist.

2. In determining phosphoric acid by means of magnesia and ammonia, it is indispensable that the acid be present in the C. modification. After adding sulphate of magnesia, ammonia and chlorid of ammonium, the solution may be gently warmed (as high as 30° C.) and after several hours filtered. The resulting phosphate of ammonia and magnesia is to be washed out with ammoniacal water in the manner recommended by Fresenius. A solution of carbonate of ammonia cannot be substituted for the pure alkali in this process.

3. Phosphoric acid cannot be perfectly separated from peroxyd of iron by means of sulphuret of ammonium, as has been heretofore supposed. The resulting sulphuret of iron contains indeed no traces of phosphoric acid, but on the other hand the precipitated phosphate of magnesia and ammonia is not free from oxyd of iron.

4. Berthier's method of separating phosphoric acid from basic oxyds (by adding a solution of peroxyd of iron and afterward ammonia) does not give satisfactory results in quantitative analyses.

5. Von Kobell's modification of Berthier's method (by means of carbonate of baryta and solution of peroxyd of iron) gives good results in cases where the basic oxyds are not precipitated from their cold solutions by the carbonate of baryta alone.

* Condensed for this Journal by Dr. Wolcott Gibbs.

6. The C. modification of phosphoric acid may be separated from magnesia by dissolving the phosphate in chlorohydric acid, adding carbonate of baryta and allowing the whole to stand for some time. The supernatant liquid contains all the magnesia, while the phosphoric acid unites with the baryta.

7. The phosphates of lime, baryta, strontia and magnesia, are not completely decomposed by fusion with alkaline carbonates, but if the phosphate of magnesia be fused with six times its weight of carbonate of soda the resolution is very nearly complete.

8. Phosphate of magnesia may be perfectly decomposed according to Weber by fusion with a mixture of equal equivalents of the carbonates of soda and potash. The same however is by no means the case with the phosphates of lime, baryta and strontia.

9. Phosphate of lime cannot be decomposed by fusion with hydrate of potash, or by boiling with a solution of carbonate of soda. If the phosphates however have not been previously ignited, the decomposition is nearly complete in a cold concentrated solution of the alkaline carbonate.

10. The phosphates of zinc, protoxyd of manganese and peroxyd of iron may be perfectly decomposed by simple fusion with carbonate of soda. The phosphate of oxyd of copper is partly reduced to a suboxyd, which however appears to contain no phosphoric acid; on the other hand the solution filtered off from the insoluble residue still exhibits traces of copper.

11. The phosphates of the oxyds of uranium and chromium may be completely decomposed by fusion with a mixture of carbonate of soda and cyanid of potassium. (For the details of the method we must refer to the original memoir.)

12. The phosphates of magnesia and soda cannot be completely decomposed by means of sulphuric acid and alcohol. On the other hand, it is well known that in this manner the separation of phosphoric acid from lime may be easily and perfectly effected.

13. The phosphates of alumina and peroxyd of iron do not admit of a perfect decomposition by means of sulphuric acid and subsequent addition of sulphate of ammonia and alcohol. The phosphate of magnesia may however be decomposed in this manner, though a small portion of the phosphoric acid is always volatilized by heating with sulphuric acid, hence the method is not to be recommended.

14. The following is the method recommended by Rosè for the separation of phosphoric from all bases. The phosphoric acid combination is to be dissolved in a moderate quantity of nitric acid, and the solution brought into a porcelain capsule. Metallic mercury is then to be added in such quantity that a small portion always remains undissolved by the free acid, and the whole

is to be evaporated to perfect dryness in a water bath. If the mass still smell of free acid, water is to be added and the solution is again to be evaporated to dryness. This process must be repeated if necessary till the dry mass no longer smells of nitric acid. Either hot or cold water may then be added, and the whole may be filtered, care being taken to use the smallest possible filter. The mass upon the filter is then to be washed out, till a few drops of the filtrate evaporated upon platina foil no longer leave a residue after igniting the foil. The filtrate now contains the bases united to nitric acid, together with much nitrate of suboxyd of mercury and a small portion of nitrate of the protoxyd. Chlorohydric acid is to be added and the precipitate if abundant is to be filtered off. It consists of $Hg_2 Cl$ and should leave no residue after ignition. If however the precipitate obtained by muriatic acid be insignificant, ammonia may be directly added and the partly black and the partly white precipitate obtained must then be rapidly filtered and protected as much as possible from the air during the washing, in order that no carbonate of lime may be formed. This method of getting rid of the mercury can be employed only when there are no bases present which are precipitated by ammonia. Chlorid of ammonium may be added to prevent the precipitation of magnesia. If the decomposition of the phosphates has been complete, the precipitate upon the filter will be entirely volatilized by heat or leave at best a few milligrammes of oxyd of iron. If however this be not the case the process has not been carefully conducted or the whole of the excess of nitric acid has not been driven off. The residue is then to be farther examined; if it consists of earthy phosphates, these may again be decomposed by nitric acid and mercury; if of earthy carbonates or of oxyd of iron, these may be dissolved in chlorohydric acid and added to the filtrate obtained by ammonia. From this filtrate the bases may then be separated in the usual manner.

Instead of separating the mercury from the solution of the bases by means of ammonia, it is frequently more simple and advantageous to evaporate the whole in a platinum capsule and then to ignite the residue in a platinum crucible. In this manner we avoid the necessity of subsequently driving off the large mass of ammoniacal salts formed in the process first described. If however nitrates of the alkalies be present as well as those of the alkaline earths, small quantities of solid carbonate of ammonia must be added from time to time during the process of ignition to convert the decomposed alkaline nitrates into carbonates, otherwise the platinum crucible will be attacked. The ignited residue is to be dissolved in chlorohydric acid and the bases separated from each other in the usual order. It now remains to determine the quantity of phosphoric acid in the residue insoluble in water.

This residue consists of phosphate and nitrate of suboxyd of mercury and of metallic mercury. The filter with the mercurial salts is to be thoroughly dried; the mass is to be carefully separated from the filter, brought into a platinum crucible, and mixed with an excess of carbonate of soda, or still better, with a mixture of equal equivalents of the carbonates of soda and potash, as this is more easily fused. The filter is to be rolled up into a ball, laid in a cavity in the mixture in the crucible, and covered with a layer of the carbonates. The whole is then to be moderately heated under a flue not however to ignition, the contents of the crucible not being allowed to fuse and the heat being continued about half an hour. In this manner the metallic mercury and the mercurial salts, with the exception of the phosphate of the suboxyd, are volatilized. The crucible is now to be subjected to the strongest heat of a spirit lamp with a double current of air and strong alcohol; the fused mass is to be treated with hot water, in which it should be perfectly soluble if the operation has been carefully conducted and if no iron were present in the original compound. The solution is to be supersaturated with chlorohydric acid and the phosphoric acid determined by means of ammonia, sulphate of magnesia and sal-ammoniac.

"By the method described," says Rosè, "all phosphoric acid compounds may be so completely decomposed that, on the one hand, all bases may be obtained free from every trace of phosphoric acid, on the other hand, the phosphoric acid is perfectly separated from all the bases with which it was united, which cannot be effected by any other method."

The following precautions must be carefully observed in the analysis of phosphates by this process. So much metallic mercury must be added to the nitric acid solution, that a distinctly recognizable quantity of the metal remains in the dry evaporated mass. The evaporation must be effected in a water bath and not by the direct application of heat, as in this case portions of the nitrates formed might be decomposed. The nitrates of the stronger bases are not decomposed under the temperature of boiling water. If however alumina or peroxyd of iron be present, the process must be slightly modified as the nitrates of these bases are partially decomposed during the evaporation, and the bases themselves remain upon the filter with the salts of suboxyd of mercury. When iron alone is present, the subsequent fusion with the alkaline carbonate effects its perfect separation, if however alumina be also contained in the mass upon the filter, it will be necessary during the fusion with the carbonates to add silica in the manner recommended by Berzelius. If the heating in the platinum crucible previous to its ignition has not been carefully conducted, oxyd of platinum will be mixed with the oxyd of iron and may be separated from this by dissolving the mass in chlorohydric acid and adding excess of ammonia, the platinum then remains in solution while the iron is precipitated as oxyd. Alumina has not yet been detected with certainty in the ashes of organic substances. The assertion of Fresenius that phosphate of peroxyd of iron cannot be perfectly decomposed by fusion with an alkaline carbonate is, according to Rosè, incorrect.

Art. XIV.—*Abstract of an Article on the Conducting Powers of the Metals at different temperatures, &c.*; by M. Edmond Becquerel.*

After an introductory view of what has been done by others on the subject of conducting powers, the author proceeds to introduce a description of the apparatus employed by himself in his researches on the conducting powers of the metals, remarking that it is similar to that employed by the elder Becquerel, but has some modifications which he thinks frees it from all source of error.

The galvanometer employed was a differential instrument, having two separate wires in its coil, these wires being first covered with silk and twisted together into a cord, after the manner of Poggendorff, before being coiled on the frame of the galvanometer. If these two wires be made parts of two distinct metallic conductors of equal conducting power connecting the poles of the same galvanic pair or battery, and so that the two currents shall be in opposite directions through the galvanometer, the needle of the latter will be stationary, and this is the test of the equality of the conducting powers of the two conductors. Of one of these conductors, Wheatstone's rheo-stat is made to form a part of the other wire to be submitted to experiment, so that if any addition be made to the length of the latter included in its circuit, a corresponding addition must be made to the length of the wire of the rheo-stat included in its circuit, in order to maintain the equilibrium of the needle. Thus if after the needle has been brought to rest, one additional metre of the wire of experiment be brought into the circuit, it will be necessary to turn the rheo-stat till such an additional length of its wire is brought into the circuit to which it belongs, as is equivalent in its resistance to conduction to the metre of the wire of experiment. Thus the rheostat is made to furnish a measure of the resistance to conduction of a given length of wire. The apparatus was arranged so that scarce any change was made in either circuit, beyond that of the

* From the Ann. de Ch. et de Ph., 3d series, vol. xvii, p. 242.

length of the included portion of the wire, the nature of the connections remaining the same, and the variations in the length of the wire of experiment could be read off on a graduated scale.

As a test of the accuracy of the method, we give the results of experiments made on an iron wire of a diameter of 0·3223^{mm} at the temperature of 12°·5 C. These results are cited by the author to prove the law, almost axiomatic indeed, that the resistances are proportional to the length of the wire.

Readings of graduated scale.	Readings of index of rheo-stat.	Lengths of standard wire of rheo-stat.	Lengths of standard wire equivalent to 0·01^m of the iron wire.	Second column calculated by least squares.	Errors of second column.	
Centim et's						Length of
0 .	94·4	·0	. .	95·9	−1·5	standard
20	257·0	162·6	8·13	256·7	+0·3	wire equiva-
40	419·6	325·2	8·13	417·6	+2·0	lent to
60	579·4	485·0	8·08	578·5	+0·9	0·01^m of the
80	737·7	643·3	8·04	739·3	−1·6	iron wire
100	900·0	805·6	8·06	900·2	−0·2	8·043.

The numbers in the columns following the first are to be regarded as arbitrary units of the standard wire, the unit being nearly equal to 2^{mm}. The fifth and sixth columns we have added to exhibit the degree of precision of the experiments, and the best result as shown by the numbers in the fifth column is that the resistance of one metre of the iron wire is equal to 804·3 divisions of the rheo-stat, and this is denominated the *equivalent of resistance* for one metre of the iron wire.

The next inquiry considered is whether the relation of the resistance to the diameter follows the commonly received law with the same degree of precision. Two iron wires unannealed, having diameters of 0·7370^{mm} and 0·3037^{mm}, gave on a mean of two experiments with each, the following results, the length being one metre.

	Equivalent of resistance.	Diameters.	Squares of the diameter.	Prod. of squares into resistances.
1st wire,	157·08	0·7370	0·5432	85·717
2d wire,	928·65	0·3037	0·0922	85·622

The close correspondence of the numbers in the last column, though exactly what might be expected in conductors of the same metal in the same state of aggregation, is yet worthy of particular notice in the case of wires. It might be anticipated in view of the violent operation of wire drawing, that the smaller wire would differ so much from the larger in texture and hardness as to cause a decided change in the conducting power, and a marked deviation from the law in question on a comparison of the two wires. But the result shows that in the case of iron at least whatever difference of texture there may be in the two wires has very little influence on their conducting power, and it has been shown* that bending a brass or iron wire, or even annealing the latter at a red heat, causes also but a slight change in their conducting power. That the annealing does produce a change, however, is shown by the following table, in which we copy the first and last three columns only.

Metals.	Conducting powers at 55° Fah.		Ratio of conducting power of annealed to that of unannealed metal.
	Unannealed.	Annealed.	
Pure silver,..............	93·448	100·000	1·0701
Pure copper,..............	89·084	91·439	1·0264
Pure gold,................	64·385	65·458	1·0166
Cadmium,..................	24·574	. .	. .
Zinc,.....................	24·164	. .	. .
Tin,......................	13·656	. .	. .
Palladium,................	13·977	. .	. .
Iron,.....................	12·124	12·246	1·0101
Lead,.....................	8·245	. .	. .
Platinum,.................	8·042	8·147	1·0130
Mercury, (temp. 57°·2 Fah.)..	1·8017	. .	. .

Of the metals named in the above table, we see that silver wire alone has its conducting power altered in any considerable degree by annealing.

The next part of the investigation relates to the conducting powers of the metals at different temperatures. The wire of experiment having had its equivalent of resistance at the atmospheric temperature previously determined, was coiled and introduced along with the bulb of a thermometer into a bath of oil. Two thick connecting pieces of copper, whose resistance to conduction could be neglected in comparison with that of the wire, were connected with the extremities of the latter in the bath. By means of this arrangement immersed in a water bath the increase of the equivalent of resistance in the wire due to heating it from the temperature of the air to the boiling point could be measured with accuracy. To ascertain whether the increase of resistance is proportional to the elevation of temperature, the heated bath was allowed to cool gradually and observations were repeated at intervals. The results of experiments on a wire of iron are given in the following table. The second column of temperatures was calculated from the two extreme temperatures on the basis of the law just stated, i. e., that the increase of resistance for 1° Cent. is constantly $\frac{398{\cdot}0-23{\cdot}7}{97^\circ{\cdot}8-15{\cdot}0}=4{\cdot}5205$. This quantity we will call $\frac{dr}{dt}$.

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* See this Journal, 2d series, vol. i, p. 239.

Temperatures observed.	Temperatures calculated.	Differences.	Readings of index of rheo-stat.
Fixed at 97°·8 C.	97°·8 C.	0°·00 C.	398·0
Temp. falling.	. .	. .	. . .
89°·50	89 ·40	−0 ·10	360·0
86 ·50	85 ·20	1 ·30	341·0
86 ·00	84 ·75	1 ·25	339·0
85 ·00	83 ·87	1 ·13	335·3
78 ·50	74 ·58	3 ·92	293·0
74 ·00	70 ·30	3 ·70	273·5
70 ·00	65 ·90	4 ·10	253·6
65 ·00	60 ·80	4 ·20	230·6
59 ·00	55 ·80	3 ·20	207·6
58 ·00	55 ·00	3 ·00	204·4
54 ·50	51 ·64	2 ·86	189·5
50 ·00	47 ·40	2 ·60	170·0
36 ·60	34 ·75	1 ·85	113·0
24 ·00	23 ·63	0 ·37	62·7
23 ·00	22 ·70	0 ·30	58·5
18 ·10	18 ·54	+0 ·44	39·7
15 ·00	15 ·00	0 ·00	23·7

The author considers these results as justifying the conclusion that $\frac{dr}{dt}$ is constant, and ascribes the differences in the third column to inequality of temperature in the oil bath, a bad conductor of heat, during the cooling. To this inference we object, because in the first place there is no presumption in the nature of the case that $\frac{dr}{dt}$ is constant for different temperatures, and in the second place, the equality of temperature being well established at the upper limit of 97°·8 C., the differences in question ought, if they depended on inequality of temperature, to have been greatest in the first and most rapid stages of the cooling, whereas the differences are then very small. We therefore regard these residuals as indicating for $\frac{dr}{dt}$ a variable value containing terms of the first and even of the second powers at least of the elevation of temperature above 0°· C. For practical purposes indeed the variation of $\frac{dr}{dt}$ may perhaps be neglected. For purposes of exact science so far as appears from the paper before us, it certainly cannot be.

Proceeding on the principle that $\frac{dr}{dt}$ is constant, experiments were next instituted on the different metals. An annealed silver wire gave $\frac{dr}{dt}=0·4444$, the whole resistance at 12°·75 C. being 116·184. Hence we have,

Increment of resistance for 1° C., . .	0·4444
Whole resistance at 12°·75 C., . .	116·184
" " " 0° C., . . .	110·518

Coëfficient of the increment of resistance,

$$\text{for } 1^{\circ} = \frac{0{\cdot}4444}{110{\cdot}518} = 0{\cdot}004021.$$

In this manner the following table was constructed, to which we add a column for use with Fahrenheit's thermometer.

	Coëfficient of increment of resistance for 1° C.	For 1° Fah.
Mercury,	0·001040	0·000578
Platinum,	·001861	·001034
Gold,	·003397	·001887
Zinc,	·003675	·002042
Silver,	·004022	·002234
Cadmium,	·004040	·002244
Copper,	·004097	·002276
Lead,	.004349	·002416
Iron,	·004726	·002625
Tin of commerce,	·005042	·002801
Tin, purified,	·006188	·003438

From this table and that of the conducting powers before obtained, is constructed a farther table copied into this Journal, 2nd ser., vol. ii, p. 255.

The principal results of the author's researches on the conducting powers of liquids and other later researches connected with the same subject, will be given in the next number of the Journal.

J. H. Lane.

Art. XV.—*A Memoir of Charles Alexander Lesueur.* Read before the American Philosophical Society, at the stated meeting, on the 6th of April, 1849; by George Ord.

At the close of the eighteenth century, the Institute of France, ever actuated by the desire of advancing the sciences, which are the basis of the durable glory of nations, conceived the project of a voyage of discovery in the southern parts of the Eastern hemisphere. Great Britain had done much for geography and navigation. She had recently founded a colony in New South Wales, singular in its conception, unexampled in its success. She was spreading her empire over various parts of Terra Australis, now termed the Fifth Continent; but still there was an extensive field open for geographical enterprise, as a large portion of the southern coasts of that immense country was yet unexplored.

The French government after a succession of extraordinary commotions, now began to assume some consistency; and the nation, always sanguine in its anticipations, hailed the event as an earnest of future prosperity. Bonaparte was elevated to the dignity of first Consul; and although the wars which had called into activity his military talents still continued, yet was it hoped that under his auspices France, long the antagonist of England in arms, might be enabled to prove herself to be a successful competitor in those pursuits which tend to the improvement and happiness of the human race.

The measure was suggested to the government; and the proposition of the Institute was seconded by the First Consul, who, as a member of the Academy of Sciences, felt a lively interest in its proceedings. The government yielded to the wishes of the Institute; and at the moment when the army of reserve was about to pass the Alps, to enter Piedmont, Bonaparte issued his orders to hasten the execution of this great enterprise.

As it was intended that this expedition should form an epoch in the history of maritime discovery, neither pains nor cost were spared to render it successful. Two sloops of war or *corvettes*, respectively named the Géographe and the Naturaliste, were equipped in the port of Havre; and a selection from the most skillful and experienced officers of the navy was made to conduct them. The scientific corps, with their coadjutors, all of whom had been recommended by the Institute, amounted in number to twenty-three; to wit: four astronomers and hydrographers, three botanists, five zoologists, two mineralogists, four artists, and five gardeners. So large and so efficient a body had never been engaged in a similar expedition.

It was not among the officers alone that there was discrimination in the choice. "The midshipmen before they were received," says the historian of the voyage, "underwent rigorous examinations; the most inferior stations had been sought for with avidity, and some of them were filled by young men of the most respectable families in Normandy, impelled by the desire, peculiar to youth, of acquiring knowledge, and of participating in those distant voyages which ever assume a character of greatness and singularity, and which enforce that respect they constantly merit and obtain. Among these interesting young men was my worthy coadjutor, my estimable friend, Mr. Lesueur, the dear companion of my dangers, my sacrifices and my toil."

Charles Alexander Lesueur was born at Havre-de-Grâce on the 1st of January, 1778. His father, who was an officer of the admiralty, bestowed upon him that education which his limited means afforded; there being several other children that equally claimed his paternal care. In French schools the elements of drawing are usually taught. The bent of the lad's mind being towards this art, his desire to excel in it became a ruling passion, which could not fail to produce the happiest results; and, at the expiration of his pupilage, his parent had the satisfaction of finding, in the productions of his pencil, the skill and finish of a master.

The bold cliffs of Normandy, termed *les falaises*, are remarkable for their savage aspect, and their geological formation. That part of them which forms the Cape *la Heve*, near the entrance of Havre, is the most conspicuous object to the mariner as he approaches the port. The shore, at the base of the Cape, is often frequented by the inhabitants; the youth, especially, resort thither for the purpose of collecting the rejectamenta of the sea; and among the cliffs those wander who take an interest in the singularities of nature, or who are pleased with an extensive prospect. Amid these scenes the boyish days of Lesueur were spent; it was here that he imbibed a love of natural history, augmented by his talents for delineation. It was with a view of the ocean perpetually before his eyes that he cherished those visions of fancy, which were at length realized in his voyage to the southern hemisphere.

It is stated above that among the young men who solicited employment in the expedition was Mr. Lesueur, then in his twenty-third year. The zeal and vivacity which he exhibited were powerful recommendations in his favor, independent of respectable influence; but he was warned of the inconveniences and privations to which he would be liable on shipboard, where every appropriate place was already occupied. He however allowed nothing to daunt him; and he was enrolled among the crew of the Géographe under the designation of *novice-timonier*, which, in English marine vernacular, might be rendered greenhorn or lubber.

In the enumeration of the geologists, it has been said that there were five. In the original plan of the scientific department, it was designed that there should be but four, two in each ship. Ultimately, at the suggestion of the Institute, a fifth was added; and as this individual, during the whole progress of the voyage, performed a most effective part, in conjunction with the subject of this memoir, it becomes proper to state who he was, and what were the motives of the Institute in favoring the application of the supernumerary.

François Péron was born at Cérilly, a town in the Department of Allier, in the year 1775. His father died while he was yet a child, leaving his mother with but slender means, and three children to support. By dint of rigid economy, she was enabled to place him in the college of Cérilly, the principal of which, attracted by his docility, gave particular attention to his instruction. On the termination of his collegiate studies, the ecclesiastical state was suggested to him; but the stirring events of the French Revolution influenced a mind naturally ardent, and he resolved to embrace the military profession. At the age of seventeen he entered the army as a volunteer; and at the battle of Kaiserslautern he was wounded and made a prisoner by the Prussians, who confined him in the citadel of Magdeburg. At the close of the year

1794, Péron was exchanged, and received a discharge from the army, in consequence of having, through his wound, lost the use of his right eye. This misfortune incapacitating him for military service, he resolved to engage in the study of medicine; and, consequently, he repaired to Paris, where he became a pupil of the School of Medicine; and for the space of three years not only assiduously followed the courses of that school, but also those of zoology and comparative anatomy of the museum at the Garden of Plants.

When the expedition for the discovery of southern lands was preparing to depart, Péron conceived a great desire to accompany it, and made application to the government to that effect. He was refused on the plea that, as the scientific corps was already complete, no addition could be admitted. This answer might have satisfied an ordinary applicant, but it was not sufficient for an enthusiastic mind, fertile in resources, and deriving vigor from opposition. He now sought an interview with M. de Jussieu, one of the commissioners who had made a selection of the naturalists, and begged him to intercede for him. To justify his apparent presumption, he stated his views of what he considered an important omission in the scientific department of the expedition. These were urged with a warmth and energy which evidently shewed that he felt himself capable of supplying the deficiency. Let me go, added he, with emphasis, you shall see what I will do! M. de Jussieu, who listened to him with admiration, advised him to write a memoir, explanatory of his motives, in order that they might be made known to the Institute. This course was promptly followed. The memoir, setting forth the importance of associating with the scientific men of the expedition a medical naturalist, one specially charged with the duty of making researches in anthropology, or the natural history of the human race, was read before the Institute; and, on their unanimous recommendation, Péron received the appointment of a place among the zoologists of the expedition, and was ordered to embark in the corvette, the Géographe.

On the 19th of October, 1800, the two ships left the port of Havre, and directing their course for the Canaries, they came to anchor, the beginning of November, in the harbor of Santa Cruz, in the island of Teneriffe. The object of touching at Santa Cruz was to procure certain provisions deemed necessary in tropical climates; which object being accomplished, they took their departure for the Isle of France, where they arrived on the 15th of March, 1801.

Péron and Lesueur, from the commencement of the voyage, seemed to be attracted to each other by mutual sympathy. They were both admirers of nature's works; and perceiving in each other certain qualities which, if properly united, might be productive of valuable results, they resolved to labor in concert; and so effectively did they put forth their strength, that they soon became conspicuous to all on board of their ship. The talents of Lesueur, it should seem, were not known, at first, to the artists appointed to accompany the scientific corps; but when these talents were revealed in his masterly drawings of the mollusca and soft zoophytes, with one accord, they pronounced him worthy of a place in their department; and the youthful aspirant was forthwith transferred by the commander-in-chief, from the humble position he occupied among the crew, to the honorable station of painter of natural history, and his appointments and privileges were made to correspond with his rank.

The chief zoologist of the corvette, the Naturaliste, was Bory de St. Vincent, a colonel in the republican army of the west, and well known for his learning and scientific attainments. Shortly after the ships came to anchor in the harbor of Port Northwest, formerly Port Louis, he went on board of the Géographe, to congratulate with his fellow voyagers on their safe arrival. On entering the cabin he perceived several persons looking over the private journal of the commander-in-chief, which was embellished by many beautiful paintings* of fishes, and of those phosphorescent animals which had been objects of uncommon interest to all the naturalists in their passage from Teneriffe to the Indian Ocean. Bory himself was no mean artist; but when he beheld the paintings in question, his admiration burst forth into eulogy, and he inquired who was the author of these master pieces of art, and where he was. "I was introduced," said he, "to a young man of modest demeanor, who, by a noble zeal, had embarked as a *novice-timonnier*, although worthy to form a part of a scientific expedition, in a manner much more useful to the progress of the arts. His talents had been discovered on board of the ship; and the commander-in-chief had availed himself of them by giving him employment. I have been since informed, that strict justice having been done him, his appointments have been assimilated to those of the principals in each department; and he truly merited this encouragement. I sincerely regret that I have forgotten the name of this skillful young man, from whom the expedition must derive one of its greatest resources."†

After a sojourn of six weeks in the Isle of France, the expedition set sail for the coasts of New Holland. They visited those parts named Endracht's Land and Leuwin's Land. Off the coast

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* Ce journal renfermait une multitude de figures de mollusques, de poissons, peints avec une perfection et une vérité dont rien n'approche.—*Bory, Voyage*, t. i, p. 161.

† Voyage dans les Quatre Principales Iles des Mers d'Afrique, pendant les années 1801 et 1802. Paris, 1804. 3 vols., 8°, et Atlas, 4°. Tome i, p. 162.

With respect to the commander's journal, report represented it of no value, excepting what was derived from Lesueur's figures.

of the latter, the ships were separated in a violent gale. The Géographe proceeded to the exploration of De Witt's Land; when her stock of provisions and water being nearly exhausted, the commander resolved to depart for the Island of Timor to obtain a supply, and to relieve his crew, dispirited by fatigue and sickness, and thinned by death. On the 21st of August, the ship was moored in the road of Coepang, the chief establishment of the Dutch at Timor. The Naturaliste after her separation explored the coasts of Edel's Land, and rejoined her consort on the 21st of September, in the roadstead of Coepang.

"Perhaps there is no country," says the historian of the voyage, "more interesting, and at the same time, there are few so little known as the great Island of Timor. Placed in the midst of the equatorial regions, covered with the most useful vegetables, and abounding with the most precious animals; intermediate between New Holland and the islands of the great archipelago of Asia, it presents in its atmospherical and geological constitution, in its different productions, and in its physical and political revolutions, important subjects of inquiry and meditation."

Timor afforded a rich field for the naturalists, and their industry was equal to their zeal; but an accident which befel Lesueur, on the 12th of September, nearly cost him his life. While pursuing a troop of monkeys, among the rocks which obstruct the course of the river Coepang, he was bitten in the heel by a venomous reptile. He was alone, at some distance from the town. A numbness, which pervaded the whole leg, was a significant indication of what he had to apprehend from such a wound. He hastened toward the fort, as fast as his condition would permit, as his leg had become rigid. To lessen the activity of the virus, he had recourse to a ligature above the knee; the thigh nevertheless began to swell visibly, and when he reached his quarters, he threw himself upon his bed, overcome with fatigue and agony, and exhibiting symptoms of a malignant fever. The surgeon-major, M. Sharidon, fortunately being at home, immediately cauterized deeply the wound, then applied to it a compress, impregnated with ammonia; he also gave the patient a strong dose of the same, and ordered him to be kept as quiet as possible. A copious perspiration took place, the pains began to abate; and in a few days Mr. Lesueur was enabled to be abroad, with no other inconvenience than a stiffness of the knee, which continued for some time, and was long occasionally felt during sudden variations in the temperature of the weather.

On a superficial view of Timor, it would seem to be an earthly paradise. Nature there exhibits her most inviting forms, and is truly lavish of her bounties. The choicest productions of the tropics there attain to their utmost perfection, and the sea and the land seem to vie with each other in contributing to the gratifications of man. But there is a counterpoise to these enjoyments in a temperature of the most enervating kind, which deranges the vital functions, and facilitates the approach of that scourge of the Indian isles, the dysentery. The natives of Asiatic descent generally escape this disease, by their habitual use of stimulating food, and that powerful tonic, betel. But the Europeans, and the Americans, who visit those shores, soon become subject to its attacks; and in some instances the entire crews of vessels have been swept off in a few weeks.*

Péron, who paid particular attention to the dietetic habits of the Malays of Timor, and their constant use of betel, became convinced of the influence of condiments and tonics in counteracting the malignant effects of the climate. He hence resolved to conform to customs which were evidently the results of observation; and he owed his preservation from the dysentery to this sensible determination. But his advice and example not being heeded by others, the disease made frightful ravages among the crews of the ships; many of the officers were ill; and of the scientific men nearly the whole were affected by it. The chief gardener died at the island; two of the zoologists, a mineralogist, and an assistant gardener, survived but a short time after their departure. Mr. Lesueur, after recovery from the accident, as related above, pursued his labors with renewed ardor. Péron warned him of the danger of rashly exposing himself in such a climate, without those precautions which the experience of the natives had taught them. But relying too much upon the vigor of his constitution, he at length became a participant of the common calamity. He was still sick when the ships left Coepang; but through the exertions of the physicians, and the unremitting attention of Péron, he was restored to health before their arrival on the shores of New Holland.

It now became evident that a longer stay in that unhealthy climate would occasion the entire destruction of the expedition; hence orders were issued for their departure. On the 13th of November they got under weigh, for Van Diemens Land. Their sojourn at Timor had been prolonged to eighty-four days. "A sacrifice of time," says Péron, "the death of many individuals, the great inconvenience of having on board of the two vessels a large number of sick, were the deplorable results of this long sojourn."

On the 13th of January, 1802, the ships reached the southern extremity of Van Diemens Land, and commenced their explorations of that coast, and the adjacent eastern islands. Off Cape Forestier, the Naturaliste was separated from her consort in a

* Capt. Flinders, in the Investigator, remained only eight days at Timor, and yet, after his departure, the dysentery appeared among his crew to an alarming extent. They got no relief until their arrival at Port Jackson. Some of his best men died.

squall, and the Géographe continued her route alone to the straits of Banks and Bass, and thence to the survey of the extensive region which lies on the southern part of the continent, between Port Western and Nuyts' Archipelago; a country named, by the geographers of the expedition, Terre Napoléon, on the supposition that they were the first to explore it, not being aware, at the time, that Captains Grant and Flinders had already explored a considerable part of it.*

The accidents and risks, which generally attend a voyage in unknown seas, were fully experienced by our navigators; but dangers, quite as formidable, presented themselves in other forms, those of want and disease. The scurvy, which had succeeded to the dysentery, pervaded the ship, to an alarming extent. "Already," says Péron, "several men had been consigned to the deep; already more than half of our crew were incapable of any duty; and of our helmsmen, two alone could keep the deck. The progress of this epidemic was frightful. Could it be otherwise? Three-fourths of a bottle of fetid water was our daily ration; during more than a year we had not tasted wine; we had not a drop of brandy; and in lieu of these liquors, so indispensable to European seamen, especially in voyages like ours, we were allowed but three-sixteenths of a bottle per man of the detestable rum distilled at the Isle of France, and which there the negroes alone make use of. Our biscuit was full of insects; all our salt provisions were rotten, to the full extent of the term; and so offensive were these meats, that the most hungry sailors, refusing to partake of them, sometimes, even in the presence of the commander, threw their rations into the sea. In short, there were no refreshments of any kind. And those consolations, on the part of authority, so grateful to the feelings of all, so conducive to the alleviation of the most painful privations—these also were wanting. The officers and the naturalists, reduced to a similar allowance with the men, had equal pains to endure both of body and mind."

Winter had now set in, and it became evident that any farther attempts at discovery, at that period, would be abortive, in consequence of their deplorable state. Relief being absolutely necessary, all sail was made for Van Diemens Land; and the ship anchored, on the 20th of May, in Adventure Bay, on the eastern coast of Bruny island, for the purpose of procuring wood and water. A supply being obtained, she departed for New South Wales. Their condition at this time, may be imagined, when it is stated that not a single person was exempt from the scurvy.

* Capt. Grant, of the Lady Nelson, had discovered the eastern part, from Western Port to the longitude 140¼°, in the year 1800, before the French ships sailed from Europe; and on the west I had explored the coasts and islands from Nuyts' Land to Cape Jervis in 138° 10'.—*Flinders*, vol. i, 191.

Of the crew, but twelve men, out of one hundred and seventy, were in a condition to do their duty.* They were several days abreast of Port Jackson, totally unable, with all their efforts, to get into port, when they were descried by persons on the look-out for them; and the governor of the colony immediately despatched to their assistance a large boat, containing a pilot, and a supply of men. Had this succor not been afforded them, it is probable that in a short time, all must have perished.

The Naturaliste, after her separation from her consort, off the eastern coast of Van Diemens Land, sought her in vain at the various rendezvous, and at length was compelled to put into Port Jackson for supplies. She had gone to sea in search of the Géographe, when the latter reached the harbor. Much anxiety having been manifested for the safety of the Géographe, in consequence of the known condition of the crew, her arrival was welcomed by all the inhabitants of the colony. The sick were immediately conveyed to the public hospitals, and received every attention which the most refined benevolence could suggest. The governor general gave the French commander to understand that he had received orders from the British government to afford every facility to the expedition in his power; and that consequently not only the public stores should be at his service, but that the bills of the commander, without limitation, should receive the guarantee of the colonial government. "Thanks to assistance so ample," says Péron, "we were enabled to reclothe our crews, who were in want of every thing; to repair our two ships, to purchase a third vessel, and, finally, to resume the continuation of our voyage."

In the mean time, the researches of the scientific men met with universal encouragement. An English guard was mounted to protect their observatory. The naturalists, as well as their assistants, were authorized to carry arms, a privilege not granted to all the inhabitants. Guides and interpreters were appointed to attend them in their distant excursions. "In short," says Péron, "the procedure of the English government here, with respect to us, was so noble, so generous, that to fail in the acknowledgment of our gratitude would prove us to be void of every principle of honor and justice."

The permanent settlement of New South Wales had no older a date than 1788, when visited by the French navigators; and yet, in that short period, the colony had advanced in agriculture, in commerce, and in population, to a degree which excited their admiration. The population, from 1030, carried thither by governor Philip, had increased to upwards of 13,000; and the products of the land not only sufficed for their wants, but afforded a

* Péron, in quoting Baudin's Journal, makes him say *four* men: "Je n'avais plus que quatre hommes en état de rester sur le pont, y compris l'officier de quart." This is evidently a misquotation.

surplus for the maintenance of foreign commerce. "Of all the European nations," says Péron, "that which appears to have best understood the true principles of colonization is the English." We need not go beyond North America to be convinced of this important truth; and when we pass in review the various people who have undertaken to plant colonies on our continents, the Spaniards, the French, the Dutch, the Swedes, and the English; what a cheering subject of reflection is it, that these United States owe their stamina to the Anglo Saxon race; and that their language, their habits, and their characteristics, are those which distinguish the most illustrious nation upon the face of the earth.

A stay of five months duration at Port Jackson, afforded the gentlemen of the expedition abundant means to study the economy and policy of that singular colony; and the results of their investigations, as detailed by Péron, are not only instructive, politically considered, but they impart to his narrative a moral effect, which renders it doubly interesting.

In consequence of the diminution of the crews of the two corvettes, by sickness, death and casualties, it was deemed advisable to send the Naturaliste to France. In her stead a small schooner of thirty tons, was purchased and fitted out as a tender, provided with means to facilitate the labors of the hydrographers, in their explorations of the coasts. She was named the Casuarina.

On the 18th of November, 1802, the vessels sailed from Port Jackson, and directed their course for the Straits of Bass. On the 8th of December, at King's Island, the separation of the corvettes took place; the Naturaliste to pursue her homeward voyage, the Géographe and the schooner to continue those investigations which the disasters of the previous navigation had interrupted.

The Géographe, and her tender, visited in succession the northwest coasts of Van Diemens Land, and the neighboring isles, Napoléon's Land, Nuyts' Land, Leuwin's Land, Endracht's Land, and De Witt's Land. Five months thus employed, amidst difficulties and dangers of no ordinary kind, a want of fresh supplies of provisions and water, compelled them to seek again the Island of Timor, rendered memorable by the calamities of the former visit; and they cast anchor in the bay of Coepang on the 6th of May, 1803. The dreaded dysentery reappearing among them, the vessels were hastily got ready for departure, and on the 3d of June they set sail with the intention of visiting the Land of Arnheim, the Gulf of Carpentaria, and the southwest extremity of New Guinea. After upwards of thirty days of buffeting against the easterly monsoon, the project of continuing their researches appeared to be hopeless, as their stock of water would not suffice for so long a course, and their deadly foe, the scurvy, was once more in the midst of them. The commander therefore resolved to make the best of his way to the only port where the resources which they stood so greatly in need of, could readily be procured. He was chiefly urged to this measure by his own condition, as he had been, for some time. afflicted with an obstinate spitting of blood. On the 7th of August the Géographe reached the Isle of France, to the great joy of all on board, harrassed by unceasing difficulties, and broken down by sickness and want.

It was now ascertained that the commander's disease admitted of no cure; and on the 16th of September, 1803, Nicholas Baudin ended his days, and was buried with all the honors which were due to the *rank* which he had held in the French navy.

In the composition of the *Etat-major*, or officers of this expedition, there was one capital defect, and that was in the choice of the commander-in-chief. Who Nicholas Baudin was, and what were his claims to that distinction which the government conferred upon him, in appointing him to conduct a voyage of discovery, I have not the means of ascertaining; but judging from the whole tenor of his conduct, as exhibited in the narrative of the expedition, and concurrent testimony, it may be said that a more injudicious selection could hardly have been made. Wanting in that sympathy which is an incentive to the sailor's virtues, he was characterized by fickleness, selfishness, arrogance and malignity. To these repulsive qualities may be added that unbounded self-confidence which is so frequently the concomitant of ignorance. Never, it is probable, having made a passage to the seas of India, and not having profited by consulting the numerous histories of voyages to the eastern hemisphere, he naturally concluded, by the inspection of his chart, that the shortest course to the Cape of Good Hope was the most eligible; consequently, after departing from Teneriffe, he stretched along the coast of Africa, instead of standing to the westward, toward the coast of Brazil, thereby to profit by the trade winds, which prevail in those latitudes. The usual obstacles to the direct route—calms, currents, and baffling winds, at length forced him to change his course. The result of this mistake was the loss of much valuable time, which materially affected the whole plan of the expedition, as, including a stay of eleven days at Teneriffe, the ships were one hundred and forty-five days in their passage from Havre to the Isle of France.

The want of nautical skill in the commander being now manifest, disgust and dissatisfaction were every where apparent. Forty of their best seamen deserted. Several of the officers, midshipmen, and scientific men, resolved to remain in the colony. The principal part of them had the excuse of indisposition; but the true cause was their sense of insecurity with one whose incapacity had already been productive of much evil.*

* Of the scientific corps, there remained in the island, Bissy, astronomer—Michaux and Delisse, botanists—Bory de Saint Vincent, zoologist—and Milbert, Lebrun, Garnier, painters.

The general impression is, that as the post of commander in chief of a scientific expedition is one of great dignity, so, the incumbent must necessarily be presumed to be a man of honor. The French government had omitted nothing which might contribute to the success of the voyage. The magazines of Havre were placed at the disposal of the commander; and large sums of money were granted him for the purchase of medicines, bottled wines, spirituous liquors, soup-cakes, preserved meats, essence of malt; in short, every thing which the health and comfort of man, exposed to the vicissitudes of an extended navigation, could seem to require. But on the arrival of the ships at the Isle of France, circumstances occurred which placed the character of Captain Baudin in no equivocal light. It was observed that upwards of eighty cases and trunks, of what had been supposed to be ship-stores, were landed and given to the care of an individual, who had embarked in the Géographe under the title of captain's secretary, but who, in reality, was a business associate of the commander.* This man at once set up a shop in Port-Louis, for the exhibition and sale of their merchandize, the value of which was estimated to amount to upwards of three hundred thousand francs! So says Bory de Saint Vincent, who declares that he there saw exposed to sale even the ship's medical stores! an act of consummate baseness, which is perhaps without a parallel in the history of maritime discovery.†

The ships had hardly left the Isle of France, when the commander ordered all on board to be put upon short allowance; that is to say, to each man half a pound of fresh bread every ten days. In place of the ration of wine, to which they had been accus-

* In the passport granted by the French government to Captain Flinders, he was expressly prohibited from engaging in any kind of commerce. Baudin, it should seem, had greater latitude in the passport which *he* received from the British government; otherwise he would not have dared to make the scientific character of his expedition a cloak for commercial speculation. "Il est bien entendu cependant, qu'ils ne s'occuperont d'aucune espèce de commerce, ni de contrebande." For a copy of this passport, see "A Voyage to Terra Australis," vol. i, p. 12.

† Je songeai sérieusement à me ménager, pour être rétabli au moment du départ de l'expédition, qui pouvait être prochain. Une bonne santé devenait d'autant plus nécessaire pour continuer le voyage, que nous allions mettre à la voile dans un dénuement absolu de tout ce qui peut être propre à adoucir les dégoûts d'une longue traversée: nos vivres devaient être de mauvaise qualité; nous allions, peut-être aller dans des contrées très-malsaines, et ce qu'il y avait de plus alarmant, c'est qu'il ne restait pas à bord un médicament, en cas qu'il y eût des malades. Sans doute, par quelque méprise, en descendant à terre plus de quatre-vingts malles et caisses marquées B, qui devaient y être déposées, on descendit aussi les médicamens de l'expédition, et même des barils de clous à l'usage du bord; car j'ai, depuis, vu vendre ces objets dans un grand magasin nommè dans ce temps, à l'Isle-de-France, le Magasin des Gabares. Ce magasin, très-considérable et tel qu'on n'en avait pas vu dans le pays depuis la guerre, contenait pour la valeur de plus de trois cent mille francs de marchandises d'Europe, sur lesquelles on gagna deux, trois et quatre cent pour cent. On disait que ces marchandises provenaient des malles marquées B, qu'on avait débarquées de nos navires.—*Voyage dans les Quatres Principales Isles des Mers d'Afrique.* Tome i, p. 186.

tomed, they were allowed only three-sixteenths of a bottle of tafia.* Buscuit and salt meat were to be their daily food. "A sorrowful prelude to those misfortunes," says Péron, "which afterwards overwhelmed us."

Immediately after the ships had sailed from Timor for Van Diemens Land, a voyage of two months' duration, abundantly supplied with water, the usual ration was curtailed, notwithstanding the remonstrances of the physicians as to the dangerous effect of an inadequate supply, especially to the sick, who were then numerous. Some of the poor sailors, during the tortures of thirst, were induced to drink their own urine!†

Although there was an abundance of ammunition on board of the vessels, the commander, on the pretext of economy, would seldom allow the boats' crew to be armed, and sometimes refused arms to the officers and scientific men, even when the hostile disposition of the natives was manifest. This prohibition of the means of self-defense could admit of no justification; for the commander could not be ignorant of the sad disasters which had frequently been the result of misplaced confidence in the innocence of savages.

Captain Baudin's system of discipline was one of extreme rigidity; hence when parties were permitted to go on shore, or expeditions were despatched on surveys, he was accustomed to prescribe a stated time for their return, without allowance for difficulties or accidents. To insure the fulfillment of his commands, they were furnished with provisions and water sufficient only for the

* About a gill and a half.

† The following observations, in Surgeon White's Journal of a voyage to New South Wales, are worthy of attention.

"Were it by any means possible, people subject to long voyages should never be put to a short allowance of water; for I am satisfied that a liberal use of it (when freed from the foul air, and made sweet by a machine now in use on board his Majesty's navy) will tend to prevent a scorbutic habit, as much, if not more, than anything we are acquainted with. My own experience in the navy has convinced me, that when scorbutic patients are restrained in the use of water (which I believe is never the case but through absolute necessity), and they have nothing to live on but the ship's provision, all the antiseptics and antiscorbutics we know of will avail very little in a disease so much to be guarded against, and dreaded, by seamen. In one of his Majesty's ships, I was liberally supplied with that powerful antiscorbutic, essence of malt; we had, also, sour-krout; and besides these, every remedy that could be compressed in the small compass of a medicine chest; yet, when necessity forced us to a short allowance of water, although, aware of the consequence, I freely administered the essence, &c., as a preservative, the scurvy made its appearance with such hasty and rapid strides, that all attempts to check it proved fruitless, until good fortune threw a ship in our way, who spared us a sufficient quantity of water to serve the sick with as much as they could use, and to increase the ship's allowance to the seamen. This fortunate and very seasonable supply, added to the free use of the essence of malt, &c., which I had before strictly adhered to, made in a few days so sudden a change for the better in the poor fellows, who had been covered with ulcers and livid blotches, that every person on board was surprised at it; and, in a fortnight after, when we got into port, there was not a man in the ship, though, at the time we received the water, the gums of some of them were formed into such a fungus as nearly to envelop the teeth, but what had every appearance of health."—*White's Journal, p.* 34. *London,* 1790, 4°.

computed period of their absence. These restrictions were a perpetual clog to the scientific men, and, in some instances, were near causing their destruction. At Sharks-bay, Endracht Land, a party of sailors, under the command of Lieutenant Montbazin, was ordered on shore, for the purpose of making salt. Péron, Petit the portrait painter, and an assistant gardener, accompanied them, These three started along the coast for the purpose of making collections of natural curiosities. Not returning according to appointment, the officer became alarmed for their safety, and despatched persons in search of them. In the mean time a gun was fired from the ship, for the recall of the boat. This was a moment of anxiety to a generous heart. The search was continued, although two guns more told what were the dictates of the stern commander. At length the poor wanderers, who had missed their way, were found when they were on the point of perishing with fatigue, hunger and thirst: they had not tasted food or water for forty-four hours. Péron could scarcely see or hear, and his parched tongue denied him the use of speech. It was late in the evening when they reached their boat. The supply of provisions was entirely exhausted, and there was not a drop of water left to allay their burning thirst. All night long were they compelled to lie upon the beach, in a state between life and death; and it was not until the afternoon of the following day that they were enabled to rejoin the ship. There were they welcomed, however, with that kindness which compassionate hearts know how to exercise. One individual alone stood unmoved amid the general sympathy, and that one was the commander himself, who, in a tone of unusual asperity, demanded why his orders had not been promptly obeyed. In vain did the Lieutenant attempt to justify his disobedience on the score of humanity; in vain did he point to the pallid countenance, and sunken eyes, of those whom he had rescued from death; his crime admitted of no palliation: he was sentenced to pay a fine of ten francs for each gun fired for his recall; "and this atrocious judgment," says Péron, "he had the audacity to record in his journal! Miserable wretch! in order to save his life at Timor,* I shared with him the small supply of some excellent *quinquina*, which I had reserved for my private use."†

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* The commander's disease was a typhus fever, which reduced him so low, that for several hours he was supposed to be dying. His restoration was owing to a powerful dose of Peruvian bark, which Péron had brought with him from France.

† Parmi les principales causes de nos désastres, il faut compter surtout l'inconcevable opiniâtreté de notre Chef à ne jamais prendre à bord de ses vaisseaux que la quantité de vivres rigoureusement nécessaire pour le temps qu'il se proposait de consacrer à chacune de ses campagnes, sans jamais tenir compte des difficultés ou des obstacles imprévus qui pouvaient en prolonger la durée. Ses mêmes calculs produisaient des résultats non moins déplorables sur nos embarcations; chacune d'elles ne recevait, en partant, que les vivres absolument indispensables pour le

From the commencement of the voyage the commander conceived a rooted aversion to the scientific corps, and missed no opportunity of evincing it by neglect or incivilities. It may be readily conjectured that a man of uncultivated mind would find himself out of place among persons of good breeding, and might seek to console himself for his inferiority, by an affectation of self-sufficiency. He was wont to say, that the Institute had given him *savants* who were of no use to him: all he wanted was *collectors*. His officers, he pretended, would have sufficed for geography and astronomy; and moreover, that he would rather discover a new mollusk than a new island!*

Such discourses as these, mingled with occasional sarcasms, must have greatly tended to wound the feelings of gentlemen, accustomed to the courtesies of society, and to that deference which worth and talents are entitled to. The learned botanist, André Michaux,† was chiefly induced to retire from the expedition at the Isle of France, by the assurance that his services could not be appreciated by one who determined the value of science on the standard of his contracted intellect.

Amid so much opposition, so many trials of body and mind, it is a subject of wonder that the astronomers and geographers of the expedition performed as much as they did.‡ Their labors

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nombre des hommes qu'elle portait, et pour celui des jours qu'ils étaient censés devoir employer à leur mission. Il en était de même pour les divers campements que nous établissions à terre. De là, ces privations pénibles, qui pesaient sur nous à la moindre contrariété que nous éprouvions dans nos opérations générales ou particulières.

Il n'était pas jusqu'au système de distribution de l'eau qui ne fût essentiellement vicieux. Ainsi, pour me borner au cas particulier dont il s'agit maintenant, la ration journalière etait d'une pinte par homme. Celte quantité, déjà si modique pour les individus qui restaient à bord du navire, devenait absolument insuffisante aux besoins des matelots qui, sous un soleil brûlant, devaient ramer quelquefois des journées entières; il en etait de même pour les naturalistes, qui, par le genre de leurs recherches, étaient obligés de faire des courses lointaines sur ces plages ardentes. Souvent le cri du besoin, plus impèrieux que la voix de la raison, réduisait les plus sobres à consommer, dans quelques heures, ce qui devait leur servir pour plusieurs jours, et à s'abandonner ainsi aux angoisses les plus dèchirantes. Il n'etait pas, sous des prétextes d'economie non moins funestes, jusqu'aux armes, jusqu'aux boussoles même, qu'on ne refusât souvent à nos embarcations.

Sans doute il est pénible d'avoir de tels détails à rapporter; mais ils intéressent trop essentiellement le succés on même le salut des navigateurs qui doivent courir la même carrière que nous, pour que ce ne fût pas une sorte de crime de les leur taire.—*Péron, Voyage de Découvertes, etc., tome* ii, *p.* 222, *note.*

* Il affecta de publier partout que la moitié des membres de l'expédition étaient inutiles à son succès; que l'Institut lui avait donné des *savants* dont il n'avait que faire; qu'il n'avait besoin que de *ramesseurs*, etc. * * * Il prétendait que ses officiers auraient suffi pour la géographie et l'astronomie; et que d'ailleurs il aimait mieux découvrir un mollusque nouveau qu'une terre nouvelle.—*Bory, Voyage, tome* i, p. 189.

† This was the father of the author of the "North American Sylva." He died, not long afterwards, at Madagascar, while engaged in collecting materials for a botanical history of that island. His "Histoire des Chênes de l'Amérique," and "Flora Boreali-Americana," are works of established reputation.

‡ It is but just to add, that they were ably seconded in their explorations by the officers of the ships, particularly by the two Freycinets, and M. de Montbazin.

are an enduring evidence of what may be done by resolute minds under every discouragement. What the naturalists effected, in spite of similar obstacles, shall be related hereafter.

There was one part of Captain Baudin's deportment which is inexplicable, and that was his total disregard of those sanitary instructions, which had been prepared for him by order of the government, especially in reference to means of preventing that dreadful disease, the scurvy. The conduct of Captain Flinders, on this head, affords a striking contrast. Both were engaged in similar explorations in the same seas; both put into Port Jackson for supplies the same season: the crew of one reduced to the extremity of misery by sickness and want, that of the other in such a state of health—every man doing duty upon deck—that their vigor was the subject of general observation.*

The Géographe remained at the Isle of France upwards of four months; and then proceeded homeward. She stopped at the Cape of Good Hope on the 3d of January, 1804. The object of this visit was twofold: to procure fresh provisions, and to take on board for the menagery of the Museum of Paris, some of the rare animals that are indigenous to southern Africa.

While at the Cape, Péron and Lesueur, the last of the zoologists of the expedition, being solicitous of obtaining exact knowledge on the subject of that anomaly in physiology, the *Tablier*, reported as characteristic of the females of a race of the natives of southern Africa; the governor-general, M. de Janssens, and the chief physician of the colony, Raynier de Klerk Dibbetz, lent all the assistance in their power to this end; and the results of their investigations were of a more definite character than those furnished by preceding travellers. This curious organ or appendage, it seems, belongs exclusively to the tribe named *Houswaana* or *Borchisman;* and is never observed in the Hottentots, properly so called. It is visible in infancy; and increases in size with the growth of the body. It disappears by the crossing of the *Houswaana* with other races.†

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* There was not a single individual on board who was not upon deck, working the ship into harbor; and it may be averred that the officers and crew were, generally speaking, in better health than on the day we sailed from Spithead, and not in less good spirits.—*A Voyage to Terra Australis*, vol. i, p. 226, 4°.

† Dr. Alard, in his Historical Eulogy of Péron, thus speaks of the *Tablier*: "Depuis long-temps le tablier naturel attribué aux femmes hottentotes, étail l'objet des raisonnements des physiciens d'Europe et des relations contradictoires des voyageurs. Les uns en niaient l'existence; les autres, tout en l'admettant, le décrivaient de manières tres-différentes. Péron, après des recherches multiplées, reconnaît enfin que cet organe singulier n'est ni un repli de la peau du bas ventre, comme on le croyait autrefois, ni un prolongement des grandes lèvres, comme l'a dit récemment Barrow; mais bien qu'il est un appendice particulier tenant par un pédicule à la commissure supérieure des grandes lèvres, s'élargissant et se divisant par le bas en deux branches qui pendent d'ordinaire, mais qu'on peut écarter, donnant ainsi à cette partie une figure triangulaire. Il reconnait que cet organe se trouve l'attribut général et l'un des caractères distinctifs d'une certaine nation sauvage et cruelle, connue des Hol-

It fortunately happened that there were at the public hospital of Cape Town, two females of this extraordinary people, an adult and a girl of twelve or fourteen. These were examined with all that care which so interesting a matter required; and Lesueur's drawings of the *Tablier*, the first, probably, that had ever been made by a competent artist, illustrated two Memoirs on this subject, which were read to the Institute of France in the year 1805. These drawings, four in number, were afterwards engraved; I cannot learn whether or not they have been published. I have in my possession impressions of the plates, presented to me by my ever-regretted friend; and I treasure them as memorials of one, in whose society I have passed many a pleasant and instructive hour.

A stay of twenty-one days at the Cape of Good Hope sufficed for the objects of the visit; and on the 24th of January the Géographe set sail for France. She arrived at the port of Lorient on the 25th of March, 1804, after an absence of upwards of three years and five months. The Naturalist had returned to Havre in June, the preceding year.

Rumors of Captain Baudin's misconduct had affected the public mind, to the prejudice of the expedition; and even the government appeared to regret that the voyage had been undertaken, under the impression, that, as respects its ultimate objects, it had

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landais sous le nom de *Boschismans*, et des Hottentots, sous celui de *Houzouanas*. Les jeunes filles l'apportent en naissant, et il ne fait que croître avec l'âge; il diminue et se perd dans les générations successivement produites par le mélange des *Houzouanas* et des Hottentots ordinaires."

Some three or four years after the publication of Dr. Alard's Memoir, an adult female of this race was exhibited in Paris, where she died in December, 1815. An account of her is given in the "Histoire Naturelle des Mammifères," by the late Baron Cuvier, after an autoptical examination. From this account we extract the following passages.

"Les premières recherches durent avoir pour objet cet appendice extraordinaire dont la nature a fait, dit-on, un attribut spécial de sa race.

"On le retrouva aussitôt; et tout en reconnaissant que c'était *exactement* ce que Péron (Lesueur) avait dessiné, il ne fut pas possible d'adopter la théorie de cet infatigable naturaliste.

"En effet le tablier n'est point, comme il l'a prétendu, un organ particulier; plusieurs de ses prédecessurs avaient mieux vue: c'est un développement des nymphes."

It is much to be regretted, that, as this illustrious naturalist differed in an essential point from Péron, he did not support his opinion by figures of the tablier. Of the accuracy of Lesueur's drawings there is no doubt: it is admitted by Cuvier himself. Must we then conclude that the question is settled? or is it still a moot-point?

The two figures of the Houswaana woman, which accompany Cuvier's essay, by no means correspond with his description; and this is equivalent to the assertion, that they are unnatural or not characteristic. The head, especially, has scarcely a feature of the original. A work, professedly scientific, should seem to require more attention to accuracy.

Among the supplementary plates before mentioned, there is a medallion portrait of the adult female Houswaana, who was examined by Péron and Dr. Dibbetz at the Cape of Good Hope. This miniature was drawn by Nicolas-Martin Petit, from *nature*, with that care and skillfulness which distinguish his works among the illustrations of the "Voyage aux Terres Australes." The configuration of the head is so dissimilar to that of Cuvier's figures, that one would be tempted to believe they were taken from individuals of different races.

turned out to be a failure. On the return to Paris of Péron and Lesueur, they experienced a coldness of reception, on the part of members of the Institute, which sorely afflicted them. In a moment of despondency, Péron was induced to wish that he had never returned. But he soon rallied the forces of his vigorous mind; and waiting upon some of the prominent men of the Academy of Sciences, he begged them to suspend their judgment until the results of the expedition could be ascertained; assuring them of his ability to show, that, notwithstanding all its crosses and disasters, it would not suffer in comparison with any that had preceded it, since the days of Cook and D'Entrecasteaux.

There was but one course for the disheartened naturalists to pursue, and that was an appeal to the fruits of their manifold labors. The collection of upwards of forty thousand specimens of animals, which had been sent home from Port Jackson by the Naturaliste, and the more numerous collection brought in the Géographe, were at the Museum of Natural History, without an indication of their intrinsic value. At the instance of Péron and Lesueur, a committee of the Academy of Sciences, consisting of Messieurs Laplace, Bougainville, Fleurieu, Lacépède and Cuvier, was appointed to examine these collections. In the performance of their duty they made a preliminary report, the tendency of which was to disabuse those public functionaries and Academicians, who had permitted their judgment to be warped by prejudice or misrepresentation. Finally, at the meeting of the Class of Physical and Mathematical Sciences, held on the 9th of June, 1806, a comprehensive report was made, from which the following summary is taken.

"Of the five zoologists appointed by the government, two remained at the Isle of France. Two others perished at the commencement of the second campaign, by diseases contracted at Timor. Péron alone was left; but supported by his invigorated ardor, and the efforts of his coadjutor Lesueur, a zoological collection was made, the extent and importance of which become more and more manifest. It is composed of more than one hundred thousand specimens of animals, several of which will constitute new genera; and the new species, according to the report of the Professors of the Museum, are upwards of two thousand five hundred. If we call to mind that the second voyage of Cook, fruitful as were its discoveries, made known not more than two hundred and fifty new species, and that all the united voyages of Carteret, Wallis, Furneaux, Mears, and even Vancouver, did not produce as great a number,—it results that Péron and Lesueur alone have discovered more new animals than all the traveling naturalists of modern days.

"An imperfect method of description has hitherto greatly impeded the progress of zoological science. Travellers, and especially several of the Linnean school, have sanctioned this method, because it is easy and expeditious. Limiting themselves to present, in a specific phrase, more or less short, certain characters, omitting a notice of those which, according to this method, were useless for the distinction of the new species from those already known, they thereby obtained only relative descriptions, scarcely sufficient for the wants of Science at the period of their discovery; and which became useless in proportion as new objects required new terms of comparison. Péron has avoided this error; and his definitions, founded upon a general and invariable basis, embrace all the details of exterior organization of the animal, establish all its characters in an absolute manner, and will consequently survive the revolutions of methods or systems.

"A description, nevertheless, how complete soever it may be, can never give a sufficiently just idea of those singular forms, which have no precise term of comparison in objects previously known. Correct figures alone can supply the imperfection of language. Here, the labors of which it is our duty to render an account, acquire a new interest. Fifteen hundred drawings or paintings, executed by M. Lesueur, with extreme precision, reproduce the principal objects which were collected by his careful industry, and that of his friend. All these drawings, either made from living animals or recent specimens, form the most complete and the most precious series of the kind that we have any knowledge of.

"Now we would venture to ask what labor more interesting and complete than that in which is comprised so many important and new animals; than that in which all the circumstances of temperature, of places, of seasons, of habitudes, of food, have been scrupulously observed and collected: wherein all the descriptions have been made from perfect individuals, after a uniform and established method; wherein all the essential objects have been drawn or painted in a natural state, with the greatest exactitude, and in all their details; wherein all these same objects have been preserved with so much care that there are but few of them of which the immediate examination may not serve as a medium of comparison and verification, as well for the description as for the drawing! We do not hesitate to declare that such labors are infinitely superior to all those of the same nature which have hitherto been effected until the present day by any similar expedition, either of our own country or of foreign nations.

"The value of the accession to the Museum of Natural History has been enhanced, not only by the objects presented to Péron and Lesueur personally, by strangers, in the various countries they visited, but even by those which they procured at their private expense, and for the purchase of which they were sometimes obliged to contract onerous debts. They have reserved nothing for themselves! a proceeding so much the more generous as it is without a precedent among any of their predecessors.

"You have seen by what we have said of the labors of Lesueur, that he was almost every where an associate in those of Péron. The history of Man is not less indebted to him. All the details of the existence of the natives have been designed by him with the most scrupulous accuracy. All their musical instruments, those of war, of hunting, of fishing, their domestic utensils; all the peculiarities of their clothing, of their ornaments, of their habitations, of their tombs; in a word, all that their rude ingenuity has been able to accomplish, is found united in the productions of this skillful and indefatigable artist. The principal site of the coasts explored by the expedition; different views of the town of Sydney, the capital of the English colony of New South Wales, its plan, &c., give to the Atlas of the History of the voyage, edited by his friend, a new character of importance.

"Such are the labors, as numerous as they are interesting, of which you have appointed us to render you an account. They receive additional value from the unfortunate circumstances in the midst of which they were performed. Notwithstanding the foresight and orders of the government, privations of every kind bore heavily upon all the individuals attached to this great enterprise. Diseases extended their ravages among the crews of the two vessels. Of the twenty-three persons presented by you to the First Consul, for divers scientific researches, three only have returned to their native land, after having accomplished the entire voyage. Some, early discouraged, abandoned the expedition; others have remained sick at different places; the remainder are no more. Surrounded by so many disasters, Péron and his constant friend never allowed themselves to be overcome; at every epoch of the voyage they manifested the most honorable attention to their duty."

The testimony of the distinguished men composing the above named committee could not fail to receive the approbation of the government; and shortly after their preliminary report, the Minister of the Marine issued orders for the publication of the narrative of a voyage, that it was now evident would redound to the honor of the nation. And who so fit to edit this important work as he whose talents and industry had been so signally displayed throughout the whole course of the expedition! Péron, then, in the character of historian, set to work with alacrity; and aided by his indispensable associate, Lesueur, arranged those rich materials which appear to such advantage in the first volume of the "Voyage des Découvertes aux Terres Australes."

A remarkable feature in the history of this enterprise presents itself to our reflection. In the composition of the scientific part of it, no precaution, which an enlightened foresight could suggest to ensure success, seemed to be omitted; and yet, such was the course of events in the department of zoology, one of the prominent objects of the voyage, little would have been done without the efforts of two obscure young men, who had been permitted to embark in the expedition, more with the view of gratifying their importunate desire of seeing foreign countries, than from any expectation of benefit from their services. Without the advantages derived from family connections, from fortune, from reputation, Péron and Lesueur had the bravery to aspire to distinction, and their endeavors were crowned with signal success.

After many difficulties, chiefly resulting from the financial embarrassments of the government, the first volume of the History of the voyage made its appearance in the year 1807; but the Atlas by no means contained as many illustrations as had been prepared for it by Lesueur. This omission was a disappointment to the public, especially to those who had been favored with a view of the invaluable collection of drawings in the possession of the artist, liable to accidents, and the loss of which would be irreparable.*

The constitution of Péron shaken by the trials of the voyage, gave no signs of amendment on his return; and it was not long before it became evident that a pulmonary affection was the cause. His exertions in the performance of his duty, were not relaxed thereby; and his second volume was commenced with unabated zeal, until it was ascertained that he was taxing his mind at the expense of his physical powers, which would ill afford such an expenditure. By the advice of his medical attendants, he was induced to undertake a journey to the southern provinces, not in the expectation of a cure, which he knew was impossible, but in the hope that a more genial climate than that of Paris might tend to mitigate those sufferings which were becoming intolerable. His inseparable friend accompanied him to Nice, where they spent a winter. But it was apparent that a change of scenes, instead of being promotive of repose, so greatly needed, serves merely as a stimulus to exertion. The shores of the Mediterranean presented objects too inviting to be resisted; and Péron engaged anew in those active pursuits, which his feeble body was unable to sustain. On his return to Paris he resumed the narrative of

* When Mr. Lesueur came to America, he brought these drawings with him. It was thought at Paris that they ought to have been deposited in the library at the Garden of Plants; and some feeling was exhibited on the occasion, among the Professors of the Museum of Natural History. In justification of Mr. Lesueur it may be said, that, as it took him the labor of years to furnish these drawings, the greater part of which had been merely sketched during the voyage, and he received no compensation for this extra labor, he consequently conceived he had a right to retain them, as his private property. The remedy for this grievance was very obvious; but the government did not care to resort to it.

the voyage; and had superintended the printing of the thirtieth chapter, when he was warned by the last symptoms of his disease, of his approaching fate. He consequently retired to his native village; where in the bosom of his family, he ended his days, on the 14th of December, 1810, in the 36th year of his age.

The death of Péron, in the midst of his labors, when so much remained to be done, occasioned a suspension of the history of the valuable discoveries which had been made by him and his coadjutor, Lesueur. The regrets of the zoologists of Europe, on this event, might have been spared, had Lesueur been enabled to turn to account the voluminous materials in his possession; for Péron had bequeathed to him the whole of his manuscripts. But the master spirit, who knew how to employ these materials, was no more; and Lesueur shrunk from a task which his disheartened mind felt conscious it was unable to perform.

The duty of completing and publishing the second volume of the history of the voyage now devolved upon Captain Louis Freycinet, the same who commanded the schooner Casuarina, fitted out as a tender at Port Jackson. The long interval of nine years between the publication of the two volumes should seem to show that more than ordinary embarrassments impeded a work of national importance undertaken by order of the government. The Atlas to the second volume, which appeared in 1816, contains only maps and plans. At least eight and twenty plates, of various illustrations, although finished, were suppressed; and amongst them those before mentioned of the *Tablier* of the Houswaana African.*

Lesueur, accustomed for so many years to an intimate association with Péron, became inconsolable at his death. His usual occupations no longer afforded him that pleasure they were wont to do when there was a kindred mind to participate in them. He would fain have sought in foreign countries, that tranquillity which was not to be found at home; but there were domestic ties to restrain him: his aged father was living and stood in need of his assistance. At length an opportunity was afforded him to gratify his desire for travelling, without inconvenience of a pecuniary nature. Mr. William Maclure, then a resident of Paris, had projected a voyage to the West Indies, and thence to the United States; and made a proposition to Mr. Lesueur to accompany him as a travelling companion. The offer was gladly accepted; and in the autumn of 1815, they departed from France, and arrived at Barbadoes on the 29th of December of the same year. They afterwards visited in succession St. Vincent, St. Lucia, Martinico, Dominica, Guadaloupe, Antigua, St. Christo-

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* In the second edition of the "Voyage aux Terres Australes," advertised in Bertrand's catalogue for January, 1831, it is said that there are twenty-five new plates; hence it is probable that those of the *Tablier* were withheld from publication. My supplementary atlas is composed of twenty-eight plates.

phers, St. Bartholemew, St. Eustatia, St. Thomas, St. Johns, St. Croix, with some of the inferior islands. The marine animals of these regions afforded ample employment for Lesueur; and among the fishes and the mollusca he gathered a rich harvest.

In the latter part of the Spring of 1816, Messieurs Maclure and Lesueur arrived in the United States from St. Croix, and immediately set out on their travels through New York, New Jersey, Pennsylvania, Maryland, Rhode Island, Massachusetts, and Connecticut. They finally established themselves permanently in Philadelphia, where Mr. Maclure was formerly domiciliated, when engaged in the active pursuits of a commercial life.

The habits of the Americans, particularly their domestic economy, do not always make a favorable impression upon the mind of a native of France, especially when he comes among us without a knowledge of the English language. Mr. Lesueur, however, had no reason to be dissatisfied with his transatlantic residence. His reputation had preceded him; and the cordial welcome which he received from the most distinguished men of science of the city, could not be otherwise than grateful to one who knew how to appreciate such disinterested kindness. The American Philosophical Society lost no time in enrolling him among its members; and the following year, 1818, he was elected into the Academy of Natural Sciences, and became one of the most efficient supporters of that rising Institution.

The branch of natural history which chiefly attracted the attention of M. Lesueur, when in the United States, was Ichthyology. In Botany and Ornithology much had been done by American Naturalists; but the fishes, which constitute an important item in our commercial statistics, had been in a measure overlooked; at least the few essays which appeared from time to time, on this subject, only served to render the deficiency more apparent. A systematic work, therefore, upon the Fishes of North America, became a leading object with Lesueur; and the means for the accomplishment of it increased so rapidly as to justify the expectations of the friends of natural science of seeing it carried into effect. But a coadjutor was wanting in this enterprise, one whose literary acquirements should enable him to give that consistency to the materials of the naturalist, without which they would be of but little avail. A competent associate, then, not being attainable, the project remained in embryo. A foretaste, however, of these rich materials, was occasionally given in the Transactions of various learned Institutions. Of these opuscules I shall speak in the sequel.

Mr. Lesueur, at the instance of several individuals, who were desirous of profiting by his skill in natural history painting, gave them a series of lessons, at his private residence. He also taught the elements of drawing to the pupils of two respectable female seminaries of Philadelphia. His increased income, by these means, placed him in that state of independence, which is the cardinal object of every honorable mind.

At length the inclinations of Mr. Lesueur were subjected to a severe trial. After a residence of nine years in Philadelphia, fortunate in a good state of health, happy in an extensive circle of acquaintance, who esteemed and honored him, with active employment for his vigorous intellect and his felicitous pencil,—he was induced by the urgent solicitations of Mr. Maclure, to join the settlement of Socialists at New Harmony, on the Wabash, in the state of Indiana. It was a sense of duty alone which governed him in this determination. If his tastes, if his feelings had been respected, he would have been permitted to remain where his talents had an appropriate field for exertion, and would not have been constrained to forego all the advantages of a well regulated society, for those imaginary benefits to be derived from a condition of association, which had never been subjected to the test of experience. The company of Mr. Thomas Say, at New Harmony, tended to reconcile Lesueur to his lot; and to mitigate that aversion which the discordant elements of the community could not fail to provoke. The two naturalists often made excursions together; and found in the solitudes of the wilderness those consolations which spring from a congeniality of tastes and pursuits. But the attachments of friendship were again destined to be severed. In October, 1834, Mr. Say ended his days; and this deprivation was the more painful to Lesueur, as it seemed to presage the termination of all the plans of scientific enterprise which he had fondly cherished since his residence in the Western hemisphere.

A journey down the Mississippi to New Orleans, served for a while to divert his thoughts from their gloomy forebodings, but failed to suppress them. A return to his native country became the subject of his meditations; still there were difficulties in the way, which, for a time, could not be well surmounted. He retraced his steps, therefore, to New Harmony, and engaged anew in his favorite occupations; but the charm was broken; and he saw no relief for his harrassed mind, but by abandoning a situation which promised advantages that resulted in disappointment and sorrow.

In the year 1837 Mr. Lesueur bade a final adieu to the Wabash and directed his course to New Orleans. There he embarked in a vessel bound to France; and after a prosperous passage, the high coasts of Normandy, the remembrances of happy days, were visible in the horizon. It is for him who has long been a sojourner in distant lands, to judge of the feelings of one who revisits his native country, after an absence of two and twenty years. The heart of Lesueur was formed of the softest mould; and when the turrets and steeples of his beloved Havre greeted his view, his emotions, expressed by his tears, showed that time had neither diminished his patriotism, nor chilled the sensibility of his soul.

In the month of September, 1838, the writer of this Memoir visited Paris; and had the happiness of embracing his old friend, whom he had not seen for thirteen years. Mr. Lesueur was then residing at No. 16, Rue Neuve St. Etienne, not far from the Museum of the Garden of Plants. He had brought from the United States a valuable collection of specimens of natural history; and all his precious drawings and manuscripts, the fruits of his researches in his voyage with Péron, and those subsequently made in the West Indies, and on the continent of North America. Perhaps no individual then living possessed a greater fund of materials for works of the highest interest in natural history; materials destined, in a great measure, it is feared, to be useless, for the want of that mind which alone could direct their application.

Sometime in the year 1843 or 1844, the project of founding a museum of natural history in the city of Havre, was set on foot; and Mr. Lesueur, who had taken a great interest in the measure, was looked to as one eminently capable of filling an important office in an establishment, which was indebted to his personal exertions for much of its favor with the community. In 1845 he was chosen Curator of the Museum; and he removed to Havre in order to superintend the building, which was advancing towards completion.

On the 9th of May, 1846, he thus writes to me: "I hasten to acknowledge the receipt of your letter of the 13th of April, which reached me via Paris. I am occupied at this time in arranging the collections of our cabinet. As my presence is now essential, I have taken a small country house, not far from Havre. It is situated in a quiet valley, a short distance from the sea, which is visible from our windows. Should you return to France, you must come and stay with us. We have a small chamber reserved for your accommodation. Come without ceremony, and partake of our pottage, which you know is excellent. How rejoiced I should be to see you once more! A little omnibus stops daily at our door, and you would be spared the fatigue of going and coming. Our Museum, with its library, would afford you recreation in town, and when fatigued you might retire to my apartment, so that you need not fear ennui."

The letter from which the foregoing extract is made, derives additional value from the circumstance that it was the last that I ever received from my estimable correspondent, whose life was near its close, although nothing, in his external condition, indicated such an event. It was his practice to set out early in the day from his country residence, for the museum; but on the 11th of December, the weather being unsettled, and feeling himself indisposed, he resolved to remain at home. During the ensuing night he complained of oppression at the breast; and a physician prescribed blisters, without suspecting immediate danger. The disease was beyond the reach of remedy; and he expired on the morning of the 12th of December, 1846, in the 68th year of his age.

The disposition of Mr. Lesueur was social and amicable; and knowing how to accommodate himself to circumstances, he every where met that welcome which his simple, unobtrusive manners could not fail to secure. Accustomed, from early life, to abstemiousness, his economical habits became confirmed, when the means of indulgence were placed within his reach. But although little inclined to self-gratification, he was liberal to others, even in cases where prudence would justify reserve. On departing from France for America, he placed all his disposable means in the hands of his father, among which resources was included the pension that was granted to him by the French government, after his return from the voyage to New Holland. At the death of his father, which took place not long after his establishment in Philadelphia, an attorney was chosen to manage his pecuniary concerns in France; it being his intention to create a fund, to which he might have recourse in case of need. It does not appear that he gave himself much concern with respect to this agency; and on his return to Paris he had the mortification to find that the agent had betrayed his trust, by appropriating to the use of his own family the entire fund, which amounted to the sum of forty thousand francs! The feelings of Lesueur were sorely tried at this event; and the wrong was the more sensible, as it was perpetrated under the guise of friendship. Notwithstanding this heavy loss, at a time of life too, when the infirmities of age began to be felt, he had still a remnant left, the produce of his industry, which modicum he shared with a brother, whose necessities were greater than his own.

At the base of Cape la Hève there is a small valley, in the centre of which the humble spire of the Church of Saint Adresse strikes the view of the voyager, as he directs his course for the port of Havre. Within the precincts of this rural temple repose the remains of Charles Alexander Lesueur: an appropriate resting place for the ashes of one, who, after many wanderings in distant regions, was permitted by Divine Providence, to breathe his last sigh in the bosom of his family, and amidst those very scenes which had awakened the aspirations of his youthful heart.

It was the design of Péron and Lesueur to publish an extensive work upon the Medusa, after the completion of the History of the voyage to Terra Australis. The death of Péron interrupted the project; but Lesueur subsequently issued a programme of this work, with specimens of the plates engraved and colored after his beautiful drawings. It is probable that the great expense attending such an undertaking, was the cause of its being abandoned.

The following is a list of the writings of Lesueur.

1. In the "Annales du Muséum d'Histoire Naturelle," years 1809 and 1810, volumes 14 and 15, conjointly by Péron and Lesueur:—

Histoire gènèrale et particuliére de tous les animaux qui composent la famille des Méduses.

Sur les Méduses du genre Equorie.

Histoire de la famille des Mollusques ptéropodes.

Histoire du genre Firole.

Notice sur l'habitation des animaux marins.

Notice sur l'habitation des Phoques.

2. In the "Mémoires du Muséum d'Histoire Naturelle," by Lesueur alone.

Tome V, 1819.—Notice de quelques Poissons déconverts, dans les Lacs du Haut Canada, durant l'Eté de 1816.

Tome VI, 1820.—Description de plusieurs animaux appartenant aux Polypiers Lamellifères de M. le Chevalier de Lamarck.

Tome XV, 1827.—Notice sur deux Espèces de Tortues du genre Trionyx de M. Geoffroy Saint Hilaire. Two quarto plates accompany this notice; but the author afterwards published five sheets, containing twelve figures of these Tortoises, folio size, carefully lithographed by himself.

3. In the "Nouveau Bulletin des Sciences, par la Société Philomathique."

Année 1813:—Memoire sur quelques nouvelles espèces d'animaux mollusques et radiaires dans la Méditerranée, près de Nice.

Anneè 1814:—Note sur deux Poissons, non encore dècrits, du genre Callionyme et de l'ordre des Jugulaires.

Sur une nouvelle espèce d'Insecte du genre Cymothoa de Fabricius.

Mémoire sur quelques Flustres et Cellépores fossiles; par MM. Desmarest et Lesueur.

Année 1815:—Mémoire sur l'organisation des Pyrosomes, et sur la place qu'ils semblent devoir occuper dans une classification naturelle. Note sur le Botrylle étoilé; par MM. Desmarest et Lesueur.

Année 1817:—Description de six nouvelles espèces de Firoles observèes, par MM. Péron et Lesueur dans la mer Méditerranée en 1809, et établisement du nouveau genre Firoloide.

4. Journal of the Academy of Natural Sciences of Philadelphia—articles prepared by Lesueur while at Philadelphia.

Vol. I.—Description of six new species of the genus Firola.

Characters of a new genus, (of the family of Pteropode Mollusca,) and descriptions of three new species upon which it is formed.

Description of three new species of the genus Raja.

A short description of five (supposed) new species of the genus Muræna.

Description of two new species of the genus Gadus.

Description of a new species of the genus Cyprinus.

An account of an American species of Tortoise, (*Testudo geographica,*) not noticed in the systems.

A new genus of Fishes, of the order Abdominales, proposed under the name of Catostomus.

Description of four new species, and two varieties, of the genus Hydrargira.

Observations on several species of the genus Actinia.

Description of several new species of North American Fishes.

Observations on a new genus of Fossil shells.

Description of several new species of the genus Esox, of North America.

Vol. II.—Description of a new genus, and several new species of fresh-water Fish, indigenous to the United States.

Descriptions of two new species of Exocetus.

Descriptions of several new species of Cuttle-fish.

Observations on several genera and species of fish belonging to the natural family of the Esoces.

Descriptions of five new species of the genus Cichla of Cuvier.

Description of three new species of the genus Sciæna.

On the Onykia angulata.

Description of a Squalus of very large size, which was taken on the coast of New Jersey.

Vol. III.—Descriptions of several new species of Ascidia.
Description of a new species of Cephalopod of the genus Loligo.
On three new species of parasitic Vermes, belonging to the Linnean genus Lernæa.
Descriptions of two new species of the genus Batrachoid of Lacépède.
Vol. IV.—Description of several species of the Linnean genus Raia, of North America.
Description of several new species of Holuthuria.
Description of two new species of the Linnæan genus Blennius.
Vol. V.—Description of a new fish of the genus Salmo.
Description of four new species of Murænophis.
Description of a new species of the genus Saurus.

Transactions of the American Philosophical Society, new series.

Vol. I, (1818.)—Description of several species of Chondropterygious Fishes of North America, with their varieties.

A celebrated naturalist having expressed an opinion that the cliffs of Normandy were uninteresting, on the score of organic remains; Mr. Lesueur, who was of a different sentiment, undertook an investigation of the stratification of the bluff forming *Cape la Hève;* and his discoveries were of a nature to call the attention of geologists to a locality which had been neglected and decried. In the latter part of the year **1843**, he published a sheet, entitled, "Vues et Coupes du Cap de la Hève." This lithographic drawing presents numerous details of uncommon interest; and is a pleasing evidence of the versatility of the talents of the author.

Art. XVI.—*On the Diurnal Variations in the Declination of the Magnetic Needle, and in the Intensities of the Horizontal and Vertical Magnetic Forces;* by William A. Norton, Professor of Mathematics and Natural Philosophy in Delaware College.

[Continued from p. 55.]

Besides the phenomena which have now been considered, there are two others, to which the laws of the nocturnal loss of temperature may be conjecturally attributed, viz. 1. The varying humidity of the soil at the earth's surface, attended with a change in its specific heat, and—2. An unequal exchange of heat between the atmosphere and the earth, by contact. That the first of these is to be rejected from the list of possible causes, will be seen at once upon considering that there is no evidence that the law of the continued decrease of the loss of temperature as the night advances, depends upon variations in the quantity of rain. There is no sufficiently general increase of humidity, except from dew, and the film of dew is too slight (as we shall see, not more than $0^{in}{\cdot}01$, on the average, in July) to produce any material change in the specific heat of an inch, or half an inch, of thickness of the soil. Besides whatever influence may arise from this cause may be set down as an effect of dew.

As for the second of the above mentioned conjectures, the following objections lie against it. In the first place the quantity of heat received from the air by simple contact, when the air is perfectly tranquil, is very small, by reason of its low conducting power. In the second place, the observations show that, in the calmest nights the diminished fall of temperature after midnight is no less certain, than when the equilibrium of the air is disturbed and different masses are brought successively into contact with the surface of the earth. Again, since this law is observed to hold with respect to the temperature of the atmosphere at the earth's surface, the air, when agitated in contact with the earth, must lose from this cause less and less heat as the night progresses. But this is impossible, since the cooling of the earth's surface, from radiation, goes on uniformly, and thus the difference between its temperature and the temperature of the air would increase, and therefore the cooling, for the same amount of agitation, should increase. In other words, the cooling of the air, attendant upon the same degree and extent of agitation, must be uniform. Unless, therefore, there is generally more wind, or the disturbance of the equilibrium of the air extends to a greater height during the latter than during the fore part of the night, the law above mentioned must have some other cause than that under consideration. Now, as a matter of fact, the observations do not disclose the existence of any general difference, of any amount, between the force of the wind before and after midnight. It appears from the curves showing the variations in the force of the wind at Philadelphia, that there are slight differences, but they sometimes lie in one direction and sometimes in the other.

In view of all that has now been stated, it may be confidently affirmed, that if the cause of the two anomalous facts connected with the nocturnal loss of temperature be any meteorological phenomenon, it must be the deposition of vapor from the atmosphere in other forms than that of rain, and chiefly therefore in the form of dew; and it may be stated farther, that either this must be the actual cause, or it must consist in variations in the amount of heat that is returned towards the surface during the night, by conduction from below, or, in other words, in the laws of the earth's cooling at night, irrespective of all atmospheric influences.

This result has been reached, it is true, by taking it for granted that, primarily, it is the temperature of the surface of the earth that varies according to the laws which I have stated, and that the temperature of the atmosphere, near the earth's surface, conforms, of necessity, in its variations, to the same laws, by reason of its relations to the earth's surface. This supposition is in accordance with the notion generally entertained upon this subject, and is not likely to be questioned, but the principles laid down in the general discussion preliminary to the present investigation serve conclusively to establish its truth. For it will be seen that the causes which make the nocturnal radiation from the earth's surface into space and the upper regions of the atmosphere uniform, will also tend to make the radiation of the air, in the same direction, uniform, and on a calm night the radiation from the air to the earth ought gradually to increase, inasmuch as the difference of temperature of the two ought slowly to increase, (radiation alone being considered,) and for small differences of temperature the radiation is proportional to the difference. From which it appears that the laws in question are not primarily true of the temperature of the atmosphere.

It was also taken for granted that there was no material variation in the radiating power of the earth's surface from one season to another, by reason of frost or more or less humidity, or changes in the state of vegetation or any other cause. That, in point of fact, the diminished loss of temperature at night in the winter cannot be owing to any such cause as this, will be seen on inspecting the following tabular statements.

Average fall of thermometer from 9 P. M. *to* 4 A. M. *at Philadelphia.*

	1842.	1843	1844.	Average.
July,	4°·40	5°·35	5°·18	4°·97
August,	....	....	5 ·02	5 ·02
September,	....	....	4 ·84	4 ·84
October,	6 ·00	4 ·04	3 ·77	4 ·60
November,	2 ·57	1 ·55	3 ·40	2 ·50
December,	2 ·61	2 ·43	2 ·01	2 ·35

***Mean Diurnal Variations of Temperature at Halle, Göttingen, Padua, and Forth Leith** (near Edinburgh.)*

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Halle,	4°·25	7°·59	9°·11	14°·22	16°·79	16°·67	16°·57	16°·05	14°·45	12°·18	6°·21	3°·76
Gottingen,	7·16	8·06	12·00	14·94	17·78	17·46	18·02	18·16	17·24	11·55	6·03	4·68
Padua,	6·21	7·27	9·00	9·90	13·68	12·01	16·90	16·31	12·45	8·15	9·31	7·40
Forth Leith,	2·66	3·56	6·15	10·58	8·58	8·33	9·68	7·58	8·04	4·88	4·08	2·30

It will be observed that the nocturnal loss of temperature steadily decreases from August to December, and that there is no cause tending to diminish the radiating power of the earth's surface that operates in the same steady manner at all places, during this interval of time.

I conclude, therefore, that the cause of the nocturnal secondary variations of the horizontal force must either consist in variations in the amount of vapor deposited from the atmosphere, or be in some way connected with the upward flow of heat below the earth's surface. This upward flow of heat is not attended with any variations in the total amount of heat lost, and we therefore can connect the secondary variations with it, only by introducing some new hypothesis. Besides there exist good reasons for believing that it cannot be the cause of the observed variations in the nocturnal loss of temperature, and therefore cannot be the cause of the secondary variations of the horizontal intensity. In the first place, it appears from equation 4, p. 48, that the loss of temperature at the surface (l), is equal to the entire loss of heat (L) minus the sum of all the losses of temperature of the layers below the surface. It follows therefore, as L is always the same for the same number of hours, that l cannot become less unless the sum of l', l'', l''', &c. becomes greater; now it is a matter of observation that when l is less, l', l'', l''', &c., are also less; the sum of l', l'', &c., cannot therefore be greater in winter than in summer, unless the number of layers which experience a change of temperature during the night increases to a sufficient extent to compensate for the diminished loss of temperature of those nearer the surface. This cannot be the case, for, in the first place the loss of temperature of the lower layers is always comparatively trifling, and in the next place the depth to which any perceptible cooling in consequence of surface radiation extends during the same period of ten or twelve hours, must depend almost entirely upon the length of the interval. Or, we may arrive at the same conclusion in another way. In the month of January the amount of heat gained during the day is lost during the night. The same is true in July. Now the quantities of heat gained during the day are quite different at these two epochs, the one of minimum and the other of maximum temperature, and therefore L must be variable, whereas it is constant. In the next place, although we are in want of the systematic observations of the diurnal variations of l, l', l'', &c., which would enable us to ascertain with certainty whether the sum of l', l'', &c. varied materially during the night or not, and therefore whether the variations of l are attributable to an unequal upward flow of heat; still, if we assume that the established law connecting the total variations of temperature of the different layers, viz., that they decrease according to a geometrical progression for equal increments of depth, is very nearly true for the variations that occur in any given time, and take $\frac{3}{4}$ for the ratio of the progression, (derived from the data on page 45, answering to the depths of 1^m, 2^m, 3^m, &c., taking variation at surface $=15^\circ$,) recollecting that the cooling progresses at the rate of about $1\frac{1}{3}$ inches per hour, we shall find that the sum of the losses of temperature of the layers below the surface up to the hour of 4 A. M. is materially less than twice the sum of the losses up to the hour of 10 P. M.—midway between the hours of maximum and minimum temperature. It can only be made equal to twice this sum by supposing that the fall of surface temperature is increased very nearly in a two-fold proportion—in other words, that it is proportional to the time, or uniform. This result does not depend upon the ratio $\frac{3}{4}$ supposed to be used in the calculation, but upon the fact that the losses of temperature of the new layers below the depth of 8^{in}, or 9^{in}, after 10 P. M., are very small. If it be erroneous, it can only be because the law which I have assumed does not accord with fact. In view of all these considerations we may conclude, that the notion of a variable flow of heat toward the surface of the earth fails entirely to explain the unequal losses of temperature at night in different seasons of the year, and that it is highly improbable that it has any considerable effect to diminish the losses of temperature from hour to hour during the night. Indeed all known facts connected with the variation of temperature, favor the idea that the laws of the nocturnal variation are the result of some cause at the earth's surface tending to diminish the amount of heat lost there, and producing the same effect as if the radiation varied between certain limits and according to certain laws. This cause can be nothing else than the deposition of condensed vapor from the air in contact with the earth.

Let us now take up the independent inquiry as to what is the testimony of observation and experiment in relation to the variations in the amount of dew deposited in different seasons and in different hours of the night, the actual amount deposited at any one season, and the quantity of heat given out in the condensation of the vapor into dew. I find the following statement with respect to the first of these points, in Lamé's Cours de Physique. "Dew is less abundant before midnight than during the hours which precede the rising of the sun. It is more frequent in spring, and especially in autumn than in summer." I conceive the meaning of the first of these statements to be, that on any individual night when the dew begins to fall early in the evening, it becomes more abundant towards morning. If this be true, it may arise from the fact that there will be sufficient displacement of the air, even on what would be called a calm night, to bring about more or less of an exchange of place between the air resting upon the surface and that which is posited above this; and as the cooling goes on, these various masses brought in succession to the surface will become more and more humid, and therefore more and more likely to deposit a portion of their vapor before they give place in their turn to other bodies of air. Such currents will be established by inequality of surface and of radiation, the irregular action of elevated objects, and perhaps other causes. When the air is perfectly tranquil, the deposition of vapor might increase towards morning by the temperature of the air above the surface becoming reduced below the dew point, in which case a portion of its vapor would be condensed and fall in a fine mist. This undoubtedly sometimes happens, and must be more frequent towards morning than before midnight. But there is another way in which such a phenomenon may be conceived to arise. The air in contact with the earth, and for a certain small distance above it, when dew is being deposited is saturated with vapor. Its temperature is probably somewhat higher than that of the ground, for the variations of temperature of the ground will not be communicated instantaneously to the air just above it. The amount of dew deposited in any small interval of time will then depend not only upon the reduction of temperature, which takes place in this interval, but also upon the difference of temperature between the ground and the contiguous air, that obtains during this interval. Now, this difference may increase, as the night advances, at the same time that the loss of temperature from radiation continues the same; and the increase may be more than sufficient to compensate for the diminished temperature of the vapor, and thus the dew may be more abundant. It will be seen farther on, that even when a small quantity of dew falls during the night, a portion of vapor is abstracted from the air to the height of several hundred feet. We may learn from this fact that we cannot derive the variations in the quantity of dew from the observed variations in the falling of the dew point, noted only at one particular height. The observations should be made at various heights to furnish the data required for such a calculation.

Whether the fact really be in accordance with our understanding of the statement of Lamé or not, there can be little question that, in the average of weeks and months, there will be more dew deposited after midnight than before; for, besides that we have the authority of Lamé in support of the assertion, it will be observed that it is only when the elevation of the temperature of the air above the dew point at 4 P. M., is equal to, or less than, the amount that the temperature falls in the interval of time between this hour and sundown, that the dew will begin to fall at sundown, and it appears from observation, that at Philadelphia, the difference between the dew point and the temperature of the air, at 4 P. M., is, on the average, about equal to the entire average nocturnal loss of temperature, and is accordingly about 8°, more or less, greater than the fall of temperature down to the time of sundown. Dew must therefore be much more frequent after than before midnight. It is to be observed here, that it is not necessary that the humidity of the air should be above the average, in order that any dew may be deposited during the night, as may perhaps be inferred from the above statement; for, if it were not for the heat given out by the falling dew, the temperature would fall much lower; in other words, the actual loss of temperature is that due to radiation diminished by the heat given out by the condensed vapor.

As to the relative frequency of dews at different seasons, it must become greater, from the very nature of things, for the same loss of heat by radiation, in proportion as the humidity of the air becomes greater; and therefore must increase from July or August to December or January. It is true, that this increased frequency in the occurrence of dew, is partially compensated for by the diminution in the amount of dew deposited from saturated air in a given time, from the same reduction of temperature, as the mean daily temperature becomes lower; but the effect of this cause is much less than appears at first sight, for, if less dew falls in any short space of time, at the lower temperature, the heat given out will be less, and therefore the cooling will be greater.

We have next to enquire into the absolute amount of dew deposited at any one season. The experiments of Professor Brocklesby, detailed in an article "upon the Influence of Color on Dew," published in the No. of this Journal for September, 1848, furnish data upon which we may base a calculation. The experiments I shall use are a suite of eleven, made at intervals from July 9th to August 4th. Strips of flannel, of the size of from 15 to 17·5 square inches, and of various colors, were placed upon closely shorn turf, or upon a smooth board elevated six or seven inches above the turf, and the amount of dew gained by them ascertained by weighing them. The average amount deposited upon the pieces of green flannel, in the eleven experiments, I find to have been 28·1 grains for a surface of twelve square inches. This is equivalent to a film of water of the thickness of $\frac{1}{100}$ of an inch. The average is very nearly the same for the other colors. It is to be observed with respect to these experiments that they were made at the season of the year when there is the least dew, and that the nights do not appear to have been selected with reference to the degree of humidity of the air, for the amount deposited on the different nights varies from about 20 grs. to 60 grs., and the first ten days are included within a space of twenty days. They were probably a fair average of the nights that occur at that season of the year. The radiating power of mold is 92, and of vegetation over 100, that of lampblack being 100. There is no reason to suppose that the radiating power of flannel is materially greater. I shall therefore consider myself entitled to assume that on clear nights in July the average amount of dew is not less than $\frac{1}{100}$ of an inch.

Connected with the question of the amount of dew is that of the height in the atmosphere to which the abstraction of vapor extends. We may obtain an estimate of the distance through which the vapor falls, by observing how much the dew point falls near the surface of the earth. At Philadelphia, where the hygrometric observations were made at the height of about four feet above the ground, this does not exceed 2°, on the average, in the months of July, August, and September. Obtaining the requisite data, and making the calculation, I find, that to furnish $0^{in}\cdot01$ of dew at the temperature of 70°, this reduction of the dew point must extend no less than 736 feet; and that this amount of dew is equivalent to all the vapor in the air, when the air is saturated, within forty-three feet of the earth's surface. In the average hygrometric state of the air (for both day and night) it is only half saturated with vapor, and all the vapor within eighty-six feet of the surface of the earth would not condense into more than $0^{in}\cdot01$ of dew, at the temperature of 70°. If we suppose the rise and fall of the dew point, occasioned by winds, to balance each other, then the average fall will represent the excess of the fall attendant upon dew and rain over the rise produced by nocturnal evaporation. The average fall attendant upon dew alone may then exceed 2°; and the withdrawal of vapor extend to a proportionally less height. We may confidently affirm, however, that on a clear night vapor must fall to the earth's surface from a height of several hundred feet. But we are not confined to mere inferential conclusions on this point, for, direct observations upon the varying hygrometric state of the air have been made upon the summits of the Righi and Faulhorn in Switzerland, which have established that even at such heights (4,530 feet and 7,240 feet), the quantity of vapor decreases during the night no less regularly than in the valleys below. But the fall of vapor doubtless occurs at a height much greater than that of the point from which it descends during the night as far as the earth's surface.

What is the amount of heat given out in the deposition of this quantity of dew? The experiments of Watt, and of Clement and Desormes have established that when a given weight of vapor is condensed into water of a given temperature, say 32° F., the quantity of latent heat disengaged is the same, whatever may be the temperature of the vapor, and is sufficient to heat the same weight of water, at the temperature of 32°, no less than 1157°. This then is the amount of latent heat evolved in the deposition of dew on a winter night. On a July night it will be 1119°. We may accordingly assume that all seasons of the year it is more than 1100°; and may therefore conclude that in the deposition of $0^{in}\cdot01$ of dew, the heat evolved is sufficient to raise this $0^{in}\cdot01$ of water 1100°, and to raise the temperature of one inch 11°. I do not find the specific heat of mold or soil in any table of specific heats in my possession, but in the very extended table given in Pouillet's Elements de Physique Experimentale, I find the specific heat of water set down as much greater than that of every solid in the list. It is therefore highly probable that the specific heat of the soil is much less than that of water. We may strengthen this conclusion, and at the same time obtain some approximation to the element sought, by attending to the specific heats of the principal ingredients of the soil. These are, of silica 0·19, of alumina 0·20, and of carbonate of lime 0·21, that of water being 1. The specific heat of dry soil is therefore probably about 0·20. That of soil in its ordinary moist state must be somewhat greater. A somewhat rough experiment gave me 0·41 for the specific heat of a mass of earth of medium moisture, composed of sand with some clay, the density of which I found to be 1·5.

To be able to determine how much the temperature of a given depth of soil will be raised by a given amount of heat, we must know the specific gravity as well as the specific heat of the soil. Now the specific gravity of sand is stated to be 1·5, that of clay to be 2·2, and that of common earth 2·0. It appears, therefore, that the increased rise of temperature of one inch of soil, above that of water, by reason of the less specific heat of the soil, should be generally pretty nearly counterbalanced by the diminution consequent upon its greater specific gravity. But, as the specific heat is doubtless less than 0·5, while the specific gravity does not exceed 2, the augmentation will be somewhat greater than the diminution, and therefore the heat given out in the deposition of $0^{in}·01$ of dew will raise the temperature of one inch of soil more than 11°. If we take the specific heat equal to 0·4, according to the before mentioned experimental determination, and the specific gravity equal to 2, the effect of this amount of heat we find to be 13°·7. Upon a perfectly dry and sandy soil it would not, probably, be less than 36° (since the density would be 1·5, and the specific heat about 0·2). On the other hand, upon a clay soil saturated with moisture, it might be as low as 10°. But I will suppose for the present, that the heating effect of $0^{in}·01$ of dew is no more than 11° to one inch in depth of soil, and proceed to enquire what quantities of dew would suffice upon this supposition, to reduce the loss of temperature due to nocturnal radiation down to the actual losses observed in different seasons. On referring to the table of annual variations of temperature at various depths below the earth's surface, given on page 45, we find that the variations at the depths, 1^m, 2^m, 3^m, &c., form pretty nearly a geometrical progression, of which the ratio is about $\frac{2}{3}$,* (the variations continuing below 8^m, and becoming nearly imperceptible at the depth of 18^m). Assuming this law and ratio for the nocturnal variations, at the depths of 1^{in}, 2^{in}, 3^{in}, &c., recollecting that in a night of twelve hours the cooling extends to the depth of about 18^{in}, and taking 12° as the fall of temperature at the surface, which is about the average for the year, and forming the progression, I find the sum of the different terms to be 36°. This then is the actual loss of heat. Now the average fall of temperature at sundown is 2° per hour. If we suppose this to be due entirely to radiation, then, but for the heat given out by the dew, the entire decrease of surface temperature in the course of the night would be 24°; and therefore the entire loss of heat would be $2 \times 36°$ or 72°. To reduce this to 36° the heat given out by the dew must be 36°; and therefore the amount of dew must be about $\frac{3}{100}$ of an inch. We have then this result; upon

* The true ratio is between $\frac{2}{3}$ and $\frac{3}{4}$ and nearest to $\frac{3}{4}$. I take $\frac{2}{3}$ in preference to $\frac{3}{4}$, as, for reasons that will appear soon, it will here furnish results nearer to the truth.

the suppositions made the average quantity of dew, for the year, that must be deposited in the interval between 5 P. M. and 5 A. M. to satisfy the requirements of the theory, is about $\frac{3}{100}$ of an inch, and therefore about three times greater than the actual average for July, as ascertained from observation;—or rather, strictly speaking, about three times greater than the average of the results of Professor Brocklesby's experiments, which, it is probable, is somewhat higher than the actual average for this month. On glancing at the curves of diurnal variation of temperature for 1844, (see p. 42,) it will be seen that the average fall of temperature about the time of sundown, varies, from one quarter of the year to another, from 1½° to 3°. This difference is probably the result of the joint action of three different causes, viz., the unequal evaporation that obtains, at this hour, on some days, the unequal deposition of dew, at the same hour, on other days, and ascensional currents varying in velocity. The first and last, so far as they act, will tend to make the fall of temperature at sundown greater in summer than it would be from radiation alone; and the second tends to make it less than this, perhaps, during the greater part of the colder half of the year. It is probable that the first tendency prevails over the second, and therefore that the average loss of heat, from radiation alone, is not greater than 2° per hour, the average loss of heat at sundown for the entire year. It is certain that it must be less than 3°. On the supposition that it is 3°, the entire loss, from radiation, would be 108°, instead of 72°, and the amount of dew required $0^{in}{\cdot}06$. On the other hand, there can be no question that the estimate I have made of the actual amount of heat lost is too high, for it is the sum of the entire variations of temperature of the different layers, to the depth of 18^{in}, in the course of a day, whereas the actual loss of heat during the night is equal to the sum of the actual losses of the same layers in the course of the night, and the loss of each layer in this interval of time will be less than its entire loss, with the single exception of the layer at the surface. From these considerations it appears that the average quantity of dew necessary to reduce the average loss of temperature due to nocturnal radiation down to the actual average loss, for the year, is certainly materially less than $0^{in}{\cdot}06$, and is probably less than $0^{in}{\cdot}03$. As to the quantities required for the other seasons, taking the radiation at 72°, 15° for the average nocturnal loss of temperature in the interval between the vernal and autumnal equinox, and 9° for the same in the interval between the autumnal and vernal equinox, I find that the heating effects of the dew during the night, in these two periods must be, respectively, 27° and 45°, and the quantities of dew $0^{in}{\cdot}04$, and $0^{in}{\cdot}024$. The average for July, to correspond to an average of $0^{in}{\cdot}024$ for the six warm months, must be less than $0^{in}{\cdot}02$, and probably, judging from the considerable variations in the amount of dew from March to July, and especially from July to October, noticed by the casual observer, should be less than $0^{in}{\cdot}01$, and therefore approximate to the actual average for July, which as we have seen is probably something less than $0^{in}{\cdot}01$. The agreement between theory and observation is therefore as close as it could reasonably be expected to be, in a case in which there is an uncertainty, within certain limits, in reference to some of the numerical results arrived at inferentially, and in which the observations have not all that completeness and definiteness which is essential to a thorough testing of the theory. This is seldom realized except where the observations are made for the express object of subjecting a theory after it has gained a foothold in the region of science, to the most rigid scrutiny.

I conclude, therefore, that the heat evolved from the dew, or condensed vapor, that falls at night, is nearly, if not quite sufficient to reduce the theoretical decrease of temperature due to radiation, down to the amount which actually obtains; and that the variations in the quantity of dew that falls at night, from one season to another, are attended with sufficient variations in the amount of heat imparted to the earth, to effect the changes observed in the nocturnal decrease of temperature during the year.

As to the general explanation of the effect of dew, I conceive that, in the average of months, the amount of dew deposited from hour to hour during any one night, and from night to night, is in proportion to the humidity of the air, and therefore must increase steadily from sunset to sunrise, and from summer to winter. I consider that it has been conclusively established, that it is only from the varying amounts of heat imparted to the earth, consequent upon these varying quantities of dew, that the observed changes in the nocturnal losses of temperature from hour to hour, and from night to night, can possibly result.

(To be continued.)

Art. XVII.—*On the Method of determining the Geographical Longitude by Altitudes of the Moon;* by W. Chauvenet, Professor of Mathematics in the U. S. Naval School.

This method has been proposed for the use of navigators on account of its practicability with the sextant, and the ease with which altitudes are observed with that instrument. It can be of little use, however, at sea, where the uncertainty of the data—the local time, the latitude and the moon's altitude—is such that the result of an observation of this kind could rarely be relied upon within 30′ of longitude.* But on land, with the artificial

* Raper (Practice of Navigation, p. 285) says ¾ of a degree.

horizon, it admits of considerable accuracy, and properly computed may be rendered quite as correct as lunar distances. Indeed, as many observers can take altitudes with the artificial horizon more correctly than they can measure the distance of the moon from a star, it may even prove superior to the "lunar." With a view to this application, I propose to point out a slight inaccuracy in the common method of computing the hour angle of the moon from the altitude, to investigate the amount of this error, and to give a more correct process.

The outline of this method is as follows. With the true altitude (α), the declination (δ) and the geographical latitude (φ), the hour angle of the moon (h) is found by the formula

$$\cos. h = \frac{\sin. \alpha - \sin. \delta \sin. \varphi}{\cos. \delta \cos. \varphi} \qquad (1)$$

or

$$\sin. \tfrac{1}{2} h = \sqrt{\frac{\cos. \frac{1}{2}(p + \varphi + \alpha) \sin. \frac{1}{2}(p + \varphi - \alpha)}{\sin. p \cos. \varphi}}$$

where $p = 90^\circ - \delta$.

Then from the known local sidereal time (T) we have the moon's right ascension by the formula $R = T \pm h$; and corresponding to this right ascension, the ephemeris gives the Greenwich time of the observation, and consequently the longitude.

Now in order to compute the formula (1) correctly, it is necessary to allow for the compression of the earth, and in every work upon practical astronomy that I have seen, we are directed simply to reduce the horizontal parallax by a quantity that is proportional to the diminution of the earth's radius at the latitude of the observer, and with this reduced parallax to correct the altitude by the usual methods. If the vertical line of the observer passed through the center of the earth, this process would obviously be correct, but the earth's radius and the vertical, making in general an angle, it involves an error in all cases except when the observer is on the equator, (or at the pole,) or when the moon is on the prime vertical. The amount of this error will be estimated by means of the accurate process, which follows. The principle of this process is familiar to astronomers, from the use made of it by Bessel, but it does not appear to have been applied to this problem.

Let the altitude be reduced to the point in which the vertical intersects the axis of the earth, which for brevity we may designate as the point P; and let the moon's declination be reduced to the same point. Since this point is in the axis, these reductions do not affect the hour angle; and since the zenith is not changed, we still employ the geographical latitude, so that we shall have

$$\cos. h_{,} = \frac{\sin. \alpha_{,} - \sin. \delta_{,} \sin. \varphi}{\cos. \delta_{,} \cos. \varphi} \qquad (2)$$

in which $\alpha_{,}$ and $\delta_{,}$ are the altitude and declination reduced to the point P, and $h_{,}$ is the true hour angle.

To reduce the altitude to the point P.—After correcting the observed altitude of the limb for the refraction and applying the apparent semidiameter,* we have the altitude α_0 as affected by parallax, to correct for which we employ a horizontal parallax π_1 obtained from the equatorial hor. par. π, by the formula

$$\sin.\pi_1 = \mathrm{B}\sin.\pi \qquad (3)$$

where $$\mathrm{B} = \frac{1}{\sqrt{(1-\varepsilon\varepsilon\sin.^2\varphi)}}, \quad \varepsilon\varepsilon = \cdot 0065466$$

and log. B is taken from a table with the argument φ. As this table is not given in works on navigation, we may substitute for formula (3) the following, obtained by developing B;

$$\pi_1 = \pi + \tfrac{1}{2}\varepsilon\varepsilon\pi\sin.^2\varphi + \&c. = \pi + \Delta\pi \qquad (4)$$

The quantity $\Delta\pi$ is very nearly the same with that which is usually given as the "reduction of parallax," so that we may with a slight sacrifice of accuracy, obtain it from a table of reduction, observing however to *add* it to the hor. par. instead of subtracting, as in the usual methods. The parallax in altitude is then $\pi_1\cos.\alpha_0$, whence $\alpha_1 = \alpha_0 + \pi_1\cos.\alpha_0$.

To reduce the declination to the point P.—We have the known relations

$$\left.\begin{array}{l} r_1\cos.\delta_1 = r\cos.\delta \\ r_1\sin.\delta_1 = r\sin.\delta + ai \end{array}\right\} \qquad (5)$$

where r = moon's distance from the center of the earth.
r = " " " point P.
ai = distance of the point P from the center of the earth.
a = equatorial radius.

$$i = \frac{\varepsilon\varepsilon\sin.\varphi}{\sqrt{(1-\varepsilon\varepsilon\sin.^2\varphi)}} = \varepsilon\varepsilon\mathrm{B}\sin.\varphi.$$

From these equations we find directly

$$\sin.(\delta_1 - \delta) = \frac{a}{r}i\cos.\delta_1 = i\sin.\pi\cos.\delta_1$$

or with sufficient accuracy

$$\delta_1 - \delta = \varepsilon\varepsilon\pi\sin.\varphi\cos.\delta \qquad (6)$$

which is the correction to be added (algebraically, observing the signs of φ and δ) to δ, in order to reduce it to the point P.

These computations are extremely simple and scarcely add to the labor of the ordinary methods. As they are not based upon rigorously exact formulæ, however, it is proper to investigate the degree of approximation which they give.

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* The apparent semidiameter will be found with sufficient accuracy for the present problem by the usual formula $\varrho' = \varrho(1+\sin.\pi\sin.\alpha_0)$, where ϱ and ϱ' are the values of the semidiameter for the center of the earth and the observer respectively; but if the square of the parallax is retained in the series and the compression of the earth also taken into account, a small correction will be found which may amount to $0''\cdot 38$, when the moon is in the zenith.

The expression for the normal ($a_{,}$) or the distance of the observer from the point P is

$$a_{,}=\frac{a}{\sqrt{(1-\varepsilon\varepsilon\,\sin.^2\varphi)}}=\text{B}a$$

whence $\frac{a_{,}}{r}=\text{B}\times\frac{a}{r}$, or *nearly* $\sin.\pi_{,}=\text{B}\sin.\pi$ as in formula (3).

Strictly $\sin.\pi_{,}$ is not equal to $\frac{a_{,}}{r}$, but to $\frac{a_{,}}{r_{,}}$. To estimate the error we have from the equations (5),

$$r_{,}=r+ai\sin.\delta$$

whence

$$\sin.\pi_{,}=\frac{a_{,}}{r_{,}}=\frac{a_{,}}{r+ai\sin.\delta}=\frac{a_{,}}{r}=(1-\frac{a}{r}i\sin.\delta-\&\text{c.})$$

or with extreme precision,

$$\pi_{,}=(\pi)-\pi^2 i\sin.\delta\sin.1'',$$

so that (π) found by (3) is in error by the quantity $\pi^2 i\sin.\delta\sin.1''$, the value of which for $\pi=61'$, $\delta=29°$ is only $0''{\cdot}21\sin.\varphi$.

To find the error of formula (6) in which the factor B is assumed equal to unity, we easily find that the maximum value of $\delta_{,}-\delta$ is about 25″, and the value of B lies between 1 and 1·0033, so that the maximum error in $\delta_{,}-\delta$ is $25''\times{\cdot}0033$ or 0″·08.

Finally, *to estimate the error of the common method.*—In this method the hor. par. is reduced by the quantity $\Delta\pi$ of formula (6) and the geocentric declination and geographical latitude are employed in the formula (1). Let α be the altitude that would be obtained by neglecting the compression of the earth, that is, employing the equatorial hor. par. π without reduction; α' that which is obtained by employing $\pi-\Delta\pi$, and $\alpha_{,}$ that which is obtained as above, by employing $\pi+\Delta\pi$. Let h, h' and $h_{,}$ be the corresponding hour angles. Differentiating (1) taking h and α as variables, we find

$$dh=-\frac{d\alpha\cos.\alpha}{\cos.\delta\cos.\varphi\sin.h}.$$

But $\alpha'=\alpha-\Delta\pi\cos.\alpha$; therefore substituting $d\alpha=-\Delta\pi\cos.\alpha=-\frac{1}{2}i\pi\sin.\varphi\cos.\alpha$

$$dh=\frac{i\pi\cos.^2\alpha\tan.\varphi}{2\cos.\delta\sin.h}.$$

Again, differentiating (1) taking h and δ as variables

$$d'h=d\delta\left(\frac{\cos.\delta\sin.\varphi-\sin.\delta\cos.\varphi\cos.h}{\cos.\delta\cos.\varphi\sin.h}\right).$$

If M = the angle at the moon included by the vertical and declination circles, we have the relation

$$\cos.\delta\sin.\varphi-\sin.\delta\cos.\varphi\sin.h=\cos.\alpha\cos.\text{M}$$

whence (substituting also the value of $d\delta = i\pi \cos. \delta$)

$$d'h = \frac{i\pi \cos. \alpha \cos. M}{\cos. \varphi \sin. h}.$$

Now

$$h' = h + dh, \quad h_{,} = h - dh + d'h$$
$$h' - h_{,} = 2dh - d'h$$
$$= i\pi \cos. \alpha \left(\frac{\cos. \alpha \sin. \varphi - \cos. \delta \cos. M}{\cos. \delta \cos. \varphi \sin. h} \right)$$

and if A = moon's azimuth, we have the relation

$$\cos. \alpha \sin. \varphi = \cos. \delta \cos. M = \sin. \alpha \cos. \varphi \cos. A,$$

whence

$$h' - h_{,} = i\pi . \frac{\sin. \alpha \cos. \alpha \cos. A}{\cos. \delta \sin. h}$$

which by means of the relation

$$\cos. \alpha \sin. A = \cos. \delta \sin. h$$

is finally reduced to

$$h' - h_{,} = i\pi . \frac{\sin. \alpha}{\tan. A}.$$

The maximum value of $i\pi = \varepsilon\varepsilon\pi \sin. \varphi = 25'' \sin. \varphi$, so that the error of the common method may be expressed by

$$h' - h_{,} = 25'' . \frac{\sin. \alpha \sin. \varphi}{\tan. A}.$$

This formula shows clearly enough that the common method is too inaccurate to be generally employed, for the error in the hour angle may even exceed 25″, when the moon is within 45° of the meridian or tan. A < 1. In the problem here considered, however, the error will always be much less, since the observations will always be taken within 45° of the prime vertical, and in many cases upon the prime vertical, when the error will be nothing. This method then might be used in certain cases, but it will be preferable to proceed by the method above given, which is always precise, and requires very little additional labor.

The method of determining the longitude by the moon's altitude has not the advantage which distinguishes moon culminations, occultations, etc., of a direct comparison with similar observations in other places, or the same or nearly the same time, but like the lunar distance, depends principally upon the accuracy of the ephemeris. It must therefore rank as a subordinate method, valuable chiefly to the traveller on account of its practicability with that "portable observatory," the sextant and artificial horizon.

Annapolis, Md., June, 1849.

Art. XVIII.—*On the Electro-Chronograph;* by the inventor, John Locke.

1. I propose first to give some brief definitions of the Electro-chronograph, and secondly to correct some erroneous opinions which have been formed, and some distorted and faulty publications which have been made, with reference to the invention.

2. A very brief though defective definition of the chronograph was suggested by the enquiry of a laboring man of this place. Sir, said he, is it true that you are making *a clock which will make marks on paper a thousand miles off?* This definition is true affirmatively as far as it goes. But the sort of marks and the use that can be made of them are essential points in the subject. It will mark down, at a distance, measured units of time representing truly duration by space. This again falls short of an account of the performance. *It marks time in such a manner as enables an observer, at any part of the circuit, to mark down the exact moment of any event in any other part of the circuit, be it ever so distant, and that too with the facility of a mere touch of the finger.*

3. It is this last item, the manner of the marking, which has been overlooked, and being overlooked has caused learned men and learned bodies of philosophers to pronounce other inventions, as Wheatstone's and Bain's interruptors, or break-circuits, so far as electrical interruption is concerned, to be the equivalents of my own, when really those interruptors could not begin to perform their part of the functions of the electro-chronograph. Introduce either Mr. Wheatstone's or Mr. Bain's interruptor into my chronograph instead of my own and not a single observation could be recorded with it. Prof. Wheatstone and others had special objects in view, and they made excellent inventions to attain those objects. They accomplished what they proposed and I have a high opinion of their merit. But when my own countrymen attribute to them that which they never sought to accomplish, and to which they have no claim, it is evident, even in the most charitable view, that they did not understand the subject which they have been so ready to hand over to foreigners.

4. I will now attempt to point out the peculiarity by which I have made it possible to record the exact time of events (astronomical phenomena) at a distant station by means of a single electrical circuit. The marks are made telegraphically on the distant paper, or other recipient, while the electrical circuit is closed throughout; the least interruption, though it be of the thickness only of tissue paper, stops the marking whether it be with Morse's machine, which traces a groove in the paper by a sharp point, or by Bain's machine which stains or inks a line by elec-

tricity acting on a chemical compound. It is evident that the best imprint which a distant operator can make on this marking machine to indicate an event, is to interrupt or disjoin the circuit, and thus interrupt the line at that moment being generated. Most of the electrical or magnetic clock machines mounted before mine, caused only momentary shocks of electricity, leaving the electrical circuit mostly open and without a current. Had they been connected with either Morse's or Bain's recording instruments, as mine is, the markings would have been dots and blanks, or Prof. Wheatstone's would have marked alternately a line and a blank, the blanks occurring in all cases while the circuit is broken and held open by the clock. Suppose now, while the clock holds the circuit open for a whole second at A, an observer distant a thousand miles at B, wishes to make an observation at C still another thousand miles off, what can he do? He can break the circuit. So he can, but the circuit is already broken by the clocks and breaking it again in another place makes no change, a blank was being generated, and it continues still to be a blank; for when a circuit is broken at one place it is broken in all places, and as regards electrical action it is, for the time being, a nullity—has no existence, and the distant operator can perform no action through it. Such were the instruments of Messrs. Wheatstone, Bain and others, set forth to a limited extent as the equivalent of mine.

5. *The distant operations are confined, necessarily to positive and negative effects, or to lines and blanks, and while the distant clock chooses to hold the circuit open, the operator has no choice, he cannot produce a position, viz., a dot or a line. He is therefore confined to a negative, a blank, which he can command by breaking a circuit otherwise every where closed.* Therefore, *in order to render the recording of observations, in the distantly generated time-scale, possible, it is indispensable that the circuit be kept closed as nearly continuously as possible.* It is a want of attention to the fact that the operator cannot mark lines as well as blanks at pleasure while the clock is operating, which has caused so many wrong and impracticable views to be taken of this question. Such then is the condition of the electrical clock-interruptor which I have invented. It causes the units of time (seconds) to be marked by long lines interrupted by short breaks in order that observations may be recorded by longer breaks, the punctum of the observation being the commencement of the break.

6. As this commencement will sometimes happen within the little break designed to mark seconds, I have devised the Metrotome key, which makes the observation break always of a uniform length, say half of a second, when its commencement can always be deduced from its ending, and whenever that com-

mencement happens in the letter break, the ending will be in the midst of a proper line.

7. That this point of the necessity of a circuit nearly continuously closed, is rather a blind one, is evident from several facts. *a.* I did not perceive it clearly myself without some study. *b.* In my correspondence with Dr. Bache, he suggested that I should improve my invention by marking seconds by dots and blanks, when I explained to him the impossibility of doing so under the conditions assumed, unless by a reverse arrangement, generating blanks while the circuit is closed, a thing possible with Morse's registering instrument, when still the circuit would be as before, mostly closed. *c.* Prof. Mitchel, of Cincinnati, in an attempt to anticipate me in the result of my researches, used an interruptor invented by me three years previous, though I presume unknown to Prof. M., and succeeded in marking dots on a Morse fillet. The interruptor was the pendulum rod swinging, at its lower end, through a globule of mercury, the pendulum and the mercury being connected with the battery poles. When Prof. M. informed me of what he had been doing, for I knew nothing of it until I had finished my invention, I asked him if he had imprinted observations upon this dotted fillet. He answered that he had not, but he thought he could do it. I asked him how. He replied that he would break the circuit. I reminded him that breaking his circuit would merely obliterate his dots, and asked him how he would mark an event which should occur fractionally between the dots. He admitted the impossibility. *d.* Various individuals of good attainments have expressed themselves unable to perceive the peculiarities which I have just described. *e.* One individual expressed his intention of making a clock perform chronographically by means of a dotting register, but in the execution he found the necessity of changing his plan.

When the clock is near the operator so that he can have an extra circuit to it, or when he is at the registering instrument so that he can strike in his observation-marks positively by hand, or by an extra circuit, then a dotting registration can evidently be adopted.

8. By way of further defining the electro-chronograph, permit me to introduce a brief history of the invention from a work which you perceive is printed but not yet published.

My attention was first drawn practically to the subject of the combination of clocks and electrical machinery for producing useful results, in 1844 and '45. I was delivering a course of popular lectures at Cincinnati on Electrology. My object was not so much to reduce any thing to a complete system in actual practice, as to show the essential elements of what was actually practicable. Having commenced and continued my studies of electrology under what are called "disadvantageous circumstances," viz.: without the usual aids of instruments, or of instrument makers, I was under the necessity of devising and making my own apparatus. Under these circumstances, I had accumulated, in the shop room contiguous to my laboratory, a very efficient and perfect set of tools, among which are the lathe and other shop tools made by the distinguished sculptor, Hiram Powers, and used by him while he occupied himself as a mechanic at Cincinnati. Whenever a new principle was announced, I found it better to devise and make the apparatus suited to its illustration than to purchase the stereotyped models often imperfectly planned and worse manufactured. Thus avoiding all servile copying, and venturing almost to avoid the trodden paths pointed out by books, we drank our knowledge as much as possible from the fountain itself, by appealing directly to nature. This course gave a freshness to popular instruction which evidently excited an interest and produced an effect proportionate to the intense toil which its prosecution demanded.

During the winter of 1844–45, I had three assistants, viz.: Thomas K. Beecher, A.M., and my two sons, John Locke, Jr., and Joseph M. Locke, all of whom were extremely expert at acquiring mechanical skill, and all of whom became enthusiastically active in the execution of instruments, which were thus invented, modelled, made, and used by our corps. The exalted character of my audience, composed as it was of men of high attainment, incited us to the utmost exertion, which was at the same time in the highest degree agreeable and yet too severe to be long continued.* It was in this course of lectures, when on the subject of magnetic or electric clocks, that I devised and made two clock-electrotomes, "break-circuits," or electrical "interruptors," which, so far as I know, were new. I used these to show my audience how they might be applied to the several purposes of repeating the beats of a clock and of causing a secondary clock to move without pendulum or weights at telegraphic distances. In one of these, the electrical circuit was interrupted by a conducting pendulum swinging at its lower point, through a little mercury cup; in the other a wheel with pins or teeth tripped a little tilt hammer and broke the circuit, not by friction, but by direct separation of contact and restored it by the reverse motion. I had read the general accounts of the magnetic clocks of Europe and had seen the *details* of some of them,† and I entertained objections to the *frictional* mode of making and breaking circuit,

* That audience included six presiding Judges, the President and officers of the Medical College of Ohio, the Catholic bishop and priests of Cincinnati, the officers and professors of St. Xavier's College, professors and officers of other colleges and institutions of learning, with members of the profession of medicine.

† Bain's for example.

and especially when that friction taxed, either directly or indirectly, the motion or force of the *pendulum;* especially did I consider it incompatible with astronomical clock performance, that the contact should be a direct friction on the pendulum. The above-named elementary inventions remained unapplied until 1848–9.

9. In October, 1848, Coast Surveying Assistant, Sears C. Walker, who had some years been determining longitude by means of electric telegraphs, the "time signals" and "star signals" being made by ordinary clock reading and by manual contacts and breaks of the electric circuit, thereby bringing the distant magnet into visible and audible action, applied to me to improve the means of determining longitude. He pointed out two desiderata—one, *a means by which the clock itself should close and break the circuit, and thus make its beats audible through the means of a distant included electro-magnet*—and the other, *a means by which an observer at one point of a telegraphic circuit of wires might start a clock at repose, at any distant part of that circuit, at any desired moment.*

10. The former, I informed Mr. Walker, had already been accomplished by the magnetic clocks of Europe, a fact of which he did not appear to have been specifically apprised. To accomplish the latter, I devised the means, a thing very easy to be done. I informed him also that I had objections to the mode of action, so far as I understood it, by which the electrical clocks produced their effects, and I was of opinion I could improve them by limiting my invention by the following conditions, which had occurred to me four years before, viz.: 1st, That nothing should interfere in the least with the pendulum, and 2d, That the electrical current should pass through no part of the proper clock. I applied my tilt hammer of 1844, and succeeded quite to my satisfaction. The most agreeable point was, that on trial it appeared that the electric attachment to my astronomical clock did not change in the least its rate of going. This attachment caused the electro-magnet to reciprocate audibly and visibly, and would have caused a proper magnetic clock to be moved secondarily at the greatest distance to which the wires extend. It fulfilled admirably the conditions suggested by Mr. Walker. But this invention, thus cleared of frictional contact and of interference with the pendulum, was still a mere magnetic clock and not a "*chronograph.*" In the course of my experiments it occurred to me that by combining two other instruments with this clock, viz.: the Morse's Register,* or its equivalent, and a break-circuit

* The term "Register" here, and in several other places, is used to mean the clock-like machine which carries forward the fillet of paper, while the magnet in Morse's machine, or the chemical tracers in Bain's, marks traces upon the paper so moved.

key, I could, at any distance, print or write down on the Morse fillet, the time in seconds or other units, represented by lines and short breaks; and *print* into the time-scale the exact moment of an event, by breaking the circuit, and thus causing a blank or break to be commenced in the line being generated. The plan was immediately drawn, the work executed, and the actual experiment made with perfect success. Almost every astronomical observer has intuitively felt a desire to have some kind of a chronograph with which to subdivide a second, and record fractionally the punctum of his observation. The idea has undoubtedly occurred again and again to the observer, that if he could have a disk revolving with *exact uniformity* one inch or so per second, and he could dot down appropriately in that inch his observation, without listening to, or looking at, a clock, it would greatly improve both his work and the means of performing it. Unfortunately, this *perfect uniformity* of motion has never been attained.

11. But in the electro- or electro-magnetic chronograph, although perfect uniformity of motion is by no means attained, yet the error thus arising is diminished to that which is inappreciable. For as the velocity, although variable, is measured every second, the only error necessarily created is that arising from the change of velocity during one second of time, a quantity exceedingly small. And even this small quantity may be quite removed by finding its value from the law or *rate* of change exhibited by several consecutive seconds, as indicated by the length of the lines representing them. The mean length of the lines preceding and succeeding the observation second, will mostly give a denominator so nearly of the true value, that, practically, the result may be considered quite perfect.

12. As the invention was developed and perfected, a copy of my journal of the work was currently transmitted to Prof. A. D. Bache, LL.D., Superintendent of the U. S. Coast Survey, to consult his opinion of its utility.

Mr. Bache became so well satisfied of its value that on the 18th of December, 1848, he made the request, by telegraphic despatch, sent by Mr. Walker, that I would grant permission that he might communicate it officially, in the form of a report, to Congress. That permission was granted by me, December 20, 1848, and the report was made. It seems, the sub-report of Assistant S. C. Walker had already been written, as it was dated December 15.

13. *Letter of Prof. Locke, published in the Cincinnati Daily Gazette of Nov.* 30, 1848.

It will be understood by my last paper on the subject of a Clock Register, that two kinds of marking upon the fillet of the telegraph are contemplated. First, the register of time in hours, minutes and seconds, made by the clock itself acting as an automaton operator. Second, the record of any event made by the hand of the observer, in the midst of the seconds, in such a manner as to indicate the precise fraction of a second at which it occurred.

First, then, the Automatic record of time.—By the Automatic Clock, the fillet will be marked to indicate seconds of time, thus:

In this specimen, *lines* and *breaks* are represented instead of dots and lines as described in my last. The beginning of a minute will be indicated by the omission of a break and the running together of two lines, thus:

The middle of this long line is then the beginning of a minute. The beginning of ten minutes will be shown by the omission of two breaks, and the beginning of every hour by the omission of three breaks when four lines will run together.

Second, of the Manual record of any special event.—The commencement of an eclipse, the noon-point of the sun, or of a star, or any other event desirable to be marked precisely, is registered by the observer by breaking the circuit at any point by hand: this will appear in the fillet thus:

In this example the event is recorded at four seconds and fourteen-hundredths of a second, the point [indicating the event] being the commencement of the break.

The apparent obliteration of the breaks, indicating seconds, by omitting two or three [as in indicating the commencement of every ten minutes and every hour] or a blank for a second or two, creates no difficulty, for they can obviously be restored by a pair of dividers. The complete circuit [for this operation] will then include a battery, register,* and keys as usual (keys for breaking the circuit), and besides these, the Automatic clock. The observer and key must be at the place of [observing] the "event," say at St. Louis, while the other parts may be ever so remote, say at Washington city, or any where along the circuit.

14. *Description of Dr. Locke's "Chronograph," from the pen of Coast Survey Assistant, Sears C. Walker, as re-published in the Cincinnati Daily Gazette.*

The following account of this late invention, from an article furnished by Coast Survey Assistant, Sears C. Walker, to the United States Gazette, is a perfectly graphic and true picture of

* See Note, page 235.

the circumstances of the invention. Mr. Walker, having witnessed the development of the thing here, and leaving on Nov. 19th, travelled direct for Philadelphia, where the article appeared on Dec. 1st. It is from an eye-witness, while it was fresh in his mind, and will therefore be the more satisfactory.

"Dr. John Locke, of Cincinnati, has invented a very cheap and simple instrument, which can be attached to the same pivot along with the second hand of any clock, and which will, when put in connection with the telegraphic circuit, make the clock beat at the same instant all along the line.

"The hours, minutes and seconds, may be registered on the fillet of paper, *and by striking on the telegraphic key at the instant of any occurrence, the date of it is recorded on the same paper to the hundredth of a second.* This invention will be useful for many practical purposes. It makes the current of time visible to the eye in a permanent record. *It does not change the rate of going of the most delicate clock.* It will doubtless be applied hereafter to many purposes for the advancement of science; such as the determination of geographical longitude, in connection with transit instruments, the measurement of the velocity of sound; perhaps, if the circuit be long enough, of the lightning itself.

"The mechanical invention is due to Dr. Locke. It is proper, however, to remark, that the first suggestion of the use of the telegraph line in connection with the determination of longitude, was made by Prof. A. D. Bache, the Superintendent of the United States Coast Survey, in the winter of 1843–4.

"The subject has, under his direction, been making constant progress towards the perfection of the art. Several thousand dollars have been expended in the construction of lenses, instruments, &c., and in practical observations for longitude. The great desideratum in the work was a telegraphic clock, which, without having its performance injured, should register, as Dr. Locke's attachment does, the hours, minutes and seconds at the stations of the coast survey, in connection with the line. The list of requisites* for coast survey operations derived from three years experience, was furnished to Dr. Locke under the direction of the Superintendent, by Sears C. Walker, the assistant in charge of this department, on the 28th of October. The invention of the attachment was completed by Dr. Locke, on the 4th of November. A model was constructed by Dr. Locke's son, a skillful mechanician, and on the 15th was attached to an astronomical clock, made by Dr. L., with his own hands. The coast survey

* This list of requisites did not include any suggestion or hint with regard to the "*printing*" or chronographic mode of observing. It consisted of the suggestions specified on page 235, *in italics*.

made an arrangement with the Telegraph Company in Cincinnati, to extend their circuit through Dr. Locke's house, on the 17th inst., and the first experiment was tried with complete success. Let us give credit to whom credit is due. Without the persevering enterprise of the superintendent of the coast survey, the immediate desideratum might not have been fixed upon. When this was known, however, it was no easy matter to effect it without injuring the performance of the clock.

"The most expert clock makers and mechanicians, and the most expert telegraph operators and inventors, including Dr. Morse himself, had been consulted. None had succeeded in a mode that was absolutely satisfactory. It required the union of all the arts of electro-magnetism, of clock-making, and of telegraph registering in the same person, in order to insure success. Dr. Locke had all the requisites. He made the invention. His son made the model. It was attached to a clock made by himself. It was tried on a register of his own invention and handicraft. He is, therefore, in every sense, the inventor of the attachment. The utility of the invention to the Coast Survey is so great, that one night's work, with the new apparatus and such accompaniment as will necessarily be provided, may perhaps be worth as much in practical results as a whole campaign would be without it.

"Dr. Locke's attachment may be made to register far smaller subdivisions of time than hundredths of a second. Instead of the fillet of paper, we may substitute a metallic cylinder, revolving like a barrel-organ, with the hours, minutes and seconds traced on it in a spiral line with such precision, that a second of time may be subdivided into ten thousand parts, all susceptible of distinct measurement with a microscope. Such a portion of time is supposed to be occupied by lightning in traveling eighteen miles. A hundred of them are taken for lightning to travel from Eastport to New Orleans. One continuous line will next year connect these places. The lightning will then take for its passage a line 100 times as long as the smallest portion capable of being measured by Dr. Locke's attachment. K."*

Dr. Locke's invention consists in part in the evolution of a perfect time-scale, marked not only with seconds or units of time, but with the larger divisions, as minutes, five minutes, and hours; and in *the entering or imprinting of the exact time of events, as astronomical observations, upon the same time-scale* by electro-magnetic or other means, as circumstances may require or permit; this being done without injuring the rate of going of the clock.

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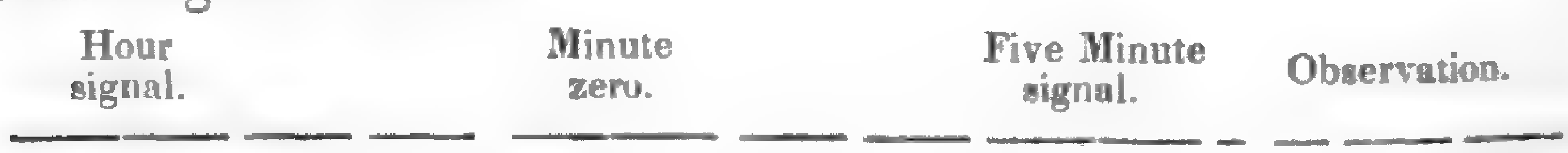
* The article was written by Mr. Walker, but was carried to the press by his half-brother, Prof. Otis Kendall, of Philadelphia.

By this invention the observer need not have a clock at his station—only one clock is necessary.

15. *Letter of Prof. Locke to Lieutenant Maury, Director of the National Observatory, Washington, D. C., dated Cincinnati, Dec.* 13, 1848.

I enclose to you a specimen of my late invention, the telegraphic-clock for longitude, (now called the electro-chronograph.) The clock breaks and closes the circuit in such a manner that the seconds are registered in lines about half an inch long, with short breaks between them. This is done without any interference with the pendulum. To indicate the minute zero, a break is omitted when two lines run into one, about one inch long.

Every five minutes, a long line (three seconds) *follows* the minute zero. Of course the five minutes terminates at the minute zero. Every hour a similar dash *precedes* the minute zero, each of these dashes is separated from the minute zero by a few distinct seconds. At the commencement of an hour the three signals come together thus:



Star transits are marked by blanks or breaks made by a finger key under the hand of the observer, (see specimen.) The commencement of the break is the punctum of time of the observation. As this may happen between the little breaks between seconds, and be thus a little (one-tenth second) indefinite, I have invented a key which shall measure the breaks and make either end available. By scale and dividers these breaks can be measured to hundredths of a second. The use of such a clock to determine longitude on a telegraphic line is evident. It occurred to me that it might also be useful in a local observatory as a faithful and convenient register of observations, and especially as it subdivides seconds very accurately. It would relieve the observer from ocular and auricular clock trouble. which when there is a noise about you is often vexatious. The observer has only to watch the transit and press the key at every wire, without ever taking his eye from his telescope. If not used as a substitute for usual clock readings, it might be a convenient check and auxiliary. If it is thought that it will be useful, it has been proposed that two such clocks be made by our government, one for your Observatory and the other for the Coast Survey. The operation of my clock is as perfect as I could wish, so far as I have observed, and the machinery does not appear to interfere with its rate.

Mostly, in the observations, the hour and five minute signals would be of little or no use, and might be thrown out of action.

16. *Lieutenant Maury's Letter announcing officially Dr. Locke's invention to the Hon. John Y. Mason, Secretary of the Navy.* (*From the National Intelligencer of June 8th,* 1849, *and dated, National Observatory, Washington, January* 5, 1849.)

I have the honor of making known to you a most important discovery for astronomy which has been made by Dr. Locke, of Ohio, and of asking authority from you to avail myself of it for the use and purposes of this Observatory.

The discovery consists in the invention of a magnetic clock, by means of which seconds of time may be divided into hundredths with as much accuracy and precision as the machinist with rule and compass can subdivide an inch of space.

Nor do its powers end here. They are such that the astronomer in New Orleans, St. Louis, Boston, and any other place to which the magnetic telegraph reaches, may make his observations, and, at the same moment, cause this clock, here in Washington, to record the instant with wonderful precision.

Thus the astronomer in Boston observes the transit of a star as it flits through the field of his instrument, and crosses the meridian of that place. Instead of looking at a clock before him, and noting the time in the usual way, he touches a key, and the clock here subdivides his seconds to the minutest fraction, and records the time with unerring accuracy.

The astronomer in Washington waits for the same star to cross his meridian, and, as it does, Dr. Locke's magnetic clock is again touched;* it divides the seconds and records the time for him with equal precision. The difference between these two times is the longitude of Boston from the meridian of Washington.

The astronomer in New Orleans and St. Louis and every other place within the reach of the magnetic wires, may wait for the same star, and as it comes to their meridian, they have but to touch the key, and straightway this central magnetic clock tells their longitude.

And thus this problem, which has vexed astronomers and navigators, and perplexed the world for ages, is reduced at once, by American ingenuity, to a form and method the most simple and accurate. While the process is so much simplified, the results are greatly refined. In one night the longitude may now be determined with far more accuracy by means of a magnetic telegraph and clock, than it can by years of observation according to any other method that has ever been tried.

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* The clock itself need not be touched, for it may be a thousand miles away from the observer. The break-circuit key must be touched, as in Lt. Maury's next paragraph.

It is, therefore, well entitled to be called a most important discovery. It is a national triumph, and it belongs to that class of achievements by which the most beautiful and enduring monuments are erected to national honor and greatness; and my feelings of professional pride will not allow me to pass it by, without calling your attention to the garland that has been hung about it by the navy.

To the navy belongs the honor of having first applied the magnetic telegraph to the determination of longitude. Five or six years ago Capt. Wilkes, of the navy, used it for determining the difference of longitude between this city and Baltimore. This was the first time it had been applied to such a purpose, and it was a great improvement upon the methods which up to that time had been used for finding the longitude, for it reduced the results down to the accuracy with which the time between the ticks of the second-hand could be measured on the face of the clock by the eye and the ear. And thus the honor of being the first to convert the magnetic telegraph into an astronomical instrument, and that too into one of great practical value and importance, was secured by one of its officers to the American navy. Though the errors of the problem were greatly reduced by this discovery, there were, however, small sources of error still remaining, and it remained for Dr. Locke, formerly an officer of the navy also, to devise a means of eliminating them so completed that now there is scarce a trace left in the results, so free are they from doubt and uncertainty. The probable error of longitude determined with Dr. Locke's clock is brought within such narrow limits that if, while the astronomer in St. Louis or elsewhere were operating upon the magnetic clock here for his longitude, the observer in Washington were to move from one instrument to another in this building, the fact that he had moved would be made known at once, and whether he had moved to the east or the west would be told by the clock, and appear in the resulting longitude.

Dr. Locke was formerly a member of the medical corps of the navy, and as such, spent a portion of his manhood and prime years of his life at sea.

It is therefore, not surprising that sailors should be quick to lay hold of the problem of longitude through any improved means that may be offered for its solution. Every one can see the importance of accurate determination of longitude, but sailors both see and *feel* it. In his letter to me, describing his clock and giving an account of its performance, Dr. Locke kindly offers to put one in this Observatory.

It would be of incalculable service and advantage. It would increase the accuracy of results, and greatly multiply them in numbers. With this clock one observer could do more and better work than two can now. An illustration of the value of such a clock just now occurs. I am writing at night, the sky is very clear, and it is the first fair night for observations that we have had this year. The wind is very high, and the observers have just come in to say they cannot hear the clock, on that account, and therefore they cannot observe. Now it is not necessary to hear, or even to see the magnetic clock, and had we one, we could work quite as well in windy as in calm weather. While, therefore, one of Dr. Locke's magnetic clocks would be of such value to the Observatory, it would, without at all interfering with that value, be of incalculable advantage to the public generally; for wherever in any part of the country there is a transit instrument and a line of wires, this clock may be used by the observer at that instrument, not only for recording his observations, but also for determining his longitude from the capitol of the country; and thus it would without cost or trouble, enable the National Observatory to perform a most important part of appropriate duties, and a most acceptable service to the world in perfecting the geography of the country, and in affording so many well-determined points of departure for the traveller, the surveyor and the navigator.

17. *The reply of Lieutenant Maury, Director of the National Observatory, at Washington, to Senator Corwin, of Ohio, (dated National Observatory, Washington, D. C., February* 17, 1849.)

I am this morning in receipt of yours of the 16th inst., in which you request my opinion as to "Dr. Locke's claim, and the utility of his clock."

I consider Dr. Locke's invention as one of the greatest improvements of the age, in practical astronomy. Other persons have invented "Magnetic Clocks," but all those clocks, as far as I know, beat seconds and leave the astronomer precisely where he was before, as it regards the subdivisions of seconds.

He had by them, as with other clocks, to trust to the eye and the ear for the division of seconds. It was a great desideratum with astronomers, and an important matter for the world, to obtain the means of subdividing the seconds of time with accuracy and certainty, for a second of time, in the determination of longitude, is equal to a quarter of a mile.

Dr. Locke took up this subject where others had left it, and by means of an attachment to a common clock, by the aid of electro-magnetism and a common registering apparatus used in telegraphic offices, devised the means of subdividing accurately and with precision, seconds of time into hundredths, or even into thousandths, if need be.

He has chosen to call his invention a "Magnetic Clock." I think that is rather a misnomer; for a clock to be driven by magnetism, instead of by weights, has been invented in England. This is truly a magnetic clock, and Dr. Locke's attachment or contrivance for subdividing seconds may be connected with the magnetic clock as readily as with any other. At any rate, without going into the fitness of terms, the expression "Magnetic Clock," is not descriptive of Dr. Locke's invention.* But as a practical illustration of the value of Dr. Locke's invention, I may mention the fact, that we have for four years been making observations here continually for the purpose of determining the longitude of this place. After we shall have been at work for twice that time—I might say for a life-time—if we succeed in determining the longitude of the Observatory within the limits of the lot in which the building stands, seventeen acres, we should consider ourselves as well repaid for the labor and time employed.

Now with Dr. Locke's invention, the difference of longitude between this Observatory and any other point, reached by magnetic telegraph, may be determined in one night so closely as to show in what part of the building the observations were made.

And thus, by having one of Dr. Locke's clocks here, this Observatory may be connected with every other observatory in the country in such a manner as to make all their observations for *their* longitude from Greenwich to other European observatories, available for determining *our* longitude also from the same places.

It will enable the Observatory in a single night to determine the difference of longitude between the capitol to any other place, reached by magnetic telegraph, with far more accuracy than it can be done without it, and thus enable this Observatory to fulfill, in the most satisfactory manner, one of the most important objects of a National Observatory, viz: that of perfecting the geography of the country and of affording in different parts of it well and accurately determined points of departure for the traveller, the surveyor and the navigator.

It will enable the observers now employed here to do double, perhaps treble, the quantity of work that they now do, and to do it better.

The instruments require five clocks;—with Dr. Locke's improvement applied to one of them, all the others may be dispensed with.

I might go on in the enumeration of the advantages to the public service, the facilities and the powers which this invention give the astronomer, were I at liberty to explain the principles and give descriptions of the invention in its present state; suffice it to say, that ingenuity has been successfully exercised to such an extent in the matter, that, though there be six astronomical instruments here, one of these clocks will record the observations

* Dr. Locke's invention is now called the "Electro-Chronograph."

of all at the same time, and the record will not only show separately the work of each instrument, but if the observations be interrupted by clouds or any other cause, as they frequently are, it will show upon what wire in the telescope the star or other object was at the time when the observation was made.* In view, therefore, of the importance and practical value of this invention, I consider that Dr. Locke has been as modest in his claims as he is with regard to his own merits.

18. *The fifteen properties of the Chronograph contrasted with the three positive properties of the common magnetic clock, as communicated to the Secretary of the Smithsonian Institution, March*, 1849, (*in a letter to Prof. Henry, from the author, dated Washington, March* 1, 1849.)

I am anxious to have your opinion on the subject of my invention, and I therefore put down some of its qualities as contrasted with those of other clocks:

ORDINARY MAGNETIC CLOCKS

1. Operate by interruptors or electrotomes.
2. Cause electro-magnets to reciprocate at a distance.
3. Impel other simpler clocks.
4. Negatively, when the secondary clocks become retarded or advanced by atmospheric electricity or otherwise, they will remain constantly in error until corrected by some external means.
5. Negatively, their mechanism is such as renders it impossible to use them for recording observations. See Art. 4 and 5.

DR. LOCKE'S ELECTRO-CHRONOGRAPH

1. Operates by interruptors or electrotomes.
2. Causes electro-magnets to reciprocate at a distance.
3. Impels other simpler clocks.
4. Positively, when the electricity interferes with the current in the wires, the time-scale, issued from the Morse Register, and marked by my clock, though its evolutions may be temporarily interfered with, yet as soon as the interfering cause is removed, will issue in exact correspondence with the clock.

The Morse Register may even be stopped and the graduating of the scale be thus interrupted, yet when it is started again, it will not recommence where it left off, but will indicate the then time of the clock.

5. The dial and hands remain on, and the clock can be used for ordinary purposes by eye and ear.

* The part of the invention to which Lieut. Maury alludes in this paragraph, was confidentially committed to him, and has never been made in any degree public. In this item the officers of the National Observatory itself are entitled to a share of credit which will ultimately be distinctly accredited to the proper authority.

6. By being connected with the ordinary telegraphic circuit it will cause a time scale to be issued at any telegraphic distance, said scale being marked by lines or dots* representing seconds or other primary divisions of time.

7. It will mark on the time scale the beginning of every minute.

8. It will mark the beginning of every 5, 10, 20, &c., minutes.

9. It will mark on the time scale the beginning of every hour.

10. It enables the operator at any part of the telegraphic wires to print down either there or at any other place in the circuit, *the occurrence of any event to the hundredth, or, if need be, to the thousandth of a second*, a property which the magnetic clocks would not possess even if they were connected with the registering machines. See Art. 4 and 5.

11. By the 10th property, *it enables the astronomer, from any point of the circuit, by a touch of his finger, to print on the time scale at any other points of the circuit, a legible and permanent record of his observations*, accurately as described in 10.

12. It enables one clock to operate through any extent of complicated circuits, to generate time scales from all registers included in them, and permits separate and independent observations to be made and printed into each and every of these time scales, without any interference with each other, and all this too, with but a single circuit, and a single battery in that circuit.

13. Thus, at two points selected for determination of difference of longitude, *one clock* only is required, and the use of that clock is better than two or more, because of the absolute unity or synchronism which is thus attained.

14. For an observatory with several instruments, or for any number of observatories situated distantly from each other, but *one clock* is needed, and for reasons named in 13, that one clock is better than many.

15. All this is done without changing the rate of going of the clock, and all the above properties have been tested by actual trial.

19. By far the most formal document which has appeared in reference to the electro-chronograph, has been the report of Dr. Bache to Congress, including the sub-report of Coast Survey Assistant, Sears C. Walker, which last has been published in your Journal.

20. My remarks upon that report will be confined chiefly to such points as are known to have produced misapprehension. An officer of government informed me, that as he understood the report of Mr. Walker, the intention, of some parts of it at least, was to attribute the invention of the chronograph not to myself, but to another person.

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* One or the other by adjustment.

21. It seems that his report has been rendered obscure and ambiguous, by the introduction of a new coined word, borrowed in part at least from an expression in my letter to the Gazette, where I name my invention the "Automatic Clock." But Mr. Walker has used the term "automatic clock register," not exactly in the sense in which I used the first part of the phrase, nor has he used it in a uniform sense as is evident from his context. It was well perhaps, as a matter of taste, to avoid the too frequent introduction of my own name, but when my invention is so often called the "Automatic clock Register" some more intelligible phrase would certainly have been preferable. I have not a copy of your Journal before me, and I therefore quote from the original document as published by Congress.

22. The following is Mr. Walker's introduction, p. 2, Doc. 21.

Washington, D. C., December 15, 1848.

"*Dear Sir:* I beg to call your attention to the importance of the use of an electro-magnetic circuit and an astronomical clock in connexion with Morse's telegraph register for the operations of the coast survey, and the general purposes of practical astronomy. Your thoughts having been first turned to the subject of the use of Morse's electro-magnetic telegraph in the longitude operations of the coast survey, in December, 1844, special instructions were issued to me in the autumn of 1845. Under these and subsequent instructions, the operations of 1846, '47 and '48, entrusted to my care, have, until near the close of the latter year, been conducted without the use of the *automatic clock register*.

"The importance of the latter instrument induced you to direct the necessary researches to be instituted, for the purpose of introducing it into use in the coast survey service. Several methods have been suggested by eminent mechanicians and electro-magnetists. That of Mr. Wheatstone is briefly alluded to in the proceedings of the Royal Astronomical Society, for 1841, November 19th. The galvanic circuit in his clock, is made and broken by the use of a circular metallic disk, put on to the arbor of the seconds' hand. Alternate intervals of a second, or one-sixtieth of the circumference, are made of a non-conducting substance. The disk is insulated and connected with one pole of a galvanic battery. A delicate spring connected with the other pole presses gently on this disk. Thus the circuit is made and broken at alternate seconds. This mode enables the primitive clock to control the motion of any number of clocks in connexion with it. Every time the circuit is broken or made, any receiving clock-wheel with sixty teeth may be made to advance one second, and this wheel may in the usual way control the minute and hour wheel."

As Mr. Walker uses the term "Automatic clock Register" in the following part of his report to signify the "Printing Method" of observing, or in other words my own invention, acknowledged to be so by him, it would seem by the above phrase, that Dr. Bache was apprised of its existence before it was invented, and that he directed "the necessary researches to be instituted for the purpose of introducing *it* into use in the coast survey service." But when Mr. Walker proceeds to say, "That of Mr. Wheatstone," &c., and again that "this mode enables the primitive clock to control any number of clocks in connexion with it," it appears that he uses "Automatic clock Register" to signify merely the common magnetic clock of Europe, or the mere clock interruptor, and with this interpretation the absurdity alluded to vanishes.

23. In the next paragraph, Mr. Walker relieves the reader entirely of all ambiguity by saying, "I find, as yet, no account of the application of these electro-magnetic circuits, and astronomical clocks to the purpose of permanently registering the current of time on the running fillet of paper, as used in Morse's Electromagnetic Telegraph," p. 3. He goes on to state, that "It is, however, this latter combination which we must employ in our telegraphic operations for longitude."

24. Mr. Walker next describes the various kinds of break-circuits, or clock interruptors, including my own, with reference to the connexion with the registering machine according to my "printing method," and adds:

"I think it is manifest that either method will succeed in practice, which alone can test their relative excellence. To Mr. Wheatstone, however, belongs the merit of priority in effecting the primary object of causing the astronomical clock to make and break the circuit of a galvanic battery, without injury to the machinery or movement of the clock."

I have shown, that none of these interruptors will perform in connexion with the registering apparatus unless they be essentially *modified*. If Mr. Wheatstone's contact wheel were made with slight breeches only, thus permitting the circuit to remain closed nearly all of the time, and rendering it possible to mark the observation, it would answer the purpose well. But this would be an essential modification, and would make it the equivalent of my own invention for the same purpose. Here Mr. Walker ought to have given me credit not only for *combining* the clock and the registering apparatus for the purpose of printing *time* and *observations* at a distance, but also for the invention of such a clock interruption of electricity as rendered the imprinting of observations *possible*. But I have already shown that this has been, in some way, naturally an obscure point, having been overlooked by others besides Mr. Walker. It is undoubtedly the misty point which had so far prevented the invention from having been made at an earlier period.

25. The experiment of Prof. Mitchel mentioned, p. 4, furnished a dotted fillet, on which not only were no observations printed, but for reasons which I have previously shown, none could be so printed, under the usual conditions of telegraphic distance, a single circuit and a single battery.

26. "On the 17th of November last, Dr. Locke's delicate astronomical clock, of his own construction, was supplied with the requisite apparatus made from his drawings by his son. At the expense of the coast survey, I directed wires to be put up for the purpose of connecting his clock with the Cincinnati and Pittsburg line, about four hundred miles in length. The experiment was eminently successful, and the registering of the seconds of time on the running fillet of paper was continued for two hours at all the offices along the line, much to the astonishment of the operators. I send you a specimen of the graduated fillet of paper. It consists, as you will notice, of an indented line of about nine-tenths of an inch in length, followed by a complementary blank space of about one-tenth. The two make a second of time, commencing with the beginning of the line."

The above paragraph, p. 4, is a clear announcement of facts.

Here Mr. Walker defines the term "Automatic clock Register," but he does not say whether "graduated fillet" means a fillet graduated both with time marks and observations, or merely the former. He uses the term subsequently, however, including both. and in that sense it is equivalent to my electro-chronograph or the Printing Method of *observation.* Prof. Wheatstone's interruptor could not furnish it.

27. "In order to carry out fully your wishes and instructions, it would be necessary that this automatic clock register should distinguish the hours, minutes and seconds. Dr. Locke proposes for this purpose to make the beginning of the ordinary minutes omit *one*, of *fives* of minutes *two*, of *tens* of minutes *three*, and of *an hour* omit *four* consecutive blank spaces. Thus *ordinary* beginnings of minutes have continuous lines of *two* seconds, *fives three*, *tens four*, and *hours five*."

The above paragraph is somewhat ambiguous and conveys the idea that the author's patron had anticipated the invention and gave "instructions" that the "automatic clock register" should "distinguish the hours, minutes, and seconds." One would suppose that this was one of the items in the "list of desiderata furnished to me."

I have given the only suggestions which were made to me, and had I done no more than accomplish the objects there proposed, I should never have claimed to myself the performing of any thing worth the effort of recovering. It is true that Mr. Walker called my attention, at that time, to the subject; and in aiding him to do what he suggested, I pursued the subject still further, and invented the electro-chronograph which superseded entirely, the plans primarily suggested to me. This invention was exclusively my own, and when it was communicated to Mr. Walker and to Dr. Bache, they both expressed their agreeable surprise; nor was it without some great effort that I made my plans intelligibly understood. It could not for example at first be seen that only one clock was necessary in the operation. Nor has the very basis of the whole affair, the *closed circuit*, been practically understood up to this moment. Mr. Walker never intended such a meaning as has been attached to the passage, for that meaning is inconsistent with truth, and with his previous statements.

28. "The mode of using the register for marking the date of any event that cannot be determined *automatically*, but whose occurrence must be known from human sensations, is to tap on a *break circuit key* simultaneously with the event. The beginning of the short blank space thus registered in the midst of the indented line of the *automatic clock register*, fixes, by a permanent printed record, the date of the event, or rather the date of the human estimate of the event, as indicated by the tap of the key.

"For this mode of distinguishing the hours, minutes and seconds on the fillet of paper, and for the idea of using the break circuit key, I was indebted to Doctor Locke. This kind of key is required by the necessity of having a closed circuit for the *register* as much of the time as possible, so that an event occurring any where along the line may be instantly recorded on the register."

In the second paragraph, "For this mode," &c., instead of being credited with the whole combination of the "Printing Method" both generally and in detail—I am represented as furnishing piece work for a master. Mr. Walker acknowledged himself indebted to me for a "break circuit key"! and a mere "tilt hammer" interruptor I suppose. So inconsistent are these expressions with the frank communication of the same author to the U. S. Gazette, already cited, that I will not attribute them to him, but to some Mentor especially solicitous that Dr. Locke and his invention should not be "praised too much."

The author closes his paragraph by a very proper allusion to the necessity of a "closed circuit" as pointed out in my letter to Dr. Bache, but he has every where practically disregarded that principle by citing machines which do not fulfill that condition, as the equivalents of my own.

29. "The great importance of an automatic telegraph clock has often been the subject of conversation between us, but your chief efforts were, necessarily, directed at first to the means of procuring it. A hasty glance at the advantages that would result from the certain possession of such an instrument, was made by

Dr. Locke and myself on the evening of the 17th of November, while watching its performance for a term of two hours or more. Having reflected much since, and consulted with my friends both in and out of the coast survey, I am more and more convinced that it is difficult to form an over estimate of its importance in every department of practical astronomy that involves the nice determination of absolute dates, or of their relative intervals in time."

In this paragraph, if we understand "automatic telegraph clock" to mean the chronograph or the "Automatic clock Register," printing time and observations, Mr. Walker represents himself and his patron in such a relation, that the readers of the article understand him to say, that it was understood by them before it was invented by me. I have no doubt the gentlemen had conversed about a common magnetic clock which should produce visible and audible action at telegraph distances, and this is the only interpretation consistent with the other productions of Mr. Walker on the same subject.

30. On p. 10, the author writes as follows:

"I would, for this purpose, respectfully recommend the mounting of one of Mr. Wheatstone's, or of Dr. Locke's clocks at some central astronomical station," &c.

Here as elsewhere, the equivalency, which I have shown has no existence, has been assumed to be true, and the credit of the combination invented by me is also disregarded. Superadding the printing or registering machinery to Mr. Wheatstone's clock, would be using my invention. Even then no observations could be registered without first modifying even the electrical machinery of that clock to accommodate it to the principle of the "closed circuit."

31. I am certainly indebted to Mr. Walker and to Dr. Bache for acknowledgments of my claim in no way ambiguous or obscure. The following as it appeared in the National Intelligencer, as the abstract of Mr. Walker's report, is precisely to the point.

"Electro-magnetic clocks were invented in England by Mr. Wheatstone, about the year 1841. They are described by Mr. Steinheil, in Munich, in 1844. They were used to make several clocks on the same telegraph line mark the same instant of time. The coast survey service has substituted Dr. Locke's recent invention, differing from any heretofore described, and having the advantage of furnishing the permanent record instead of the fugitive indication of the course of time."

Dr. Bache also, in his introduction to Mr. Walker's sub-report, p. 2, observes:

"I have received from Dr. Locke, of Cincinnati, specimens of recording by his electro-magnetic clock, which entirely fulfill all the conditions required by the astronomer."

32. To Dr. Bache and his officers of the coast survey, belongs the credit of systematic and persevering efforts to determine longitude telegraphically; and incidentally their efforts to improve the means of such determination have been the cause of my making the invention under consideration. Mr. Walker is enthusiastic; his manner and conversation are exciting, and he was very prompt to perceive, appreciate, and make known, the advantages of the *printing method of observing*. His invention of a telescope with cross hairs multiplied in proportion to the rapidity with which observations can be made by my chronograph, is evidently a valuable one. Indeed in that which is the special department of Mr. Walker, the astronomical part of the report, it is unnecessary for me to say that he has done himself his usual credit. The ambiguities which I have been obliged to notice, have been the result of rather a hasty use of a new term, a want of a clear perception of the necessity of a closed circuit, and a consequent confounding of my invention with the ordinary magnetic clocks, neither intended for *printing of observations*, nor possible to be used as a *part* even of the mechanism for that purpose.

33. At certain points I have indeed had good cause to feel indignant at the course pursued towards me. Men professing to be astronomers, have not only asserted their determination to use my invention, not only without my permission, but without giving me the least credit; but they have endeavored by all means in their power to belittle my claims, and to defeat my political friends in procuring that reward from government which in their opinion was merited.

In the last point it appears they have been unsuccessful. However grateful it may have been to me that my friends in Congress have made themselves fully and particularly acquainted with the subject of my labors, and have procured from such high authority, a decision in my favor, still I have deemed it incumbent on me thus to place in a clear light those points, concerning which I had been informed there had been some misapprehension.

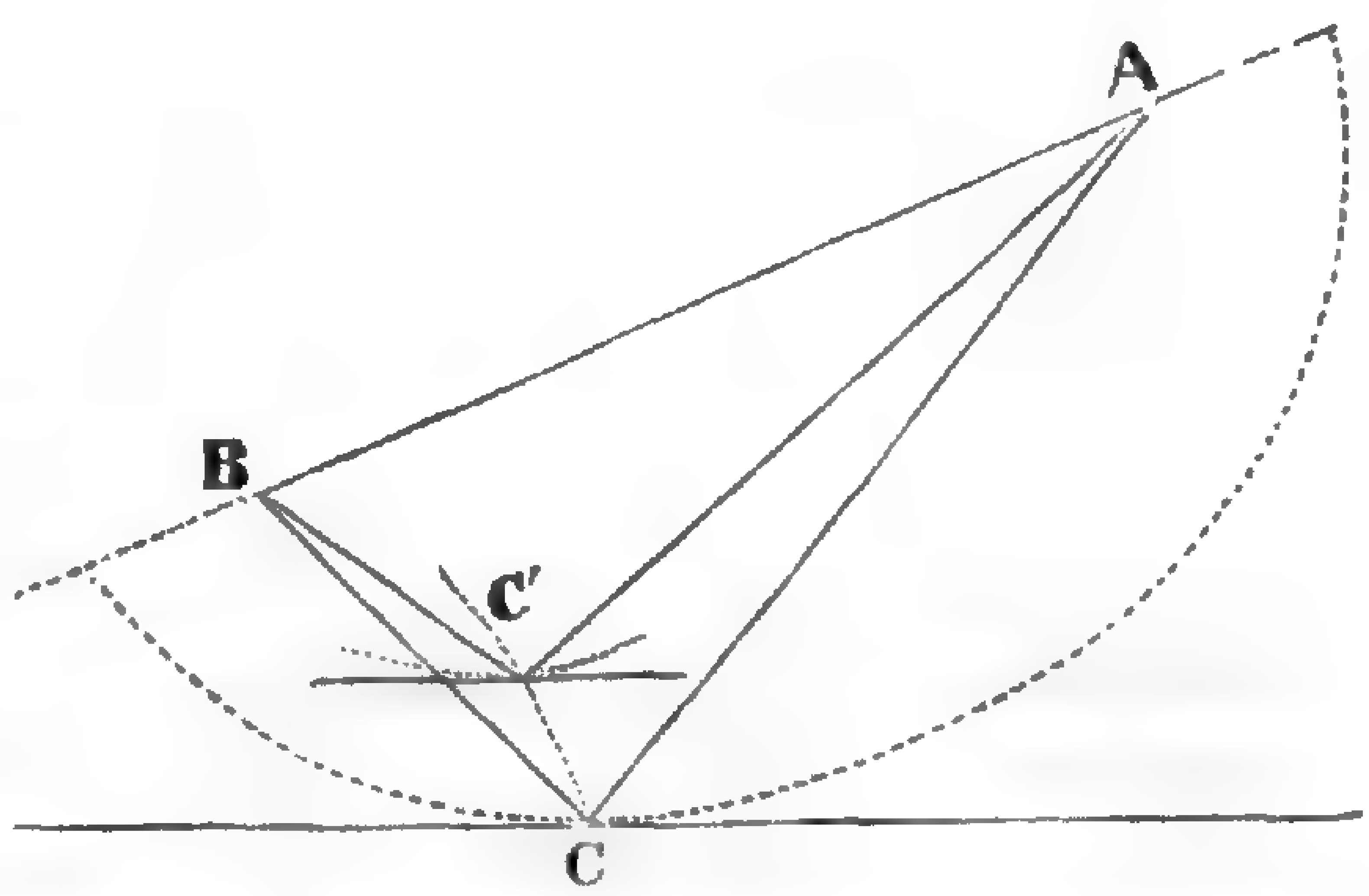
Art. XIX.—*On the Curve described by a Movable Pulley;* by A. Secchi, Prof. of Nat. Philos. and Mathematics in Georgetown College, D. C.

It frequently happens, that many obvious facts remain unconsidered during a long space of time, until attention is drawn to them by mere chance, and I doubt whether this may not be the case with the problem which I now lay before the public. It is a fact, (which has been no doubt often observed,) that the movable pulley when raised, describes a curve; but I am quite uncertain whether any one has determined what kind of a curve is formed. This I discovered almost three years ago, and the result then seemed so simple and evident that I could scarcely believe that no one had ascertained it before: and for this reason I delayed its publication. If the subject has ever been touched by any one, it has never I think been considered on so large a scale as this. In the process of the solution it will be seen that besides the advantage of a mechanical invention, we have in it a hitherto unknown affinity between the ellipse and hyperbola and a new kind of a general mathematical problem.

Problem.—To find the curve described by a movable pulley, when the fixed point and fixed pulley are *not* in the same horizontal line.

Suppose for the sake of simplicity, that both pulleys have an infinitely small radius; so that they may be regarded as points, or what is the same that the pulleys are rings, through which the cord passes without friction.

I.



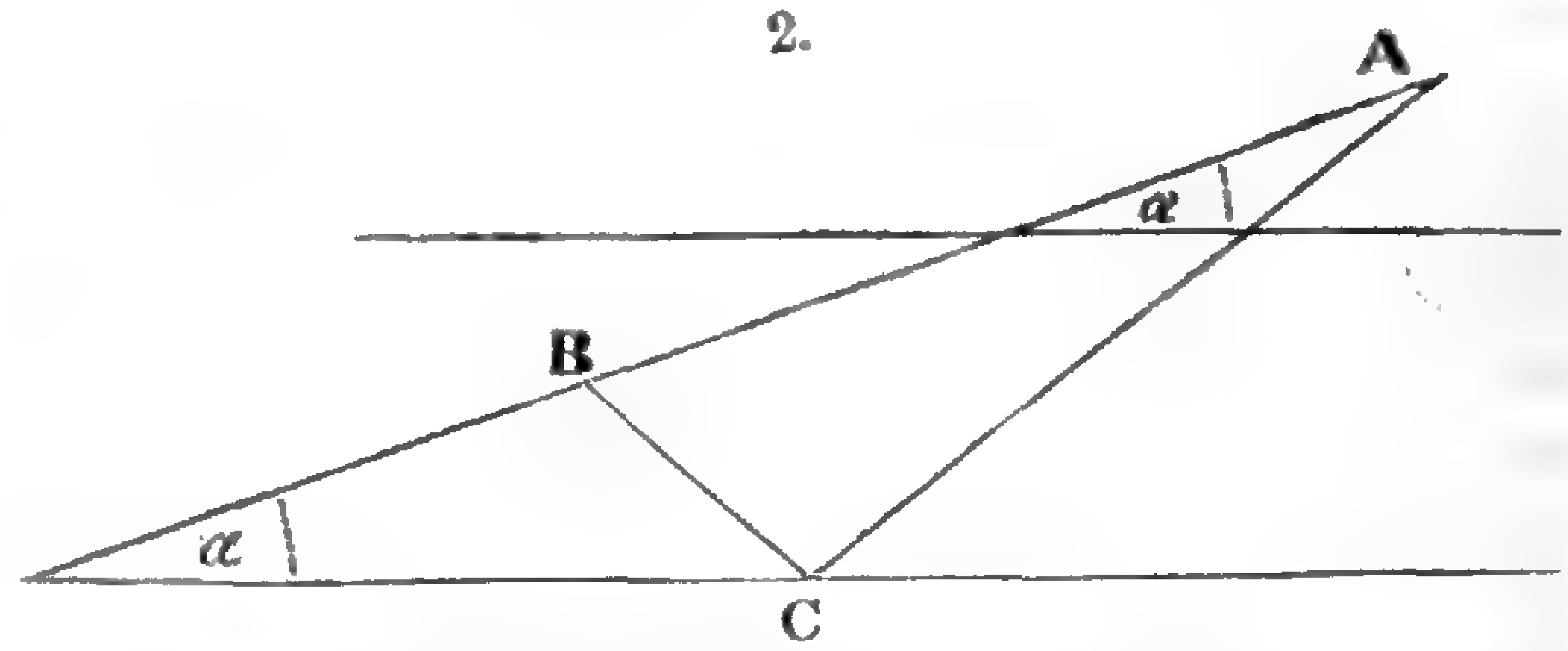
Let A be the fixed pulley, B the fixed point and C the movable pulley. BCA is the cord that suspends the pulley. It is well known by the principles of mechanics—that a pulley or ring, thus suspended, will be in equilibrio, when the direction of gravity is *normal* to the curve it would describe if moved freely along the cord, and always in the same vertical plane. But this curve is an ellipse whose foci are A and B, and whose transverse axis $=AC+CB$; and the line of gravity being vertical, and the lowest point of the ellipse being the only one at which the tangent is horizontal, it follows that the pulley will be in equilibrio only at the lowest point C of the ellipse.

When the cord is pulled, the movable pulley passes successively through other positions of equilibrium which are at the lowest points of ellipses whose foci are A and B, and whose transverse axes are the lengths of the thread from A (through the successive positions of C) to B. These successive positions will therefore be determined precisely as C is determined, and will be on the perimeter of an ellipse of a variable transverse axis and at its point of contact with the horizontal tangent.

By means of these considerations, the proposed problem is reduced to

Finding the locus of all the points of contact between an ellipse and a straight line, the transverse axis of the ellipse being variable; whilst its inclination to the straight line is constant: the distance between the foci being also constant.

2.



To resolve this problem, let us assume the equation of the ellipse

$a^2y^2+b^2x^2=a^2b^2$

or $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1.$ (1)

Calling the distance between the foci $2c$, we have $b^2=a^2-c^2$; —calling the angle of the tangent with the axis α and differentiating (1) we have

$$\tan\alpha=\frac{dy}{dx}=-\frac{b^2x}{a^2y}=-\frac{(a^2c^2)x}{a^2y}=m \quad . \quad . \quad . \quad (2)$$

which being constant we place equal to m.

We may now combine (1) and (2) eliminating a

From equation (1) we get—

$$y^2=\frac{b^2}{a^2}(a^2-x^2)=\frac{(a^2-c^2)}{a^2}(a^2-x^2)$$

from (2):

$$\frac{a^2-c^2}{a^2}=-\frac{my}{x}, \text{ and } a^2=\frac{c^2x}{my+x}.$$

These in the last equation give

$y^2-x^2+yx\left(\frac{1-m^2}{m}\right)+c^2=0$, which is the equation required—(3).

Comparing this with the general equation of lines of the second order

$$Ay^2+Bxy+Cx^2+Dy+Ex+F=0$$

we find $B^2-4AC=\left(\frac{1-m^2}{m}\right)^2+4>0.$

Hence the curve described by the pulley is a hyperbola whose centre is the centre of the ellipse, and whose axis is inclined to the axis of the ellipse.

To determine this inclination and thereby the position of the hyperbola, let ω represent this angle. Then the equations of transformation from one set of rectangular axes to another, the origin being the same, are

$$x=x'\cos\omega+y'\sin\omega\ldots.. \text{ and } y=y'\cos\omega-x'\sin\omega\ldots..$$

These values of x and y substituted in (3) which may be transformed into

$$y^2-x^2+\frac{2}{\tan 2\alpha}xy+c^2=0 \left(\text{because } \frac{1-m^2}{m}=\frac{1+\tan^2\alpha}{\tan\alpha}=\frac{2}{\tan 2\alpha}\right)$$

will give

$$\left.\begin{array}{l} y'^2\left(\cos^2\omega-\sin^2\omega+\frac{2\cos\omega\sin\omega}{\tan 2\alpha}\right)+x'^2\left(\sin^2\omega-\cos^2\omega-\frac{2\cos\omega\sin\omega}{\tan 2\alpha}\right) \\ +2x'y'\left(\frac{\cos^2\omega}{\tan 2\alpha}-\frac{\sin^2\omega}{\tan 2\alpha}-2\cos\omega\sin\omega\right)+c^2=0\ldots.. \end{array}\right\}(4)$$

which will be the equation of the hyperbola referred to its centre and axes, if $\frac{\cos^2\omega}{\tan 2\alpha} - \frac{\sin^2\omega}{\tan 2\alpha} - \sin\omega\cos\omega = 0.$
or (clearing fractions and dividing by $\cos^2\omega$) if

$$\tan^2\omega + 2\tan 2\alpha, \tan\omega - 1 = 0, \text{ whence}$$

$$\tan\omega = -\tan 2\alpha \pm \sqrt{1+\tan^2 2\alpha} = -\tan 2\alpha \pm \sec 2\alpha, \text{ or}$$

$$\tan\omega = \frac{\pm 1 - \sin 2\alpha}{\cos 2\alpha}$$

but $-\frac{{}^*1+\sin 2\alpha}{{}^\dagger\cos 2\alpha} = -\frac{2\cos^2(45^\circ-\alpha)}{2\cos(45^\circ+\alpha)\cos(45^\circ-\alpha)} = -\frac{\cos(45^\circ-\alpha)}{\cos(45^\circ+\alpha)}$
$= -\frac{\sin(90^\circ - [45^\circ-\alpha])}{\cos(45^\circ+\alpha)} = -\frac{\sin(45^\circ+\alpha)}{\cos(45^\circ+\alpha)} = -\tan(45^\circ+\alpha)$
in a similar manner we find the first value of $\tan\omega$

$$\tan\omega = +\frac{1-\sin 2\alpha}{\cos 2\alpha} = +\tan(45^\circ-\alpha). \quad \text{Hence}$$

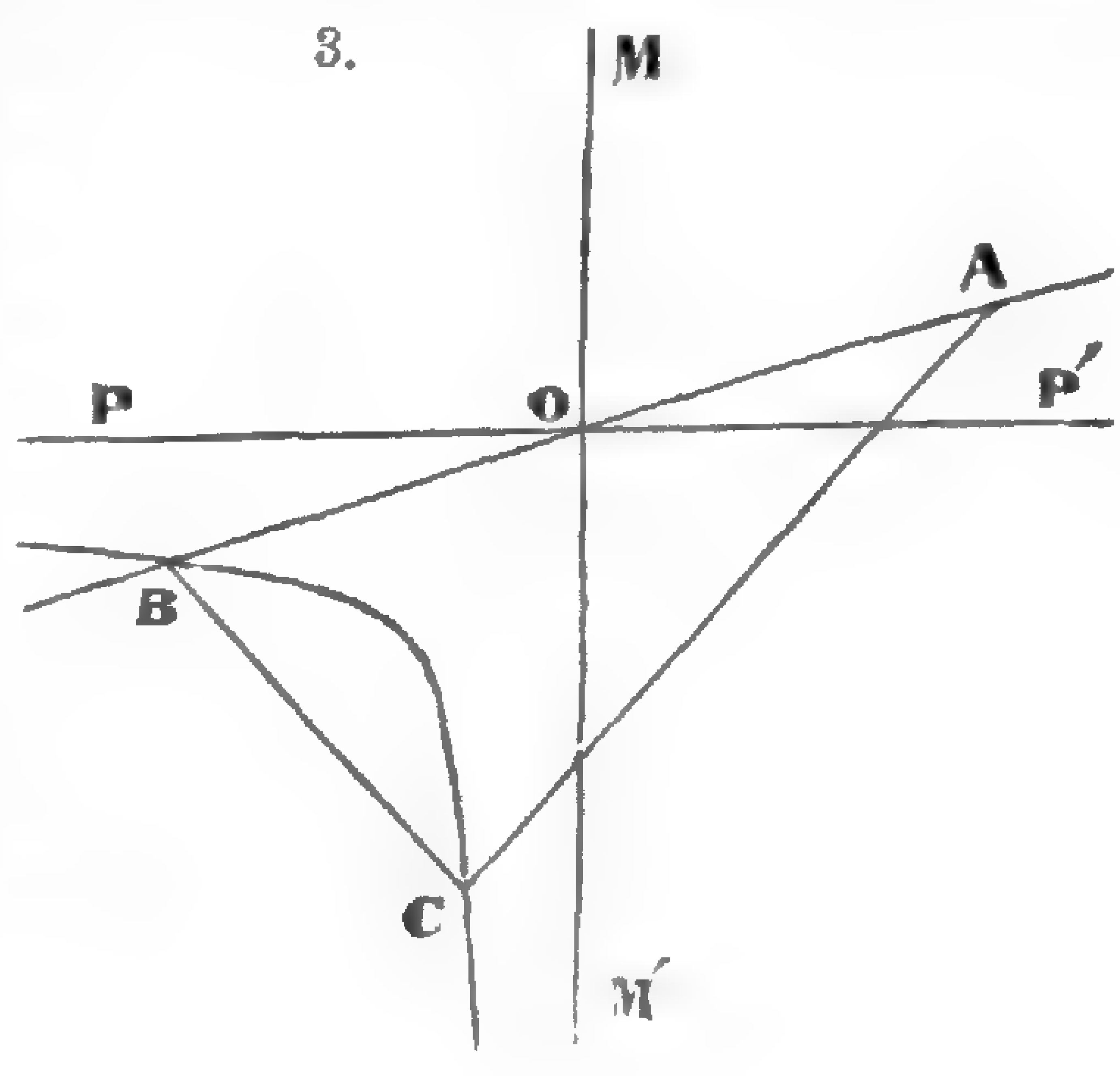
$$\tan\omega = \pm\tan(45^\circ \mp \alpha). \quad \text{Therefore}$$

$$\omega = 45^\circ - \alpha \ldots\ldots \text{or } = 180^\circ - (45^\circ+\alpha).$$

The difference between these two values is 90°. Therefore if the first value is the inclination of the transverse, the second is that of the conjugate axis.

Since α is the angle made by the axis of the ellipse with the horizon, and ω that made by the axis of the hyperbola with that of the ellipse, $(\omega+\alpha)$ is the inclination of the axis of the hyperbola to the horizon. But $\omega+\alpha = (45^\circ-\alpha)+\alpha = 45^\circ$: therefore its axis makes an angle of 45° with the horizon, and is entirely independent of the inclination of the line of the foci to it—which is remarkable.

3.



It may also be shown that this hyperbola is equilateral, and consequently the vertical line MOM′ and the horizontal POP′ are its asymptotes; because, observing that $\sin^2\omega - \cos^2\omega = \cos 2\omega$; $2\sin\omega\cos\omega = \sin 2\omega$, and substituting for ω its value $(45^\circ-\alpha)$, the coëfficient of x'^2 will be reduced to $-\cos 2\omega - \frac{\sin 2\omega}{\tan 2\alpha} = -\sin 2\alpha - \frac{\cos 2\alpha}{\tan 2\alpha} = -\frac{\sin^2 2\alpha + \cos^2 2\alpha}{\sin 2\alpha} = -\frac{1}{\sin 2\alpha}$, and that of y'^2, to .... $+\frac{1}{\sin 2\alpha}$.

* $\text{Sin}(45^\circ+\alpha) = \sqrt{\tfrac{1}{2}}(\cos\alpha+\sin\alpha)$; squaring, $2\sin^2(45^\circ+\alpha) = \cos^2\alpha + \sin^2\alpha + 2\sin\alpha\cos\alpha = 1+\sin 2\alpha$. Hence $1+\sin 2\alpha = 2\sin^2(45^\circ+\alpha) = 2\cos^2(45^\circ-\alpha)$.

† $2\cos(45^\circ+\alpha)\cos(45^\circ-\alpha) = 2(\sin^2 45^\circ \sin^2\alpha - \cos^2 45^\circ \cos^2\alpha) = 2\cos^2 45^\circ(\sin^2\alpha - \cos^2\alpha) = 2(\sqrt{\tfrac{1}{2}})^2\cos 2\alpha = \cos 2\alpha$. Hence $\cos 2\alpha = 2\cos(45^\circ+\alpha)\cos(45^\circ-\alpha)$.

Equation (4) then becomes $\frac{y'2}{c^2 \sin 2\alpha}+\frac{x'^2}{c^2 \sin 2\alpha}=1$ (5)

$\alpha=45^\circ$, gives the greatest axes of the hyperbola.

The principles of this solution may be applied to several other problems of the same kind. If it were proposed, for example, to find the locus of all the points of contact of a straight line with a hyperbola whose foci are fixed, and whose transverse axis varies continually, whilst the tangent to the successive hyperbolas makes a constant angle with the axis.

In the same manner as in the preceding problem, we have:

$\frac{y^2}{a^2}-\frac{x^2}{b^2}=1$ .... $b^2=c^2-a^2$ .... $m=\frac{x(c^2-a^2)}{ya^2}$ .... whence we obtain the same equation (4) and consequently the same curve.

To account for this identity of solution we must remark, that the movable pulley C may be regarded as a point of the hyperbola whose foci are A and B; and the direction of gravity, always bisecting the angle ACB of the lines drawn to the foci, is tangent to the curve at C.

Now this line makes a constant angle with the line of the foci; therefore the curve described by the movable pulley may be determined by finding the locus of the points of contact of a variable hyperbola with a right line making a constant angle with the axis.

This result shows a new relation between these two conic sections which are already well known as kindred.

A new field is now open for many problems of the same description, but perhaps of no very useful application.

As for parabolas whose parameter varies continually and whose equation is, $y^n=px$, we have $m=\frac{dy}{dx}=\frac{p}{ny^{n-1}}$, the resulting locus will be the straight line $y=mnx$.

For ellipses and hyperbolas of higher orders $\frac{y^n}{a^n}\pm\frac{x^n}{b^n}=1$ the solution will be an equilateral hyperbola of the same species. This when $b^n=a^n\mp c^n$; and $\alpha=45^\circ$ (which makes $m=1$) is $\frac{x^n}{c^n}-\frac{y^n}{c^n}=1$.

For the curve $(x^2+y^2)^2=a^2y^2+b^2y^2$, (which is that of the orthogonal projection of the centre of the ellipse on the tangent) we find

$$x^2+y^2=c^2y\left(y+\frac{m}{x+my}\right)$$

supposing between a, b, and c, the same relation as in the ellipse.

For the circle, m being independent of r, the problem is indeterminate: but it will be easily understood—that the locus is a right line coinciding with the radius continually diminishing.

The practical application of this problem may sometimes be interesting: because by settling conveniently the fixed point and the fixed pulley, a body can be raised and transported to a new position, without the use of complicated machinery.

For this purpose let the body rest at C, and suppose we wish to transport it to m. Regarding the pulley and body as points, the question is reduced to finding an equilateral hyperbola passing through the points C, m, and B. The angle α, c, and the position of the centre must be determined with regard to the point C.

Let u and v be the coördinates of the point C: and through this point take two rectangular axes cx', cy', one parallel to the horizon and the other perpendicular to it; u and v will also be the coördinates of the centre O of the hyperbola relatively to point C. Since the axis of the equilateral hyperbola (see (5)) makes an angle of 45° with the horizon, the equations of transformation to the point C will be

$x=u-(x_1+y_1)\sqrt{\tfrac{1}{2}}$....

$y=v-(y_1-x_1)\sqrt{\tfrac{1}{2}}$

by means of which, (5) becomes

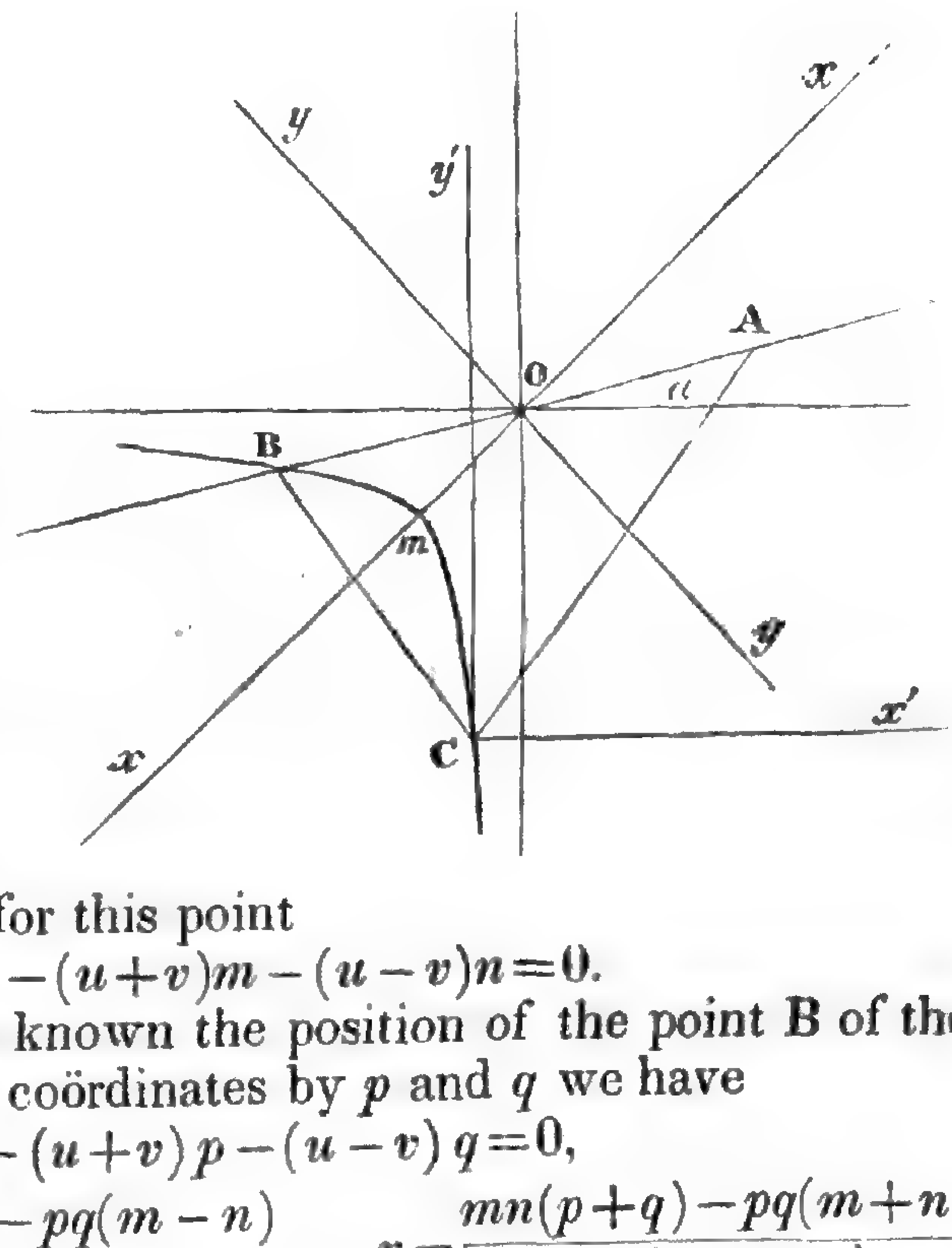
$u^2-v^2-\sqrt{2}(u+v)x_1-\sqrt{2}(u-v)y_1+2x_1y_1=c^2\sin 2\alpha.$

For the point C $x_1=0$ and $y_1=0$, which reduce this to $u^2-v^2=c^2\sin 2\alpha.$ (6)

whilst,

$2x_1y_1-\sqrt{2}(u+v)x_1-\sqrt{2}(u-v)y_1=0.$

4.



If m and n denote the coördinates of the point m we shall have for this point

$$mn\sqrt{2}-(u+v)m-(u-v)n=0.$$

We may also take as known the position of the point B of the curve, and denoting its coördinates by p and q we have

$$pq\sqrt{2}-(u+v)p-(u-v)q=0,$$

whence $u=\dfrac{mn(p-q)-pq(m-n)}{\sqrt{2}(np-qm)}$..... $v=\dfrac{mn(p+q)-pq(m+n)}{\sqrt{2}(mq-np)}$

from these equations we know the value of $c^2\sin 2\alpha$: but c and α remain yet undetermined to the great advantage of practice; because we can choose the inclination or the length of the line AB, according to convenience, provided they satisfy equation (6).

Substituting in (6) the values of u and v just found, the condition is reduced to

$$c^2\sin 2\alpha=2\,mnpq\frac{(n-q)(p-m)}{(qm-mp)^2}$$

the second member of which is entirely known; and any value assumed for c or α, will give the corresponding value of the other.

Art. XX.—*Thoughts on Ancient Metallurgy and Mining in Brigantia and other parts of Britain, suggested by a page of Pliny's Natural History;* by John Phillips, Esq., F.R.S., F.G.S.

(Continued from p. 102.)

Did the Cornish or Gallician miners make bronze? For this is generally the compound indicated by the Roman *æris metalla*, though it is undoubted that they also knew of, and distinguished zinc brass. There is, I believe, no instance of a single bit of pure tin or pure copper being found with the numerous 'celts,' which occur in so many parts of England; nor is any other proof given that the direct union of tin and copper was effected by the natives of Britain. Copper is so abundant in Cornwall that it might tempt to the other hypothesis; but this copper is a sulphuret; it is found united to the sulphuret of iron, in deep veins, and in a matrix of quartz; and these are things which render the production of pure copper one of the most refined operations in smelting. Cæsar tells us the brass used by the natives of Britain was imported. Probably Cyprus,—colonized by the Phœnicians, to which old authors refer as the original source of brass—Cyprus with its ancient copper mines (Tamassus), which has given its name to the metal, might be one of the points from which bronze radiated over the Grecian, Roman and barbarian world. It was from Cinyras, the king of Cyprus, that Agamemnon received his splendid breastplate with twenty plates of tin, and its liberal additions of turquoise, lazulite, or rather malachite, obtained perhaps from the soil of the island. (Pliny, xxxiii, p. 633, Hard.)

The works of Ἥφαιστος, the Crawshay of antiquity, may have been fixed on Lemnos on account of some volcanic appearances there; but the tradition shows at least that the various operations of refined metallurgy were not strangers to the islands of the Mediterranean; and the uniformity of design and composition in the ancient celts, chisels, μάκελλα, and instruments of war, implies a common, and that not a barbarous origin. The perfection and variety and great proportions of the brass work executed in the Grecian states and colonies, may also be regarded as indicating the local seat of the early as well as the later art of working in bronze.

Lead was obtained in Spain and Gaul from deep and laborious mines (xxxiv, p. 669, Hard.), but so abundantly near the surface in Britain as to suggest a law for preventing more than a limited production—a Brigantian law of vend. The Romans employed lead in pipes (fistulæ) and sheets, which were soldered with alloys, as already mentioned. This lead was previously refined, and its silver removed; the silver indeed being often the object of the enterprise. How earnestly silver was sought—how well the mining operations were carried on by the 'old men'—appears from the notice of the Carthaginian mines in Spain, the pits and levels driven by Hannibal being mentioned as in wonderful preservation by Pliny. The same may be said of at least one set of mining works of Roman date, in the extreme parts of South Wales, viz., the Gogofau near Lampeter, where gold was extracted with much labor from broken and pounded quartz, of which enormous mounds remain. The adit still exists, and was lately entered by Sir H. T. De la Beche, who found in it a specimen of native gold. In the vicinity, tradition indicates a Roman settlement; and a massive chain of gold and other remains were found, and are now possessed by the family of Johnes of Abercothi.*

The districts in Britain, where lead veins coming to the surface in abundance might justify the praises of Pliny, are, in the south, Mendip; in the west, Flintshire, &c.; in the north, Derbyshire, Yorkshire and Cumberland, that is to say, the Brigantian territory: and it is to this last district that the descriptions apply most correctly. Lead cast in Roman moulds, pigs, in fact, of the age of Hadrian and other emperors, have been found in Flintshire, Derbyshire, Yorkshire, and some other counties. But few ancient mining instruments have ever been found in the lead-bearing districts of Britain;† and I am strongly of opinion that much of the lead ore was collected from the surface by aid of water, artificially directed. The process, in fact, is described by Pliny in terms so exactly applicable to the modern 'hushes' of Swaledale, that no doubt can remain of this custom, which is now esteemed rude and semi-barbarous, being of Roman or earlier date in Britain.

As thus from Roman or earlier times our lead-mining derives its 'hush,' its levels, and shafts, implements for washing, and other processes of the workmen, and the forms, weights, and marks of its melted metal, we may easily admit a similar origin for the melting process. Lead mostly occurs in the sulphuret, which offers no particular difficulty in the fire. By cautious roasting, its excess of sulphur may be removed, and the subsequent melting with charcoal, or a flux, be facilitated. Indeed without roasting, and without flux in many cases, the lead will flow out of the ore, if placed among flaming wood or peat, and subjected to a sufficient stream of air.

But the use of fluxes could not long remain unknown in the limestone districts of Northumbria, or amid the fluoric veins of

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* See Sir R. I. Murchison's remarks on Gogofau (Sil. Syst., p. 367, 368).

† Sir R. I. Murchison mentions Roman mining utensils at Shelve in Shropshire (Sil. Syst., p. 279).

Derbyshire—limestone and fluor being to this day valuable aids in the furnace. Peat was the fuel in Cornwall, and still is in Yorkshire; and perhaps the Roman smelters did really erect their furnaces on waste ground and heaths at Dacre and Matlock, far from the mines of Greenhow and Youlgreave, even as is done at present with the cupolas of Lee and Langley mills.

The use of crucibles (χόανοι), bellows, cavities of some peculiar sort (κάμινοι), perhaps chimneys, great variety of carbonaceous fuel, the power of purifying and alloying, and knowledge of the properties of alloys, appear quite conspicuous among the ancient arts.

The inscriptions* on these masses of lead are in the same general form as the 'marks' of the different mines now in work, and which, no doubt, are their literal and lineal descendants. Thus the Ald or Auld Gang mine of Swaledale, old in the days of the Saxons; the mines of Greenhow Hill, which supplied sheet and pipe lead for our baths and coffins at York, as well as tribute to the imperial treasury; the mines of Middleton and Youlgreave (Aldgroove), from which the Lutudæ sent not only lead, but 'exargentate' (that is to say refined) lead from which the silver had been removed, use to this day the pig of the same weight of 1½ cwt., of similar shape and similar mark to that of 1800 years antiquity.† And just as at the present day, the countryman whose galloway is tired drops the leaden load by the way side, for another day's work, so in the days of Rome, the Brigantian lead

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* The following inscriptions have been recorded on pigs of lead obtained from British mines during the Roman sway in Britain. It will be remarked that they belong to early imperial times.

IMP. CAES. DOMITIANO. AVG. C. C. S·VII. Found at Hagshaw Moor, Dacre Pasture, near Pately Bridge, Yorkshire, in 1734.

A Roman pig of lead, weighing 126 lbs., was found on Cromford Moor, near Matlock, in the year 1777, having the following inscription in raised letters on the top:

IMP. CAES. HADRIANI. AVG. MET. LVT.

A second was discovered near Matlock in 1783. It weighed 84 lbs., and was 19 inches long at top, and 22 at bottom. Its width at top was 3½ inches, and at bottom 4½. The inscription appears to contain these letters:

L. ARVCONI. VERECVND. METAL. LVTVD.

A third, with the inscription also in raised letters on the top, was found in Matlock Moor in the year 1787. It weighs 173 lbs., and was 17½ inches in length, and at bottom 20½.

TI. CL. TR. LVT. BR. EX. ARG.

Glover's Derbyshire, vol. i, p. 71, 72.

A fourth is stated to have been found at Castleton, on which only the letters IMP could be read distinctly. It was said by Mr. Mawe to be preserved in the museum of Mr. Green at Litchfield.

Sir R. I. Murchison records a Roman pig of lead (from the Shelve mines in Shropshire probably), bearing the inscription, IMP. ADRIANI. AVG. (Sil. Syst., p. 279.) This pig is said to be unlike the modern pig.

† The modern pig is made near to $\frac{2820}{16}$ of a fodder or 176¼ lbs. Three Roman pigs found near Matlock in 1777, 1783, 1787, weighed 173, 126, and 84 lbs., these being as 1, ¾, and ½ of the modern pig.

was thrown down from the tired caballus by the side of the ancient mining road, on Matlock Moor in Derbyshire, and Dacre Pasture in Yorkshire.

This fact of the discovery of the Roman lead, ***not at the mines***, but at a distance of some miles from them on a track leading ***towards*** a Roman or rather a Pre-Roman station, is of much importance in archæology. For thus we arrive, in the first place, at the conviction of the existence of very ancient mining roads not of Roman work, nor probably of Roman but of earlier date, leading toward Cataractonium, Isurium, Eburacum, Mancunium, Derventio, or rather to the Brigantian towns or centres of trade, on which the Romans following their wont in Africa, Spain, and Gaul, fixed their attention and established their war camps and their colonies. The politic lords of the world broke up no national industry, set no legionaries to supplant the native miners, but stationing a few cohorts on the ancient roads, in or close to the mining district, as at Hope and Bainbridge, to control a rude population, received regularly the fruits of the industry which they might direct, but did not personally share. Viewed in this light, how complete appears the grasp of the Roman treasury on the mining fields of Britain! The Fossway from the Ocrynian promontory crosses the Mendip Hills—the road from Mancunium to Bremetonacum traverses the Calamine district of Bowland—the road from Derventio or Tutbury to Mancunium runs along the west of the great Derbyshire field, and the legionary path from Carlisle to York goes right across the metalliferous country of Yorkshire and Durham.

We may even ask with some confidence, whether the line of the Hadrian wall, which cuts off from the north all the richest mines of the Derwent, the Allen, and the Tyne, but abandons the mossy dales of bleak Northumbria, was not drawn with especial reference to the mining wealth of the districts.

May we not regard, as a confirmation of all that has been advanced touching the antiquity of our mining processes, the fact of the existence to this day, though impaired by recent acts of parliament, of peculiar rights and privileges in the mining districts? These rights are sometimes guaranteed by and appear to emanate from royal charters, as in the stanneries of Cornwall and Devon, but they are probably of far earlier date, and have merely been confirmed as old customs by John and his successors. In Mendip, the Forest of Dean and Derbyshire, the miners' rights were preserved by royal officers, but the rights themselves transcend all history and tradition. To sink a pit or drive a level in any field; to cover the rich herbage with barren ore-stuff; to cut a way to the public road; to divert, employ, and waste the running waters; and to do all this without consent of owner, and without compensation being so much as asked by lord or villein, landlord or tenant, implies in Derbyshire a settlement of mining rights long anterior to Domesday Book, the charters of Repton Abbey*, the neighing of the Saxon horse, and the flight of the Roman eagle. In connection with all that has been mentioned before,—the furnaces, the roads, the restricted vend, the foreign trade—they seem to me to indicate a people who came with many inventions from the metalliferous east to the metalliferous west, before the Athenians drew silver from Laurion, or the Carthaginians from Iberia.

To these ancient, these Semitic mining processes we have added perhaps steel instruments, and certainly explosive agents; the ore-hearth still remains, but it is generally yielding to the reverberatory furnace; silver is no longer obtained by oxydation of some thousand times its weight of lead; steam blows our furnace fires, rolls and pipes our metals, and flies with iron wings on roads more solid than the Appian Way. The world of George Stephenson is much different from that of Julius Agricola; but some features of the past remain to connect the earliest with the latest aspect of our country: and among these the least altered, and the most instructive, appear to be the mineral products and the mining processes. If by these we judge the great Brigantian tribes which surround Isurium, they must be placed far higher on the scale of civilization than the place usually accorded by the Saxon to the Celt.

I presume to think, indeed, that without full attention to the mining history of Britain, as indicated by fragments in classic authors, and illustrated by processes not yet extinct, the opinion which may be formed of the ancient British people would be altogether conjectural, derogatory, and erroneous.

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* The mines in the neighborhood of Wirksworth were wrought before the year 714; at which period that district belonged to the nunnery at Repton, over which Eadburga, the daughter of Adulph, king of the East Angles, presided as abbess. In that year the abbess sent to Croyland, in Lincolnshire, for the interment of St. Guthlac, who was originally a monk of Repton, a sarcophagus of lead lined with linen (plumbum lintheumque). This lead was obtained from the possessions of the old Saxon religious establishments at Repton, part of which were the mines near Wirksworth. In the year 835, Kenawara, then abbess of the same nunnery, made a grant to Humbert, the alderman, in which she surrenders that estate of mines, called Wircesworth, on condition that he gives annually, as a rent to Archbishop Ceolnoth, lead to the value of 300 shillings, for the use of Christ's Church, Canterbury. On the destruction of the religious houses by the Danes in 874, it is probable that the lead mines became the property of the Crown. As such they are mentioned in Domesday Book.—*Glover's Derbyshire*, vol. i, p. 73.

SCIENTIFIC INTELLIGENCE.

I. Chemistry and Physics.

1. *On Margaritinic Acid;* by Louis Saalmueller, (communicated for this Journal, by M. Schleiper.)—During my stay in Giessen, I occupied myself with the investigation of castor oil, but from want of time, and material, I was prevented from studying more closely the solid fat acid of this oil. Since that time I have had occasion to procure larger quantities of the sediment deposited from castor oil, which has enabled me to investigate more exactly the qualities of the margaritinic acid. In spite of the great difficulties which offered themselves, in the way of obtaining this acid of a constant melting point, I think I am enabled to state it pretty accurately. From 5 pounds of the above mentioned precipitate, treated according to the method which I have described in my former paper on this subject, (Annalen der Chemie und Pharmacie, vol. lxiv, p. 108,) I obtained only 10–12 grammes of the solid acid. The melting point of the solid acid, free from alkalies, was at first 25° C.; but by more than twenty recrystallizations, I succeeded in getting an acid which melted at 51° C., and which melting point remained constant,—at least, it did not change any more at the three last crystallizations.

Bussy and Lecanu called this acid margaritinic acid, from its pearly lustre. It was obtained as mentioned previously, by saponification of the oil, separation of the fat acids by means of monobasic acid, and mixture of the fluid fat acid with $\frac{1}{3}$ alcohol. By keeping this mixture a longer time at a temperature below the freezing point, the separation of the solid acid commences, but mixed with bicinoleic acid in combination with potassa. To purify the crude acid it is necessary to press it repeatedly between blotting paper, and recrystallize it many times from alcohol, adding small quantities of muriatic acid, to separate the strongly adhering potassa. The white mass swimming on the surface was then filtered off, washed out, pressed between paper and dissolved in strong alcohol; this solution by means of spontaneous evaporation, then deposits the acid in white globular aggregates, sometimes in fine crystallized white shining plates. These crystals dissolve easily in alcohol and ether, have a slight acid reaction and burn with a bright, shining, blackening flame; the remaining coal burns easily without leaving any residue. The acid cannot be distilled without decomposition; the distillate which I obtained, had a melting point of 54° C., was colored yellow, and in the retort there remained a light spongy coal.

The analysis of this acid gave the following numbers:*

I. 0·3525 grm. acid burnt with chromate of lead, gave 1·0025 grm. carbonic acid and 0·4145 grm. water.

II. 0·235 grm. acid gave 0·6715 grm. CO_2 and 0·265 grm. HO.

III. 0·256 " " " 0·7372 grm. CO_2 and 0·2972 grm. HO.

* According to my previous investigations, the melting point, just as well as the amount of carbon of the solid acid, seems to change, in the different sorts of castor oil, which supposition is more strongly confirmed, by my present investigation.

Out of these numbers the following empiric formula for margaritinic acid hydrate may be described:

$$C_{60}\,H_{59}\,O_5.$$

	Calculated		Found.		
			I.	II.	III.
C_{60}	·300	78·43	77·56	77·97	78·54
H_{59}	59	12·85	73·06	12·52	12·90
O_5	40	8·72	9·38	9·51	8·56
$C_{60}H_{59}O_5$	459	100·00	100·00	100·00	100·00

Fused with oxyd of lead it diminished in weight, and gave water on heating it in a test-tube.

The formula of the anhydrous acid would accordingly be—

$$C_{60}\,H_{57}\,O_3\,.$$

and the hydrate:

$$C_{60}\,H_{57}\,O_3+2HO,$$

containing two equivalents of basic water which can be replaced by bases.

Margaritinate of Potash.—This salt was obtained by saponification of the acid with an excess of potassa, which process took place very rapidly; after a few hours' standing, the potash salt separates from the clear filtered soap solution as a soft cake. After washing it with cold water, and pressing it between filtering paper, it dissolves easily in hot alcohol, and separates itself on cooling in small white indistinct crystals. This salt so obtained, was dried over sulphuric acid and in the water bath, but remained unaltered; on analyzing it, the following numbers were obtained:

I. 0·544 grm. potash salt gave 0·168 grm. sulphate of potash =0·090866 grm. potassa.

II. 0·421 grm. potash salt gave 0·137 grm. sulphate of potash =0·07409 grm. potassa.

These numbers conduct to the formula:

$$C_{60}\,H_{57}\,O_3+2KO$$

as results from the comparison of the found and calculated values:

	Calculated.		Found.		
			I.	II.	Average.
1 equiv. marg. acid,	=441	82·40	——	——	——
1 " potassa,	= 94·23	17·60	16·70	17·60	17·15
	535·23	100·00	100·00	100·00	100·00

Margaritinate of Silver.—The best method to prepare this salt, is, to dissolve the margaritinate of potash in alcohol, to dilute the solution a little with water, and to decompose it with a solution of nitrate of silver; it forms a light, white and curdy precipitate, becoming brown, by exposure to the light, more so in drying it over sulphuric acid or in the water-bath. This salt is easily soluble in ammonia and partly so in water and alcohol. By analysis I obtained the following numbers:—

I. 0·1674 grms. silver-salt gave 0·0535 grm. silver.
II. 0·1715 " " " 0·055 " " .
III. 0·161 " " " by combination 0·310 grm. carbonic acid and 0·126 grm. of water.
IV. 0·1845 grm. silver-salt gave 0·3561 grm. carbonic acid and 0·1445 grm. water.

According to these values, the following formula is calculated for the silver-salt:

$$C_{60}H_{57}O_3+2AgO.$$

	Calculated.		Found.	
			I and III.	II and IV.
60 C	360	53·48	52·51	52·62
57 H	57	8·47	8·69	58·70
3 O	24	4·58	4·47	4·16
2 Ag O	232	34·47	34·33	34·52
$C_{60}H_{57}O_3+2AgO=$	673	100·00	100·00	100·00

The slight loss in carbon will be easily accounted for, when the small quantity of substance which I was enabled to submit to analysis is taken in consideration.

Margaritinate of Barytes.—Notwithstanding all the pains I took, I did not succeed in obtaining this salt of a constant composition. The precipitates partly obtained by decomposition of a watery solution of the soap with chlorid of barytes, partly by precipitating the alcoholic solution of the potash salt in the same way, formed a white, curdy, voluminous mass, soluble in alcohol and ether, insoluble in water, and which was not altered by exposure to a temperature of 100° C.

Margaritinic ether was easily produced by introducing a stream of hydrochloric acid gas into an alcoholic solution of the acid in question; the ether separated at the surface of the liquid in yellow oily drops, becoming crystalline in cooling. After having washed them repeatedly with water, they had a melting point of 32° C. The quantity obtained was too small to allow of an organic analysis.

2. *On some New Phenomena of Light and Actinism;* by Mr. Hunt, (Proc. Roy. Soc., Athen., No. 1122.)—The chemical change produced in chlorid of silver when exposed to the action of the sun's rays, by which powerful chemical affinity is broken up, chlorine liberated and silver in a state of fine division left, was selected as an exemplification of the actinic force, which was the subject of consideration. This chemical change takes place in white light, and hence all those photographic phenomena which have created so much interest have been referred to luminous power. If, however, we examine the conditions of light as analyzed by the prism,—presenting not seven colored bands as stated by Sir Isaac Newton, but *nine* as proved by recent experiments, —it is found that these colored bands possess opposite properties. For instance, the chlorid of silver will not darken in the mean luminous ray of the spectrum, nor will it darken either at the end which gives the greatest calorific effect, or at the end which is embraced by the lavender ray, usually regarded as representing the most chemically active part; consequently we find three points in the spectrum which will not

produce any change in chlorid of silver. Where we have the most light, and at two extremities where the light ceases to affect the human eye, and also laterally bands are exhibited which show the same physical conditions, and thus it would appear that the *circle of light* is not the agent producing this peculiar alteration. Regarding, as appears natural, the ordinary prismatic spectrum as the representation actually of two spectra consisting of but three colors—red, blue and yellow, which is shown by the reappearance of red light in the blue and of yellow light in the lavender ray, which blue light appears again at the least refrangible end in the extreme red or crimson ray, we have an explanation of the result above mentioned, and the want of chemical action is shown to arise from the operation indeed of the most luminous bands. By absorbent media, as colored glasses and fluids, these results were more fully explained. The most remarkable results have, however, been lately obtained by the use of colored media; and it has been shown that every luminous ray, independent of color, may be made to protect chlorid of silver from that chemical change which is induced by the direct action of diffused daylight,—the portion upon which those rays fall being actually preserved as a white space, every other part being blackened. It was contended that no hypothesis of interference would explain this result, which more decidedly proved than had hitherto been done the wide difference between the phenomena of light and actinism. The fact that luminous effect—phosphorescence—was produced by the blue rays of the spectrum appears to oppose this view; but when we find that almost any variety of glass prevents this phenomenon, and that in like manner electricity was interrupted, it appears more rational to refer phosphorescent phenomena to some peculiar electric excitation. The action of the solar rays on the development of vegetable life was then explained, and the following conclusions suggested as the explanation of experimental results frequently repeated:—1. *Germination*, which will take place in the dark, is quickened by the actinic force, and retarded and often stopped by the luminous power.—2. *Lignification*. The decomposition of carbonic acid by the plant is due to some excitement of luminous power and is stopped by the actinic force.—3. *Formation of Chlorophyle*. Due entirely to the luminous rays.—4. *Flowering and Fruiting*. Dependent upon the action of the thermic or parathermic rays of the spectrum, as distinguished from both the luminous and actinic forces.—5. *Motion of Plants*. Bending to the blue light and receding from the red, proving the excitement of actinic force.

3. *On the direct production of Heat by Magnetism;* by W. R. Grove, Esq., (Proc. Roy. Soc., Athen., No. 1131.)—The author recites the experiments of Marrian, Beatson, Wertheim and De la Rive on the phenomenon made known some years ago, that soft iron when magnetized emitted a sound or musical note. He also mentions an experiment of his own, where a tube was filled with the liquid in which magnetic oxyd had been prepared, and surrounded by a coil; this showed to a spectator looking through it an increase of the transmitted light when the coil was electrized. All these experiments the author considers go to prove that whenever magnetization takes place a change is produced in the molecular condition of the substances magnetized; and it occurred to him that if this be the case a species of molecular

friction might be expected to obtain, and by such molecular friction heat might be produced. In proving the correctness of these conjectures difficulties presented themselves, the principal of which was that with electro-magnets the heat produced by the electrized coil surrounding them might be expected to mask any heat developed by the magnetism. This interference the author considers he eliminated by surrounding the poles of an electro-magnet with cisterns of water, and by this means, and by covering the keeper with flannel and other expedients, he was enabled to produce in a cylindrical soft-iron keeper when rapidly magnetized and demagnetized, a rise of temperature several degrees beyond that which obtained in the electro-magnet, and which therefore could not have been due to conduction or radiation of heat from such magnet. By filling the cisterns with water colder than the electro-magnet, the latter could be cooled while the keeper was being heated by the magnetization. The author subsequently obtained distinct thermic effects in a bar of soft iron placed opposite to a rotating permanent steel magnet. To eliminate the effects of magneto-electrical currents, the author then made experiments with non-magnetic metals and with silico-borate of lead, substituted for the iron keepers, but no thermic effects were developed. He then tried the magnetic metals nickel and cobalt, and obtained thermic effects with both, and in proportion to their magnetic intensity. Some questions of theory relating to the rationale of the action of what are termed "the imponderables" and to terrestrial magnetism then were discussed; and the author concluded by stating that he considers his experiments prove, that whenever a bar of iron or other magnetic metal is magnetized its temperature is raised.

4. *Glonoine.*—It is now more than two years since M. Sobrero first announced the discovery of this body by the action of nitro-sulphuric acid upon glycerine.* When a mixture of two volumes of sulphuric acid, sp. gr. 1·838, and one of nitric acid of 1·43, is surrounded by a freezing mixture, and syrupy glycerine is slowly added with constant agitation to prevent an elevation of temperature, it dissolves without any escape of gas. From this solution, water precipitates the new compound in the form of a heavy yellow oil which may be washed without loss, as it is quite insoluble in water. By solution in alcohol and precipitation by water, it is obtained pure with the exception of a little moisture which may be removed by exposing it *in vacuo* over sulphuric acid. It is inodorous, but sweet, pungent and aromatic to the taste. The smallest portion placed upon the tongue was found to produce a violent headache, and the discoverer recommends the greatest care in its preparation. He did not submit it to analysis, but from the mode of its formation, it is probably a nitric species of glycerine.

The physiological action of this substance is most extraordinary; the observations of M. Sobrero having attracted the attention of Dr. Hering of Philadelphia, he with some other medical gentlemen of that city have made a series of experiments with it, upon men and the lower animals.† As the discoverer had not named the new body, Dr. Hering,

* See Chem. Gazette, May, 1847, from Compt. Rendus, Feb. 17th, 1847.

† American Journal of Homœopathy, May, 1849, from which, in part, the following details are taken.

regarding it as a compound of oxyd of glycyl with nitrous acid, proposed for it the name of *glonoine* from the symbols of those substances with the termination *ine;* this is objectionable as tending from a similarity of termination to confound it with the alkaloids, but may serve until farther investigations shall have determined its composition and its real nature. When taken in small doses its effect is an almost immediate acceleration of the pulse with giddiness and a sense of fullness and pressure in the frontal region, followed by a severe headache, which is often confined to the coronal region, sometimes to one side of the head and attended with twitchings of the muscles of the face, throbbing of the temporal arteries, and sometimes a difficulty in articulation. The pain is greatly aggravated by motion and on shaking the head is almost intolerable. These symptoms subside spontaneously in a short time and are often succeeded by a diminished pulse and a feeling of soreness and heaviness about the head.

The most extraordinary feature connected with these observations is the very minute quantity required to produce the effect described. In the experiments of Dr. Hering one drop of the glonoine was placed in a bottle to which 5000 globules of milk-sugar were added, and by agitation the whole were impregnated. The number of these globules required to produce the symptoms above described is from 5 to 20, 50 and in some individuals 200. The majority of persons experience the symptoms in a marked degree, after having taken $20 = \frac{1}{250}$th of a grain, and many susceptible subjects are painfully affected by $5 = \frac{1}{1000}$th of a grain. The lower animals are less sensible to its action; ten drops were required to destroy a frog; four drops given to a cat produced convulsions, but the animal recovered; another cat was killed by three drops. The strongest dose taken by a man has been $\frac{1}{10}$th of a drop. Common coffee is found to be an antidote to the unpleasant effects of an over dose.

A substance of such unexampled potency in its action upon the human system, can scarcely be without use in the treatment of disease, and Dr. Hering with several other of the homœopathic physicians in Philadelphia is at present occupied in proving it by a careful examination of the various symptoms produced by it under different circumstances and in different doses. T. S. Hunt.

Montreal, May 20th, 1849.

5. *On the Action of Alkalies and Acids upon Aldehyde;* by H. Weidenbusch, (Ann. der Chim. und Pharm., in Chem. Gaz., Jan., 1849.)—That aldehyde was revivified by alkalies,—blackened by sulphuric acid and converted into acetic acid by nitric acid—was the sum total of our knowledge on this subject until the present investigation, the results of which are as follows.

Potash in acting upon aldehyde beside producing the ordinary resin, gives rise to an irritating odor due to a thick yellow oil with an odor of cinnamon. This oil by its rapid oxydation produces a resin different from common aldehyde resin, and containing a large per cent. of oxygen; at the same time the action of alkalies seems to form from the aldehyde, acetic and formic acids.

Action of Acids.—Aldehyde with half its bulk of water and a trace of sulphuric or nitric acid, on cooling to 32°, separates into fine crystals of the metaldehyde of Liebig, and a liquid insoluble in water which when purified proves to be a new modification of aldehyde. The density of vapor is the same as that of elaldehyde; its properties are however different. It is a thin acrid liquid soluble in alcohol and ether, slightly in water, boils at 257° and changes rapidly into a crystalline acid not yet examined. It is quite curious that with heat a trace of sulphuric acid reconverts this modification into common aldehyde. The same acid thus forms the substance and reconverts it as we use a high or low temperature.

Action of Sulphureted Hydrogen.—A large quantity of this gas passed through a mixture of aldehyde and water causes the deposit of a thick oil, with an insupportable garlic odor. To this oil is assigned the formula $C_{12} H_{13} S_7$—or elaldehyde with S instead of O, and united to HS, although the analysis agrees well with this—the oil does not seem to be a definite compound—its boiling point, 356°, continually rises. It absorbs ammoniacal gas and produces thialdine.

From this oil, by exposure to the air, or by the action of acids, is formed a substance called by the author acetylic mercaptan $C_4 H_4 S_2$, or aldehyde with S_2 instead of O_2. [It is more probably the sulphur species of elaldehyde and from it thialdine is immediately derived by NH_3 replacing S_2. We have noticed a similar garlic odor on the decomposition of thialdine, and it is not improbable that with an excess of sulphureted hydrogen, both substances may be formed at the same time.]

G. C. Schæffer.

6. *On an Organic Compound containing Arsenic;* by Prof. Wöhler, (Liebig's Annalen in Chem. Gaz., Feb., 1849.)—Dry distillation of a mixture of butyrate of potash and arsenious acid, produced a liquid, which when purified strongly, resembled alcarsin in odor and other properties, but did not ignite spontaneously. The experiment was considered to prove the formation of alcarsin or some analogous compound.

G. C. S.

7. *On Liquid Protoxyd of Nitrogen;* by M. Dumas, (Comptes Rendus, Nov., 1848.)—The apparatus used for liquefying this gas, was the forcing pump of M. Natterer of Vienna, strengthened by a belt of wrought iron, and supplied with a contrivance for cooling the body of the pump and even the piston rod, by the circulation of cold water. Thus arranged, the apparatus is capable of condensing, in two hours, 200 litres (53 gals.) of the gas, which must be pure and quite dry. The condensation of 20 litres produces the pressure of 30 atmospheres, the remainder furnishes the liquid. Two pounds of nitrate of ammonia are sufficient for the experiment.

The liquid may be retained in the reservoir for one or two days with but trifling injury to the valve. The first portion which is allowed to escape becomes solid, the remainder and larger part is liquid and may be kept in the air half an hour or longer. Protoxyd of nitrogen is thus found as a clear colorless very mobile liquid; every drop that touches the skin produces a severe burn; metals dropped into it hiss like red hot iron; quick-silver is instantly frozen, as are also sulphuric and nitric acids; ether and alcohol are not frozen by it; water is instantly frozen and produces by sudden evaporation of the liquid, a sort of explosion.

Potassium, phosphorus, sulphur, iodine and charcoal, float upon this liquid without change. Ignited charcoal floats and burns with great brilliancy. G. C. S.

8. *On Anhydrous Nitric Acid;* by M. Deville.—This remarkable substance is obtained by a simple process. Perfectly dry chlorine is passed over equally dry nitrate of silver; no action takes place at ordinary temperatures, but the nitrate must be heated at first to 203° F. and then lowered to 140°–150°; the decomposition then proceeds quite regularly. At first hyponitrous acid is formed, but on lowering the temperature the new substance is deposited in crystals, in the cooled part of the apparatus, although a cold of 6° was employed to condense the vapors, the crystals were found to form when ice alone was used. The vapor of the anhydrous nitric acid penetrates caoutchouc tubes with such ease, that it is necessary that all parts of the apparatus through which it passes should be solidly joined at the blowpipe. Colored vapors are given off throughout the operation and the decomposition does not seem to be quite definite.

The *anhydrous nitric acid* forms large, brilliant, colorless crystals in six-sided prisms of the trimetric system. The melting point is 85°, the boiling point 113°. With water much heat is evolved and solution takes place without the escape of gas; the solution forms nitrates. Decomposition takes place so near the boiling point of the crystals that the density of the vapor cannot well be determined.

On attempting to recrystallize the substance in a sealed tube in which it had been suffered to liquefy, a violent explosion took place. Probably the substance had decomposed gradually into hyponitric acid and oxygen, and the tension of the latter caused the accident.

[The claims of this remarkable substance, to the name of *anhydrous nitric acid*, seem somewhat doubtful, although there can be no doubt as to its composition. The further investigations of M. Deville may give us new light.

In some investigations of M. Kuhlman on the action of the anhydrid of sulphuric acid on nitric acid, a reaction took place closely resembling that above described, and *white* crystals were formed which seem not to have been examined. Having merely an abstract of the paper before us, it is impossible to decide whether these were identical with the anhydrous nitric acid of M. Deville, or only a compound of sulphuric and nitrous acids.] G. C. S.

9. *On the Composition of Stearic and Margaric Acids;* by Messrs. Laurent and Gerhardt, (Comptes Rendus, March, 1849.)—The composition usually assigned to these acids, makes them two different oxyds of the radical, analogous to the arrangement in hyposulphuric and sulphuric acids—the acids are supposed anhydrous.

The authors were led to doubt these formulas, because the acids have a strong resemblance in their physical properties, their metamorphoses under various reagents are identical, and moreover the formula assigned to stearic is at variance with the well known principles laid down by the authors.

The results of experiment showed, as has generally been allowed, that the atomic weight of the two acids is the same. Seven analyses of stearic acid derived from four different sources gave results strikingly concordant and affording exactly the formula for margaric acid, $C_{34} H_{34} O_4$ ($C_{17} H_{34} O_2$, Ger.)

The statement of Chevreul, that stearic acid may be distilled without change, is also confirmed. If the melting point is changed in the product, it is owing not to a decomposition but merely to a molecular change.

This discovery which places stearic and margaric (metastearic) acids in the same relation with tartaric and racemic (metatartaric) acids, greatly simplifies the whole of a hitherto intricate subject, explains the identity of margarone and stearone, &c., and above all, does away with the difference between the fat of man and the pig and that of other animals, a result highly important to physiology. G. C. S.

10. *On Caprylone;* by G. Gückelberger, (Liebig's Ann., Feb., 1849, in Chem. Gaz.)—This is a new body of the acetone series—obtained from the baryta salt of the caprylic acid from cocoanut oil. In forming this and the similar bodies, the decomposition is not always simple, but in the case of caprylone an excess of hydrate of lime with the baryta salts, raised rapidly to a red heat, was found to furnish the purest product. By pressure in filtering paper, washing with cold alcohol and crystallizing from hot alcohol, caprylone may be obtained in a state of purity. It is white like wax in appearance and smell, insoluble in water, soluble in ether and oils, and even to some extent in cold alcohol. Boiling alcohol and pyroxylic spirit dissolve large quantities. It melts at 104°, solidifies at 100°, and boils at 352° without decomposition.

Caprylic acid being $C_{16} H_{16} O_4$, caprylone is given by the author as $C_{15} H_{15} O$: it should be $C_{30} H_{30} O_2$, to agree with acetone as referred to 4 volumes of vapor,—acetic acid being $C_4 H_4 O_4$, acetone $C_6 H_6 O_2$ (Dumas). G. C. S.

11. *Composition of Bone Earth;* by Dr. W. Heintz, (Berlin Bericht, Feb., 1849, in Chem. Gaz.)—On the authority of Berzelius, the phosphate of lime in bones has usually been stated as $8CaO, 3PO_5$—but others have doubted the accuracy of this rather extraordinary formula.

On examination, Dr. Heintz found the carbonic and phosphoric acids insufficient to combine with all the lime and magnesia. This excess of base was exactly accounted for on estimating the fluorid of calcium—on subtracting this and the carbonate of lime, the remaining lime and magnesia were found to represent the ordinary tribasic phosphate $3RO, PO_5$. No iron was found in the bones exhausted with water, its supposed presence in bone arising probably from the coloring matter of the blood. G. C. S.

12. *On the reaction of Iron and Zinc with Anhydrous Sulphuric Acid and with Sulphates;* by A. D'Heureuse, (Poggendorff's Ann. in Chem. Gaz.)—With anhydrous sulphuric acid at a red heat, iron is converted into a mixture of proto-, and per-oxyd and proto-sulphate. Zinc is also converted into oxyd and sulphuret.

With sulphate of potash at a red heat, iron produces a complete decomposition of the sulphuric acid, and the residue contains oxyd and sulphuret of iron with caustic potash; no sulphuret of potassium is formed. Pure caustic potash cannot, however, be obtained by this process as on solution in water some sulphuret of iron is taken up. The author states, however, that crude carbonate of potash may be freed from sulphur by fusing in the finely divided iron.

With zinc, sulphate of potash produces sulphuret of potassium and oxyd of zinc. With sulphate of soda, the reaction of zinc and iron is similar to that stated above.

Sulphate of baryta is decomposed into sulphuret of barium and more readily than by charcoal; the whole cannot, however, be extracted by hot water.

The following process is said to furnish very good chlorid of barium. Heat to redness two parts sulphate of baryta, two of iron, and one of chlorid of calcium—reduce the mass when cold to powder—and exhaust by boiling water, add a few drops of muriatic acid and evaporate. Too high a temperature is injurious.

Zinc treated with sulphate of baryta furnishes a compound not easily acted on by hot water.

The decomposition of sulphate of strontia requires a much higher heat, but is otherwise similar to that of the baryta salt. G. C. S.

13. *Hydrated Valerianate of Zinc.*—Wittstein has found that this salt when prepared from carbonate of zinc, poured into a part of the water into which the requisite quantity of acid is stirred—is no longer anhydrous, but contains 12 equivalents of water or 44·5 per cent., which it loses at 212°. This observation is important, as this valuable medicine may be given in but half the quantity intended. The two salts are moreover said to be identical in appearance. G. C. S.

14. *On the Passage of Hydrogen gas through solid bodies;* by M. Louyet.—This author, in a communication to the Brussels Academy, has shown that hydrogen gas passes with facility through paper and also gold and silver leaf. On directing a stream of the gas against one side of the leaf it may be lighted on the other.

15. *On Emulsine;* by B. W. Bull.—In the memoir by Mr. Bull in this volume, the formula is given, page 86, as $C_{36}\,H_{35}\,N_4\,(O+S)_{24}$. After the manuscript was sent from Giessen, as the author writes, he was led by the advice of Liebig to change it to $C_9\,H_9\,N\,(O+S)_6$,—which is one-fourth the above with a slight change in the hydrogen—and it is thus printed in Liebig's Annalen. This formula gives the calculated percentage,

C_9	43·20
H_9	7·20
N	11·20
S+O	38·40=100

From a calculation by Strecker the proportion of sulphur is expressed by the formula $10\,(C_9\,H_9\,NO_6)+S$.

II. Mineralogy and Geology.

1. *On Chloritoid and Masonite;* by J. D. Whitney, (Proc. Bost. Soc. Nat. Hist., Jan., 1849, p. 100.)—The true chemical composition of the substance called chloritoid is a matter of some uncertainty. Bonsdorff, who, according to G. Rose, undoubtedly analyzed the real

chloritoid, in which water was an essential ingredient, gave as the result of his analysis,

$$(\dot{Fe}, \dot{Mg})^3 \dddot{Si} + \dddot{\mathbf{Al}}^2 \dddot{Si} + 3\mathbf{H};$$

the ratio of the oxygen of $\dot{R}$, $\dddot{\mathbf{Al}}$, $\dddot{Si}$ and $\mathbf{H}$, being 7·88 : 16·61 : 14·27 : 6·17, for which he adopted the ratio 3 : 6 : 6 : 3. Rammelsberg has taken the ratio as **3 : 6 : 5 : 2**, and gives for the formula of this mineral

$$3\dot{R}^3 \dddot{Si} + 2\dddot{\mathbf{Al}}^3 \dddot{Si} + 6\mathbf{H},$$

which requires

$$\dddot{Si}\ 25·18,\ \dddot{\mathbf{Al}}\ 23·61,\ \dot{Fe}\ 85·31,\ \mathbf{H}\ 5·88 = 99·98.$$

Erdmann has analyzed a mineral supposed to be the chlorite-spar or chloritoid described by Fiedler, and gives as the result of two analyses, agreeing closely with each other, the formula,

$$\dot{Fe}^3 \dddot{Si} + \dddot{\mathbf{Al}}^3 \dddot{Si}.$$

The substance analyzed by Erdmann did not contain water, and there seem to be two distinct substances, one of which is a hydrous silicate, and the other anhydrous. That the analysis of Bonsdorff was probably correct, is shown by the following analysis of the mineral described by Jackson as Masonite, which I find to have the same composition as the chloritoid of Bonsdorff, which it closely resembles in external characters.

The results of an analysis of Masonite were as follows:

		Oxygen.	Ratio.
Silica	28·27	14·55	3·2
Alumina	32·16	15·02	3·3
Protoxyd of iron . . .	33·72	4·49	1·6
Magnesia	·13		
Water	5·00	4·44	1·
	99·28		

The ratio of $\dddot{Si}$, $\dot{Fe}$, $\dddot{\mathbf{Al}}$, and $\mathbf{H}$, being nearly 6 : 3 : 6 : 2, the formula will be

$$\dot{Fe}^3 \dddot{Si} + \dddot{\mathbf{Al}}^2 \dddot{Si} + 2\mathbf{H},$$

which is that given by Bonsdorff for chloritoid, with one atom of water less, which we may easily conceive to have been stated too high, if the mineral had not been carefully dried, especially as there is an excess of 1·6 per cent. in the analysis.

The formula given above requires

$$\dddot{Si}\ 28·56,\ \dddot{\mathbf{Al}}\ 32·06,\ \dot{Fe}\ 33·60,\ \mathbf{H}\ 5·60 = 100·02.$$

This, it will be seen, agrees very nearly with the results of analysis; I would therefore suggest that the name of Masonite should be retained for the hydrous chloritoid, as the formula given by Erdmann has been generally adopted for what is supposed to be the real chloritoid.

2. *Black Oxyd of Copper of Lake Superior;* (Ib., p. 102.)—Mr. Whitney made some remarks on the remarkable vein of black oxyd of

copper which was formerly worked at Copper Harbor, Lake Superior, but which was abandoned after some forty or fifty thousand pounds of this very valuable ore had been raised. It was the only vein of this substance, and perhaps the only locality known in the world, and specimens will be highly prized by the mineralogist hereafter. The substance called copper-black, and sometimes black oxyd of copper, which occurs in an earthy, pulverulent form, is not to be confounded with the pure oxyd of copper found at Copper Harbor. Copper-black is a mixture of various hydrated oxyds, especially of iron, manganese, and copper, of which the latter forms but a small portion; it occurs in an incrustation on other ores of copper, and is evidently the result of their decomposition. Semmola, however, has described a substance occurring in small tabular crystals, belonging to the hexagonal system, which, according to him, are pure oxyd of copper, $\dot{Cu}$. To this substance he has given the name of Tenorite. The oxyd of copper found at Copper Harbor is generally compact, though the purer specimens have a crystalline structure. Mr. Teschemacher has, however, two specimens, which he has kindly allowed me to examine, in which this substance is distinctly crystallized in cubes, with their solid angles replaced. The question arises, was the substance described by Semmola as crystallized in the hexagonal system, really $\dot{Cu}$, or is this substance dimorphous?

Some portions of the oxyd of copper from Copper Harbor are almost chemically pure, though it is generally mixed with a little silicate of copper. One of the purest specimens contained only 1·2 per cent. of impurities, mostly silica, with traces of lime and iron.

As the oxyd of copper of this remarkable vein has not been mineralogically described, the following description is added.

Substance tesseral, crystallized in cubes, with their solid angles occasionally replaced; generally, however, massive, with crystalline structure, sometimes earthy; no traces of cleavage. H.=3; G.=6·25; color, steel-grey to black; lustre, metallic, the earthy varieties acquire a metallic lustre on being scratched or cut with a knife; opaque. Chemical composition $\dot{Cu}$, almost pure; containing copper, 79·86, oxygen, 20·13.

3. *On Arkansite.*—This mineral which Mr. J. D. Whitney makes out to be Brookite, has been examined by Mr. Teschemacher, (Proc. Bost. Soc. N. H., April, 1849, p. 132,) and he gives the following for its angles—see figure in this Journal, vol. iv, p. 279—M : M=100° and 80°. M : c=133° 35′, c : c=135° 45′, a : a=124°. Shepard made M : M 101° to 101° 15′, and a : a 123°. According to the measurements of Mr. Teschemacher, the angles are those of Brookite.

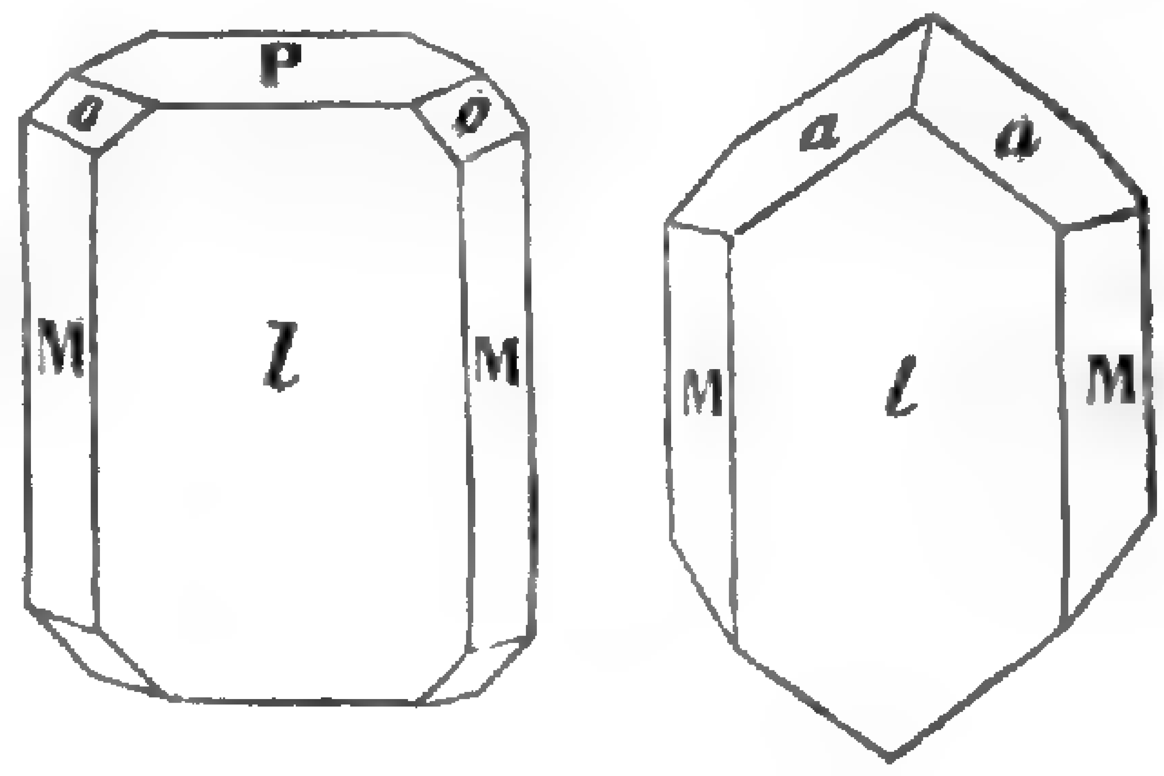
4. *Baïerine*, (L'Institut, No. 793.)—The metal pelopium has been found in the Columbite of Bavaria, by G. Rose, and in that of Limoges by Damour. It is proposed to distinguish this variety of Columbite by the name *baïerine* given it by Beudant. The specimens from these two localities agree well in external characters and in analyses.

5. *Notices of American Minerals;* by Prof. C. U. Shepard, (communicated for this Journal.)—*Pyrophyllite* in beautiful white *stellæ* occurs along with very brilliant and perfect crystals of *rutile* on a soft,

semi-steatitic kyanite at Crowder's mountain in North Carolina; from which region I also possess large masses of deep blue *lazulite* associated in some instances with *topaz;* the latter in distinct crystals.

Brookite occurs in the gold washings of Rutherford county, N. C. Mr. Clingman has supplied me with nearly one hundred crystals, among which I find the following new forms. The angles appended are only approximations.

1. 2.



P on *o* 116° 20′. P on *x* (a plane on the edge P : *l*) 151°. P on M 90°. M on M 100° 45′. M on *l* 140° 30′. M on *o* 151° 40′. *o* on *o* 126° ? *o* on *o′* 78° 0′. *o* on *x* 140° ? *a* on *a* 137° 30′ ?

Monazite.—Crystals of this substance are also abundant in the same situations. They closely resemble the same species from the Urals.

Wavellite.—This mineral has been sent to me by Dr. Pendleton of Athens, Ga. It occurs on a jaspery opal in Washington county near Saundersville, Georgia.

Babingtonite at Athol, Mass. This mineral has been brought to light in the railroad excavations in this town during the past year, in very splendid crystals, associated with epidote, apophyllite, &c.

New Haven, June 20, 1849.

6. *On the existence of Mercury in the Tyrol;* by M. H. Rose, (L'Institut, Fevrier 21, 1849; Lond., E. and D. Phil. Mag., April, 1849.)—M. Weidenbusch, in analyzing in the author's laboratory a specimen of tender gray copper ore, stated to be from Schwarz in the Tyrol, found it to contain a notable quantity of mercury, amounting to 15·5 per cent. This gray copper is mixed with quartz and sulphuret of copper. Its powder is almost black, and has a specific gravity of 5·1075; when heated in a flask, it yields a little metallic mercury with a light reddish-brown sublimate. If it be mixed with carbonate of soda and heated, a large quantity of mercury is obtained. It contains also zinc, iron, antimony and sulphur, and traces of arsenic and silver. These substances exist in it in the same proportions as in other gray copper ores. A crystallized gray copper, also stated to be from Schwarz in the Tyrol, did not contain any mercury.

7. *Mud of the Nile.*—The following analysis of the mud of the Nile, by M. Lassaigne (Journ. de Pharm., t. v, p. 468), is more recent and complete than that given by Lieut. Newbold from Regnault.

Silica,	42·50
Alumina,	24·25
Magnesia,	1·05
Peroxyd of iron,	13·65
Carbonate of lime,	3·85
Carbonate of magnesia,	1·20
Humic acid,	2·80
Water,	10·70
	100·00

III. Zoology.

1. ***Conspectus Crustaceorum quæ in Orbis Terrarum Circumnavigatione, Carolo Wilkes e Classe Reipublicæ Fœderatæ Duce, lexit et descripsit*** Jacobus D. Dana—(Proceedings of the American Academy of Arts and Sciences, Boston, May 4, 1847, vol, i, p. 150–154, and Nov. 8, 1849, vol. ii, pp. 9–61.)—This Conspectus includes descriptions of 183 new species of Entomostraca, collected by Mr. James D. Dana during the cruise of the Exploring Expedition. We here cite the descriptions of the genera and families introduced, as they contain some modifications of those received, and mention only the names of the new species included in the Conspectus under each genus. As elsewhere stated, the full Report on the Crustacea of the Expedition is in course of preparation and will be illustrated by drawings of these and the other new species collected.

Ordo 2. ENTOMOSTRACA.

Subordo 1. GNATHOSTOMATA.*

Tribus I.—CRUSTACEA CYCLOPACEA (vel Copepoda).†

Familia I. Cyclopidæ.

Oculi duo simplices tantum. *Palpi* mandibularum maxillarumque breves aut obsoleti. *Sacculi ovigeri* duo.

Genus I. Cyclops.—*Antennæ maris anticæ* subcheliformes aut articulo geniculante instructæ.

Sp. C. brasiliensis, curticaudus, pubescens, MacLeayi, vitiensis.

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* See this Journal, 2nd Ser., i, 225.

† Cyclopaceorum membra sunt:—

Cephalothorax 4–7-articulatus. *Abdomen* 1–6-articulatum, carapace non tectum. *Frons* sæpissimè rostrata, rostro aut simplice, aut furcato, aut transversim emarginato, aut appendicibus instructo.

Oculi duo simplices, pigmento aut connati aut disjuncti; quoque in quibusdam oculi duo coaliti sub capite insistentes; aliis, oculi maximo lenticulo prolato et corneâ latè oblatâ constructi.

Antennæ anticæ 4–28-articulatæ, aut simplices, aut appendiculatæ; *posticæ* 2–5-articulatæ et sæpe ramum ferentes, aliis ad apicem setigeræ, aliis subcheliformes.

Mandibulæ ad apicem dentatæ, sæpius palpigeræ:—membra cephalothoracis ad normam quarta; itaque breviter denominata ct. iv.

Maxillæ duæ (ct. v.) setosæ; sæpe palpigeræ, palpo sive parvulo et vix discernendo, sive setas diffusas ferente.

Maxillipedes (vel Maxillæ, ct. vi.) duo, aliis parvi et parcius setigeri, aliis crassiores et valde setigeri.

Pedes antici (ct. vii) duo simplices, aut obsolescentes aut elongati, aliis setigeri, aliis subcheliformes.

Pedes biremes decem (ct. viii, ix, x, xi, xii); octo anteriores sæpius natatorii, sed duo antici interdum subprehensiles; duo posteriores plurimum obsoleti aut parvuli; in quibusdam masculinis pergrandes et uno ambove prehensiles.

Abdominis ad basin pertinentes sæpissimè *pedes spurii*, sive obsolescentes sive oblongi et setis armati; ad extremum, styli caudales duo, unusquisque 4–6 setis plerumque plumosis instructus.

Cephalothorace *septem*-articulato, ad segmentum primum antennæ quatuor pertinent; ad secundum, mandibula, maxillæ, et maxillipedes (ct. iv, v, vi); ad tertium,

Familia II. Harpactidæ.

Oculi duo simplices tantum. *Palpi* mandibulorum maxillarumque parvuli, aut obsoleti, setis diffusis non instructi. *Sacculus ovigerus* unicus. *Antennæ posticæ* setis habitu digitorum ad apicem instructæ.

Genus I.—Harpacticus. (*Milne Edwards.*)—*Frons* subrostrata, appendicibus nullis. *Antennæ anticæ maris* subcheliformes, aut articulo geniculante instructæ; *feminæ* basi 2–5 articulatâ et quasi flagello curto sæpius minutè 5-articulato compositæ, ad apicem basis appendicem brevem ferentes. *Cephalothorax* 4-articulatus. *Pedes antici* subcheliformes mediocres.

Syn.—Arpacticus, et Cyclopsina partim (C. castor excluso), *M. Edwards.*—Nauplius, *Philippi.*—Canthocarpus, *Westwood.*—Doris, *Koch.*—Canthocarpus et Arpacticus, non Cyclopsina, *Baird.*

Sp. H. virescens, concinnus, sacer, linearis, roseus, acutifrons.

Genus II. Clytemnestra. (*Dana.*)—*Frons* subrostrata, appendicibus nullis. *Antennæ anticæ* flexiles; *maris*, non subcheliformes. *Pedes antici* (ct. vii,) permagni, subcheliformes.

Obs. Non *Arpacticus* Bairdii: *Cyclops chelifer* Arpacticis pertinet. Magnitudo pedium anticorum character genericum non bene validum, nisi pedes pergrandes, quoque pro antennis geniculatis in coitu usitati sunt; ideoque est antennæ *maris* Clytemnestræ non subcheliformes.

Sp. C. scutellata.

Genus III. Setella. (*Dana.*)—*Corpus* angustissimum fere lineare, anticè attenuatum et subacutum, et fronte appendices duas parvulas falciformes subtus gerens. *Antennæ anticæ* flexiles, appendice brevi instructæ, setis brevibus; *maris* non subcheliformes. *Pedes antici* (ct. vii) mediocres aut parvi. *Pedes proximè sequentes* lateraliter porrecti, ad apicem breviter setigeri. *Pedes abdominis* elongati et longè setigeri. *Setæ caudales* duæ longissimæ, (in speciebus scrutatis corpore valde longiores, spinulosæ, et strictè appressæ,) reliquæ brevissimæ. (Tubum cibarium sæpius lætè rubrum.)

Sp. S. tenuicornis, longicauda, gracilis, crassicornis, aciculus.

Familia III. Calanidæ.

Oculi simplices; etiam sæpe alii duo inferiores deorsum spectantes. *Pedes mandibulares maxillaresque* articulati et longè setigeri. *Sacculus oviger* unicus. *Antennæ anticæ* elongatæ, non appendiculatæ. *Antennæ posticæ* ad apicem setigeræ.

Genera notis sequentibus distinguenda:—

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pedes quatuor antici (ct. vii, viii); (cephalo-thorace *quadri*-articulato, hæc tota adhuc enumerata ad segmentum anticum pertinent;) ad segmenta sequentia, singulatim, duo pedes biremes, (ct. ix, x, xi, xii).

Mandibula est articulus pedis mandibularis primus, et "palpus" articuli sequentes pedis reliqui.

Setæ antennarum plerumque valent ad species distinguendum, et præcipuè illæ articulorum ultimorum. Articulos 2, 3, aut 4, ultimum præcedentes, *subultimos* sæpe vocamus; et eorum setæ, *anteriores* et *posteriores*, scrutandæ et comparandæ.

- Oculis inferioribus nullis.
  - Antennis anticis nec angulo flexis nec articulatione geniculatis.
    - Pedibus posticis (ct. xii.) non prehensilibus, sæpe obsoletis.
      - Pedibus anticis (ct. vii.) majoribus quam maxillipedes (ct. vi.), lateraliter porrectis, non geniculatis. .... 1. Calanus.
      - Pedibus anticis minoribus quam maxillipedes; maxillipedibus sub corpore geniculatis; abdomine longissimo. .... 2. Scribella.
    - Pedibus posticis elongatis, subulatis, uno subprehensili; pedibus anticis duplo geniculatis, sub corpore gestis, ad apicem deflexis. ...... 3. Euchæta.
  - Antennis anticis angulo levissimè flexis, nunquam articulatione geniculatis; pedibus posticis *maris* prehensilibus. .... 4. Undina.
  - Antennâ *maris* anticâ dextrâ geniculante.
    - Maxillipedibus duplo geniculatis, inflexis, setis longis, nudis. .... 5. Candace.
    - Max. rectis, setis longis, setulosis. .... 6. Cyclopsina.
- Oculis superioribus nullis, inferioribus grandibus; antennâ *maris* anticâ dextrâ geniculante; aliis *Calano* affinibus. .... 7. Catopia.
- Oculis inferioribus et superioribus.
  - Antennâ *maris* anticâ dextrâ non geniculante, ambabus flexilibus, setis diffusis; pedibus posticis parvulis, uniarticulatis. .... 8. Acartia.
  - Antennâ *maris* anticâ dextrâ geniculante; setis non diffusis; pede postico dextro crasso, prehensili. .... 9. Pontella.

Genus I. Calanus. (*Leach.*)—*Rostrum* furcatum. *Antennæ anticæ* sive leviter curvatæ sive rectæ, *maris* non geniculantes. *Pedes postici* (ct. xii.) obsolescentes, *maris* non prehensiles. *Pedes antici* (ct. vii.) elongati, latè porrecti, maxillipedibus (ct. vi.) majores, non geniculati. *Oculi inferiores* nulli. Cephalothorax 4–5-articulatus. *Rami antennarum posticarum* subæqui, ramo breviore ad apicem 3 setis instructo, in dorso setigero.*—Hab. in maribus Atlantico et Pacifico.

Syn.—Cyclops, *Müller.*—Calanus, *Leach.*—Cetochilus? *Roussel de Vauzème.*

Sp. C. rotundatus, comptus, nudus, magellanicus, crassus, furcicaudus, arcuicornis, turbinatus, stylifer, curtus, scutellatus, pavo, levis, medius, placidus, recticornis, setuligerus, pellucidus, affinis, flavipes, tenuicornis, sanguineus, mundus, inauritus, simplicicaudus, appressus, communis, amænus, bellus, gracilis, elongatus, attenuatus, rostrifrons, cornutus.

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* Species optimè distinguendæ sunt:—

1. Per gustum antennarum anticarum; etiam per discrimina setarum, præcipuè apicalium et subapicalium; per longitudinem et numerum articulorum:
2. Per structuram maxillipedium, et pedium anticorum:
3. Per pedes posticos thoracicos:
4. Per numerum segmentorum cephalothoracis, et characteres segmentorum antici posticique:
5. Per stylos caudales et eorum setas:

Articulatio cephalothoracis non character *generica.* Numerus segmentorum abdominis per ætatem variat, et vix valet *species* distinguere.

Genus II. SCRIBELLA. (*Dana.*)—*Antennæ anticæ* elongatæ, pauci-articulatæ, longè setigeræ, setis diffusis, *maris* non geniculantes. *Antennæ posticæ* simplices (?). *Maxillipedes* (ct. vi.) maximi, pedibus proximis majores, 4-articulati, geniculati et prorsum flexi. *Oculi inferiores* nulli. *Cephalothorax* 4–5-articulatus, capite non discreto. *Abdomen* valde elongatum, cephalothorace non brevius. *Styli caudales* oblongi, divaricati. [Sæpius, e basi pedis biremis, seta grandis lateraliter porrecta.]—Hab. in maribus Atlantico et Pacifico.

SYN.—Scribella, *D.*, Amer. Jour. Sci., Ser. 2da, i, 227.

Sp. S. scriba, setiger, abbreviata.

Genus III. EUCHÆTA. (*Philippi.*)—*Frons* acuta. *Rostrum* transversim emarginatum. *Antennæ anticæ* duplo leviter curvatæ, nunquam minimè angulo flexæ, *maris* non geniculantes. *Pedes* maris *postici* (ct. xii.) ambo valde elongati, subulati. *Pedes antici* (ct. vii.) maxillipedibus (ct. vi.) majores, duplo geniculati et sub corpore gesti, penecillum setarum nudarum reflexum ferentes. *Oculi inferiores* nulli. *Cephalothorax* 4–5-articulatus, capite non discreto.—Hab. in maribus Atlantico et Pacifico.

SYN.—Euchæta, *Philippi*, Archiv für Naturgeschichte, vol. ix, p. 55.—Euchirus, *Dana*, Amer. Jour. Sci., Ser. 2da, i, 228.

Sp. E. communis, concinna, pubescens, diadema.

Genus IV. UNDINA. (*Dana.*)—*Antennæ anticæ* ante medium angulo leviter flexæ, ad apicem fronte posteriores, *maris* non geniculantes. *Pedes postici* (ct. xii.) *maris* grandes, dextro subcheliformi. *Pedes antici* (ct. vii.) elongati, maxillipedibus sæpe majores et valde porrecti, non geniculati. *Oculi inferiores* nulli. *Cephalothorax* 4–5-articulatus, capite non discreto.—Hab. in maribus Atlantico et Pacifico.

Sp. U. vulgaris, simplex, inornata.

Genus V. CANDACE. (*Dana.*)—*Frons* quadrata. *Oculi inferiores* obsoleti. *Antennæ anticæ* regulariter et breviter setigeræ, transversæ; dextrâ *maris* articulatione geniculante. *Maxillipedes* (ct. vi.) pedibus proximis majores, duplo geniculantes et inflexi, 4-articulati, setis nudis, longis. *Pedes maris postici* dispares, dextro prehensili. *Abdomen* mediocre. *Styli caudales* breves, setis strictè appressis. [Animal sæpius partim nigrescens.]—Hab. in maribus Atlantico et Pacifico.

SYN.—Candace, *D.*, Amer. Jour. Sci., Ser. 2da, i, 228. 1846.

Sp. C. ornata, pachydactyla, ethiopica, curta, acuta, truncata.

Genus VI. CYCLOPSINA. (*Milne Edwards.*)—*Rostrum* furcatum. *Antennæ anticæ* sive rectæ sive leviter curvatæ, *maris* dextrâ articulatione geniculante. *Maxillipedes* (ct. vi.) pedibus proximis majores, non geniculati, setis longis spinulosis instructi. *Oculi inferiores* nulli. *Cephalothorax* 4–7-articulatus, capite sæpe discreto. *Antennæ posticæ* iisdem *Calani* similes. *Pes maris posticus dexter* grandis et prehensilis. [Maxillipedes, et antennam *maris* anticam pedemque posticum dextrum, *Pontellæ* affinis; antennam posticam, oculos, et habitum, *Calano* similis. *Si oculi inferiores* adsunt, species *Pontellæ* pertinent.]—Hab. in maribus Atlantico et Pacifico.

SYN.—Cyclopsina (C. castor), *Milne Edwards.*—Cetochilus? *Roussel de Vauzème.*—Monoculus (M. castor), *Jurine.*—Cyclops (C. castor), *Desmarest.*—Dioptomus (D. castor), *Westwood.*—Non Cyclopsina *Bairdii.*

Sp. C. longicornis, calanina, tenuicornis, gracilis.

Genus VII. CATOPIA. (*Dana.*)—Antennas posticas et antennarum habitum anticarum *Calano* affinis. Antennam *maris* anticam dextram *Pontellæ* affinis. *Oculi* superiores nulli; oculus inferior unicus (?)—Hab. in mari Sinensi.

Sp. C. furcata.

Genus VIII. ACARTIA. (*Dana.*)—*Antennæ anticæ* rectiusculæ, flexiles, setis irregulariter diffusis, dextrâ *maris* non geniculante. *Maxillipedes* (ct. vi.) pedibus proximis majores, recti, setis setulosis longis instructi. *Pedes postici* (ct. xii.) parvuli, uni-articulati, 2 setas divaricatas gerentes. *Oculi* duo inferiores et duo superiores. *Setæ caudales* mediocres.—Hab. in maribus Atlantico et Pacifico.

Sp. A. limpida, negligens, tonsa, laxa.

Genus IX. PONTELLA.—*Rostrum* furcatum. *Oculi* duo *superiores*, pigmentis sive coalitis sive remotis; duo *inferiores* coaliti. *Antennæ anticæ* multiarticulatæ, setis non diffusis, antennâ dextrâ *maris* geniculante. *Cephalothorax* 4–7-articulatus, segmento cephalico sæpe discreto. *Maxillipedes* (ct. vi.) grandes, recti, setis longis, setulosis. *Pedes antici* (ct. vii.) minores. *Pes maris posticus* (ct. xii.) *dexter* crassus, prehensilis.—Hab. in maribus Atlantico et Pacifico.

SYN.—Pontia, *Milne Edwards.**—Irenæus, *Goodsir.*—Broteas, *Lovén.*

Sp. P. elliptica, brachiata, plumata, turgida, curta, contracta, media, crispata, detruncata, simplex, exigua, agilis, acutifrons, acuta, rubescens, emerita, regalis, perspicax, strenua, protensa, hebes, frivola, detonsa, argentea, speciosa, princeps, fera.

Familia IV. CORYCÆIDÆ.

Oculi duo grandes plus minusve remoti, lenticulis duobus prolatis maximis, et corneis oblatis instar conspicillorum, constructi; quoque duo oculi connati minutissimi. *Antennæ anticæ* pauci-articulatæ, simplicissimæ. *Antennæ posticæ* simplicissimæ. *Pedes mandibulares maxillaresque* brevissimi. *Sacculi ovigeri* duo.

Genus I. CORYCÆUS. (*Dana.*)—*Corpus* crassum, anticè rotundatum. *Conspicilla* fronte affixa. *Antennæ posticæ* pedibus anticis majores. *Pedes antici* sexu vix dissimiles digito subuncinato tenuique confecti. *Abdomen* pauci-articulatum, appendicibus basis nullis, stylis caudæ styliformibus.—Hab. in maribus Atlantico et Pacifico.

SYN.—Corycæus, *D.*, Proc. Acad. Nat. Sci. Philad., 1847; Am. Jour. Science, Ser. 2da, i, 228.

Sp. C. gracilis, decurtatus, deplumatus, varius, longistylis, obtusus, crassiusculus, laticeps, vitreus, agilis, orientalis, lautus, speciosus, remiger, latus, venustus, pellucidus, concinnus, productus, longicaudatus.

Genus II. ANTARIA. (*Dana.*)—*Corpus* crassum, antice rotundatum. *Conspicilla* fronte affixa. *Antennæ posticæ* parvæ, ad apicem breviter setigeræ, pedibus anticis (ct. vii.) non majores, carpo posticè angulato. *Pedes antici* sexu vix dissimiles (?), digito tenui subuncinato. *Abdomen* pauci-articulatum. [Cephalothorax postice obtusus.]—Hab. in maribus Atlantico et Sinensi.

Sp. A. crassimana, gracilis, obtusa.

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* *Pontia* Papilionum generis vocabulum, itaque *Pontella* nobis scripsa.

Genus III. Copilia. (*Dana.*)—*Corpus* depressum, fronte latè quadratum, et conspicilla ad angulos anticos gerens. *Antennæ posticæ* digitiformes, digito elongato, subulato. *Abdomen* pauci-articulatum, appendicibus ad basin nullis.—Hab. in mari Pacifico.

Sp. C. mirabilis, quadrata.

Genus IV. Sapphirina. (*Thomson.*)—*Corpus* depressum. *Sexus* antennas posticas stylosque caudales similes, et abdomen pedesque anticos (ct. vii., *vere* maxillipedes,) dissimiles. *Antennæ posticæ* pediformes, digito tenui, 2-articulato, ad apicem unguiculato. *Abdomen feminæ* 5–6-articulatum, thorace subito angustius, appendices breves ad basin latere gerens; *maris* 4–5-articulatum, thorace subito non angustius, appendicibus nullis. *Pedes maris antici* digitum elongati, *feminæ* breves. *Styli* caudales laminati.—*Mares* sæpe lætè opalini aut fulgidè metallini, interdum cærulei. *Feminæ* sæpius incoloratæ, plus minusve pellucidæ; interdum opacæ et azuleæ.—Hab. in maribus Atlantico et Pacifico.

Sp. S. iris, angusta, elongata, metallina, coruscans, inæqualis, ovata, splendens, ovalis, detonsa, indigotica, orientalis, ovato-lanceolata, gemma, bella, opalina, versicolor, tenella, obesa, obtusa.

Familia V. Miracidæ.

Oculi duo conspicillis maximis constructi. *Antennæ posticæ* ad apicem setigeræ. *Pedes mandibulares maxillaresque* brevissimi. *Abdomen* feminæ (an *maris* ?) 6-articulatum. *Sacculus ovigerus* unicus.

Genus Miracia. (*Dana.*)—*Corpus* elongatum, non depressum, ad frontem duas appendices falciformes subtus gerens. *Antennæ anticæ* appendiculatæ, flexiles et non geniculantes. *Pedes antici* (ct. vii.) mediocres, uni-unguiculati; *pedes* duo sequentes biremes, lateraliter porrecti. *Pedes abdominis* longè setigeri. *Setæ caudales* elongatæ.—*Setellæ* affinis, sed conspicilla oculorum diversæ.—Hab. in maribus Atlantico et Pacifico.

Sp. M. efferata, gracilis.

Tribus II. DAPHNIACEA (vel Cladocera).

Corpus testâ plerumque tectum, capite antennisque posticis sæpius exclusis. *Pedes* plures natatorii. *Antennæ anticæ* sæpe obsoletæ, raro elongatæ. *Oculus* compositus. [Membra tota cephalothoracis mandibularia, maxillaria, pediformiaque, numero 12–16.]

Familiæ sunt:—

1. Penilidæ.—Pedes duodecim. Antennæ anticæ obsolescentes.
2. Daphnidæ.—Pedes decem. Antennæ anticæ sive obsoletæ sive uni-articulatæ.
3. Bosminidæ.—Pedes decem. Antennæ anticæ elongatæ, multi-articulatæ.
4. Polyphemidæ.—Pedes octo. Antennæ anticæ obsolescentes.

Familia I. Penilidæ.

Genus Penilia. (*D.*)—*Caput* discretum, longè rostratum. *Antennæ posticæ* grandes, ramis duobus 2-articulatis. *Abdomen* non inflexum, stylis duobus corneis confectum.—Hab. in maribus prope oras.

Sp. P. avirostris, orientalis.

Familia II. Daphnidæ.

Genus I. Daphnia.—*Abdomen* inflexum. *Antennæ anticæ* obsolescentes. *Antennæ posticæ* birameæ, ramis 3–4-articulatis. *Intestina* non convoluta.—Hab. in stagnis.

Sp. D. textilis, australiensis, macrura.

Genus II. Sida.—*Abdomen* rectum. *Antennæ anticæ* fere obsoletæ. *Antennæ posticæ* birameæ, uno ramorum 2-articulato. *Intestina* non convoluta.—Hab. in stagnis.

Sp. S. angusta.

Genus III. Lynceus.—*Abdomen* inflexum. *Intestina* convoluta. *Antennæ anticæ* fere obsoletæ. *Antennæ posticæ* parvæ.

Sp. L. latifrons.

Familia IV. Polyphemidæ.

Pedes octo. Oculus maximus.

Genus Polyphemus.—*Caput* discretum magnum. *Antennæ* birameæ, validæ.—Hab. in mari.

Sp. P. brevicaudis.

Tribus III. CYPRIDACEA (vel Ostracoda).

Corpus testâ bivalvi omnino tectum, posticè incurvatum, capite antennisque nunquam exclusis. *Pedes* nulli biremes nec natatorii. *Oculi* vel simplices vel compositi. *Antennæ* quatuor. [Membra cephalothoracis mandibularia, maxillaria, pediformiaque numero decem.]

Genus I. Cypris. (*Müller.*)—*Testa* integra ad frontem nec perforata nec incisa. *Oculus* unicus. *Antennæ anticæ* setigeræ, subnatatoriæ. *Antennæ posticæ* subpediformes, setigeræ. *Pedes mandibulares* 3–5-articulati. *Maxillæ* quatuor, breves. *Pedes* quatuor, duo uncinis longè confecti, duo sequentes graciles, 4–5-articulati, ad ova pertinentes. —Hab. in stagnis.

Sp. C. speciosa, albida, chilensis, pubescens, vitiensis.

Genus II. Cypridina. (*Milne Edwards.*)—*Testa* breviter rostrata corpus omnino tegens, et clausa. *Oculi* duo compositi, remoti. *Antennæ anticæ* setis paucis inæquis ad apicem instructæ, setis rectis, sæpe divaricantibus, vix natatoriis. *Antennæ posticæ* 5–7 articulis brevissimis longè et plumosè setigeris confectæ. *Pedes mandibulares* 5-articulati, digitiformes, apicem unguiculati. *Maxillæ* sex, breves, breviter setigeræ, paris secundi laminam ciliatam ad basin gerentes, setis longis, plumosis. *Pedes* duo, longissimè vermiformes, omnino flexiles, ad ova pertinentes, ad apicem setis spinulosis partim reversis armati. *Abdomen* spinulis biseriatis confectum.—Hab. in maribus Pacifico et Atlantico.

Sp. C. luteola, punctata, olivacea, gibbosa, formosa.

Syn. Asterope, *Philippi.*

Genus III. Conchæcia. (*Dana.*)—*Testa* interdum breviter rostrata, corpus omnino tegens, fronte apertâ. *Oculi* simplices. *Antennæ anticæ* 3–4-articulatæ, apicem longè setigeræ. *Spiculum* inter antennas sarcosum, simplex, exsertile. *Antennæ posticæ* 5–7-articulatæ, articulis brevissimis longè setigeris confectæ, ramo altero brevi. *Pedes man-*

dibulares fermè 5-articulati, non unguiculati, apice articuli primi interno et sæpius basi secundi interno simul corneis (instar mandibulæ) et denticulatis. *Maxillæ* quatuor. *Pedes* quatuor, tenues. *Abdomen* spinulis biseriatis confectum.—Hab. in maribus Pacifico et Atlantico.

Sp. C. agilis, rostrata, brevirostris, inflata.

Subordo 2. CORMOSTOMATA.

Os rostriformis.—Tribus quatuor sequentes :—

I. Monstrillacea.—Corpus elongatum (Cyclopiforme). Maxillæ pedesque antici obsoleti. Pedes postici octo natatorii.

II. Caligacea.—Corpus sæpius depressum. Maxillæ pedesque toti numero 12–14, octo pedes ultimi plerumque natatorii, plurimi testâ tecti.

III. Lernæacea.—Corpus depressum aut vermiforme. Antennæ pedesque partim obsoleti.

IV. Nymphacea.—Corpus breve, araneiforme, abdomine obsolescente.

Tribus I. MONSTRILLACEA.

Genus Monstrilla. (*Dana.*)—*Cephalothorax* fere cylindricus, 4-articulatus. *Abdomen* 5–6-articulatum. *Antennæ* duæ. *Oculi* duo simplices ; quoque oculus inferior sicut *Pontellis*. *Truncus buccalis* parvulus subconicus, maxillis pedibusve non munitus. *Pedes* octo, natatorii.—Hab. in mari "Sulu."

Sp. M. viridis.

Tribus II. CALIGACEA.

Familiæ quinque sequentes :—

1. Argulidæ.—Corpus anticè latè peltatum. Ovarium externum nullum. Pedes antici largè tubulati, suctatorii.

2. Caligidæ.—Corpus anticè latè peltatum. Ovarium externum tubiforme, rectum, ovis uniseriatis. Pedes quatuor antici subprehensiles. Antennæ posticæ carapace tectæ.

3. Dichelestidæ.—Corpus depressum, valde angustum. Antennæ posticæ carapace non tectæ. Ovarium externum tubiforme, ovis uniseriatis.

4. Ergasilidæ.—*Corycæis* affines. Corpus vix depressum, plus minusve Cyclopiforme. Antennæ posticæ carapace non tectæ. Ovarium externum elongatum aut sacculiforme, ovis non uniseriatis.

5. Nicothoidæ.—Corpus plerumque Cyclopiforme, sed e lateribus longissimè alatum. Ovarium externum sacculiforme, ovis non uniseriatis.

Familia II. Caligidæ.

Subfamiliæ Caligidarum nobis sunt :—

1. Caliginæ.—Truncus buccalis subovatus, obtusus. *Maxillæ* trunco buccali remotiusculæ, posticè aculeo-elongatæ. *Tubum* ovigerum externum rectum. Corpus anticè latius. (Genera sunt *Caligus*, *Lepeophtheirus*, *Chalimus*, *Caligeria*, *Calistes*.)

2. Pandarinæ.—Truncus buccalis tenuis acuminatus. Maxillæ ad truncum buccalem appressæ, parvulæ, lamellatæ. Tubum ovigerum externum rectum. Corpus posticè interdum latius. (Genera sunt *Pandarus*, *Trebius*, *Nogagus*, *Specilligus*, *Dinematura*, *Phyllophora*, *Euryphora*, *Lepidopus*.)

3. Cecropinæ.—Truncus buccalis tenuis, acuminatus. Maxillæ ad truncum buccalem appressæ. Tubum ovigerum externum sub testam convolutum. Corpus posticè latius. (Genera sunt *Cecrops*, *Læmargus*.)

Caligaceorum segmenta corporis auctoribus sæpe malè data. Segmentum *abdominis* anticum, ovarium externum gestans, *thoracis* posticum sæpe vocatum.* In Cyclopaceis Caligaceisque ovarium externum ad segmentum secundum abdominis *normalem* semper pertinet. His animalibus et Cyclopaceis Crustaceisque aliis comparatis, affinitates veræ educentur. Tabula sequens, membris ordine enumeratis, hæc comparationem exhibet.

Segmenta.	Astacus.	Lucifer.	Cyclops.	Pontella	Caligus.	Penilia.	Daphnia.	Cypris.
1. *Cephalothoracis.*								
I.	Oculi	Oculi	00	00	00	00	00	00
II.	Ant. I.	Ant. I.	Ant. I.	Ant. I.	Ant. I.	Ant. I.	00	Ant. I.
III.	Ant. II.	Ant. II.	Ant. II.	Ant. II.	Ant. II.	Ant. II.	Ant. II.	Ant. II.
IV.	Mand.	Mand.	Mand.	Mand.	Mand.	Mand.	Mand.	Mand.
V.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.
VI.	Max.	Max.	Maxd.	Maxd.	P. verg.	P. nat.	P. nat.	Maxd.
VII.	Maxd.	Maxd.	P. preh.	P. preh.	P. preh.	P. nat.	P. nat.	P. verg.
VIII.	Maxd.	Maxd.	P. nat.	P. nat.	P. nat.	P. nat.	P. nat.	P. ovar.
IX.	Maxd.	P.subnat.	P. nat.	P. nat.	P. nat.	P. nat.	P. nat.	00
X.	P. chel.	P.subnat.	P. nat.	P. nat.	P. nat.	P. nat.	P. nat.	00
XI.	P. verg.	P.subnat.	P. nat.	P. nat.	P. nat.	P. nat.	00	00
XII.	P. verg.	P.subnat.	0 vel 00	P. genit.	00	00	00	00
XIII.	P. verg.	0	00	00	00	00	00	00
XIV.	P. verg.	0	00	00	00	00	00	00
2. *Abdominis.*								
I.	P. rud.	P. rud.	0 vel P. rud.	0 vel 00	0 vel 00	P. rud.	0 vel P. rud.	0 vel 00
II.	P. rud.	P. rud.	0	0	0	0	0	0
III.	P. rud.	P. rud.	0	0	0	0	0	0
IV.	P. rud.	P. rud.	0	0	0	0	0	0
V.	P. rud.	P. rud.	0	0	0	0	0	0
VI.	Ap. caud.	Ap. caud.	Ap. caud.	Ap. caud.	Ap. caud.	Ap. caud.	Ap. caud.	Ap. caud.
VII.	0	0	00	00	00	00	00	00

In hâc tabulâ abbreviationes sequentes:—

Ant.	Antennæ.	*P.*	Pedes.	*Preh.*	Prehensiles.
Ap.	Appendices.	*Chel.*	Cheliformes.	*Ovar.*	Ovariani *vel* ovarium.
Mand.	Mandibulæ.	*Verg.*	Vergiformes.	*Rud.*	Rudimentarii.
Max.	Maxillæ.	*Nat.*	Natatorii.	*Caud.*	Caudales.
Maxd.	Maxillipedes.	*Subnat.*	Subnatatorii.		

0. Membra segmenti obsoleta.

00. Segmentum ejusque membra simul obsoleta.

Subfamilia 1. Caliginæ.

Genus I. Caligus.—*Cephalothorax* 2-articulatus; segmento antico latè peltato, fronte discis duobus suctatoriis plerumque instructâ; postico parvulo, non alato. *Oculi* simplices pigmento unico conjuncti. *Antennæ posticæ* prehensiles, et extus basin spinâ crassâ sæpius munitæ. *Pedes* duo antici vergiformes, bifidi;† duo proximi sequentes subprehensiles digito acuto confecti; sex sequentes natatorii; duo reliqui simplices, vergiformes. Venter furculâ parvulâ armatus. *Abdomen* 2–3-articulatum, appendicibus caudalibus sublamellatis, marginem setigeris. [Sexus antennas posticas, pedes paris secundi et formam abdominis, valde dissimiles.]

Sp. C. thymni, productus, gracilis, (Lepeophtheirus) bagri.

* Vide "*Hist. Nat. des Crustaces*, par M. Milne Edwards," iii, 445 et seq.

† Extremitas bifida articulo tertio et apice secundi elongato composita.

Genus II. Calistes. (*Dana.*)—*Caligo* similis. *Cephalothorax* 2-articulatus, segmento postico non alato. *Pedes duo postici* biramei, subnatatorii.

Trebio affinis, sed cephalothorax non 3-articulatus et maxillæ nec lamellares, nec ad truncum buccalem appressæ.

Sp. C. trigonis.

Genus III. Caligeria. (*Dana.*)—*Caligo* similis. *Cephalothorax* 2-articulatus, segmento postico bialato. *Pedes duo postici* biramei, setis brevibus, non natatoriis.

Sp. C. bella.

Subfamilia 2. Pandarinæ.

Genus I. Nogagus. (*Leach.*)—*Cephalothorax* 4-articulatus, fronte arcuatâ, segmento secundo ad latera posticè producto, duobus sequentibus non alatis. *Abdomen* stylis brevibus sublamellatis setigerisque confectum. *Oculi* simplices, remotiusculi: (an quoque oculus subtilissimus intermedius?). *Pedes* paris secundi crassè cheliformes; pedes natatorii octo, grandes.

Sp. N. validus.

Genus II. Specilligus. (*Dana.*)—*Nogago* segmenta cephalothoracis pedesque affinis. *Oculi* duo remotiusculi, et *conspicillis grandibus* instructi, eisque Sapphirinæ similes.

Sp. S. curticaudus.

Genus III. Pandarus. (*Leach.*)—*Cephalothorax* 4-articulatus, carapace grandi, segmentis sequentibus transversis, secundo ad latera alatè producto, tertio quartoque posticè alatis, et bilobatis. *Abdomen* 2–3-articulatum, segmento ultimo tecto, secundo posticè rotundato et utrinque stylis caudalibus sæpius munito. *Pedes* paris secundi crassè cheliformes; natatorii octo, setis brevissimis. *Oculi* duo, remotiusculi. *Styli caudales* styliformes, acuti, subnudi.

Sp. P. concinnus, satyrus, brevicaudus.

Genus IV. Dinematura. (*Latreille.*)—*Cephalothorax* 3-articulatus, segmento secundo parvo, testâ tertii dorsali posticè valde expansâ et profundè bilobatâ, eoque elytroideâ. *Abdomen* 2-articulatum, carapace paulo angustius, oblongum, segmento antico maximo, posticè bilobato, postico parvulo, celato. *Styli caudales* lamellati, terminales.

Sp. D. braccata.

Genus V. Lepidopus. (*Dana.*)—*Corpus* anticè non latius. *Cephalothorax* 3-articulatus, carapace minore quam abdomen, segmentis duobus sequentibus posticè largè bialatis. *Abdomen* 2-articulatum, segmento postico parvulo, celato, antico maximo et posticè bilobato. *Antennæ posticæ* articulo tenui falciformi confectæ. *Pedes paris secundi superficie terminali latâ prehensili squamatâ instructi. Pedes natatorii* quatuor ultimi similes, latè lamellati.

Sp. L. armatus.

Tribus IV. NYMPHACEA.

Genus Astridium. (*Dana.*)—*Pycnogono* affinis. *Caput* duobus maxillipedibus subtus instructum parvulis, debilibus, ad apicem obtusis, non prehensilibus. *Pedes* octo unguiculo confecti. *Abdomen* perbreve.

Sp. A. orientale.

IV. Miscellaneous Intelligence.

1. *On Certain Frozen Leaves;* by J. Gorgas, (communicated to the Wilmington Botanical Society and sent for publication to this Journal.)—During the recent cold weather (April 15th and 16th, 1849), the leaves of the Buxus sempervirens, (tall box,) common in cultivation, the flowers having mostly fallen and the fruit beginning to form at the time, exhibited some unusual appearances. The leaves of this plant are of a peculiar structure, and have what may be termed a lining so entirely free from the upper blade, except on the edges, that when the edges, forming the suture, are pared off, the two laminæ fall apart without the use of any mechanical means to separate them. The sutures as well as both blades of the leaf proved upon experiment to be entirely impervious to water. On the mornings of both the days above mentioned, the leaves were found to be very much distended by the presence of some hard substance between the upper and lower blades, and upon paring away the edges of the leaf the blades separated, disclosing a firm piece of clear ice, entirely free from discoloration, of the shape and size of a large seed of the common pumpkin, and in the larger leaves full one-sixteenth of an inch in thickness, swelling them in some instances almost to bursting. Upon an examination at 9 o'clock A. M., these pieces of ice were found to have disappeared from the leaves on the sunny side of the tree, remaining however in those on the shady side. At 12 o'clock, all had disappeared, the leaves having assumed the natural shape without apparent detriment, from having been subjected to an ordeal so unusual and severe; nor was any moisture apparent in the leaves either at this time or on the evening of the first day when a reëxamination was made. The lumps of ice were much larger on the second and colder morning than on the preceding one, and might have burst the leaves had it been still colder. A thermometer hanging in a piazza adjoining the garden in Wilmington, Del., where the tree was situated, indicated at sunrise on the morning of the 15th, 32°, and on that of the 16th, 30°, but the mercury was much lower in some situations in the surrounding country, even as low as 22°, it is said, in some places near Wilmington. After making these statements the author enquires, whence came in a few hours a quantity of liquid sufficient to form in the leaves masses of ice comparatively so large? and how could it so completely disappear again in a few hours more? the leaf being, as he concludes, so firm and compact and the edges of its two laminæ so completely joined as seemingly to preclude the possibility of absorption of the liquid from the atmosphere as well as the evaporation of the melting ice, and he supposes that for some purpose necessary to the well being of the plant, at a time so trying, the sap is rapidly forced into the leaf and there congealed, to be as rapidly withdrawn when melted by a milder atmosphere which renders its presence in the leaf unnecessary. Another member of the society has suggested as an explanation of the facts, that probably this superabundant sap was forced into the leaves by the congelation and consequent expansion of a portion of that in the stem, into which it would of course be reabsorbed as soon as both portions reassumed the liquid state. It has been

further suggested that the regular evaporation of moisture from the leaves was checked by the cold, whilst its supply to them from the plant was continued, and hence the collection of liquid, which, as the ice formed from it was thawed, would be evaporated as usual through the pores of the leaf.

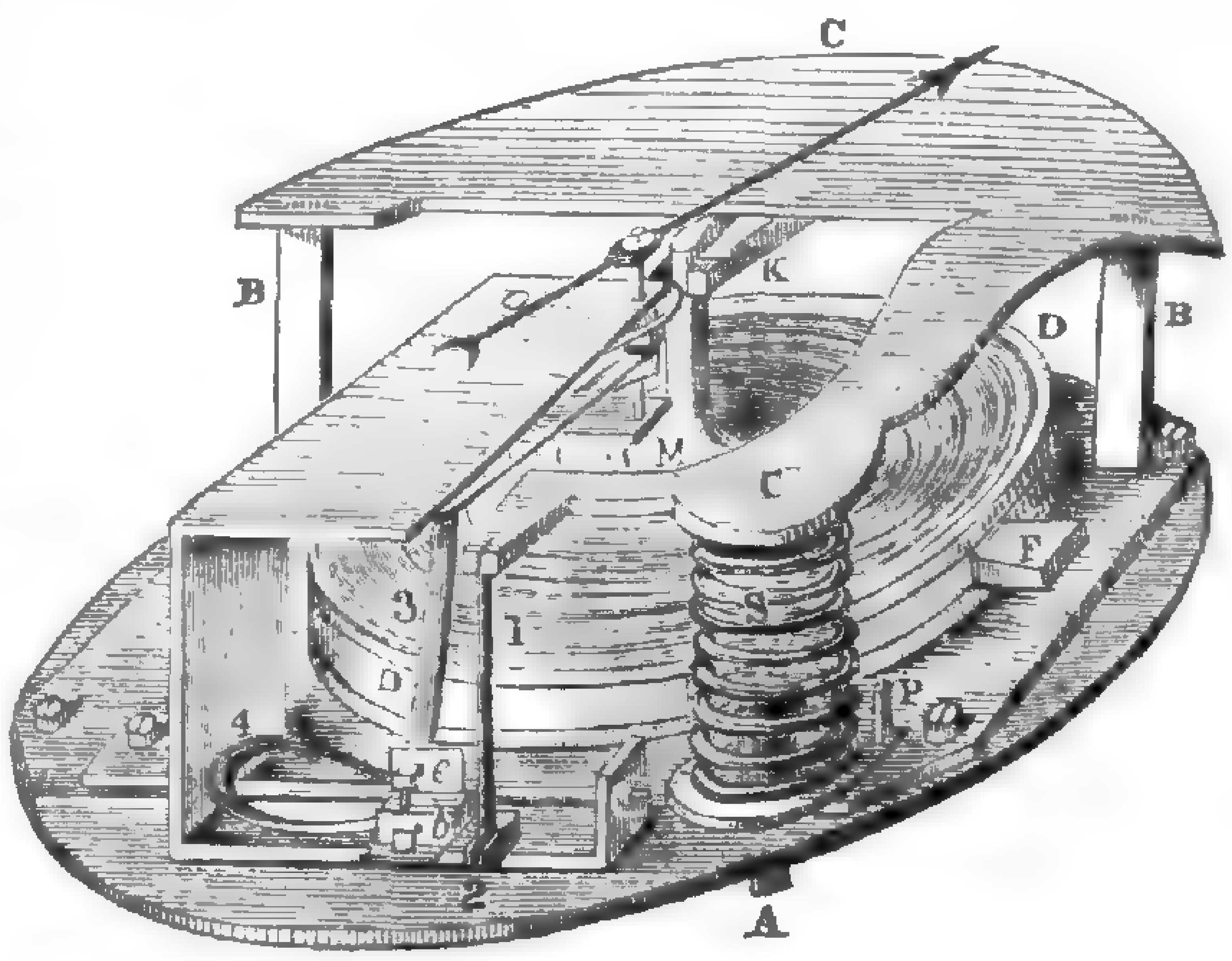
2. *On the Mechanism and Functions of the Organs of Voice in Man; with the introduction of a case of double utterance;* by Dr. Pettigrew, (Royal Society, Athen., No. 1126.)—After a few prefatory observations upon the pleasure derived from the study of anatomy, more especially when assisted by the labors of the scientific chemist, the natural philosopher and mechanician,—the lecturer entered upon the subject above mentioned; first describing the situation of the larynx and its contiguous parts. Its skeleton was made up of a number of parts; the material chosen for which was gristle, the best vibratory substance found in the frame,—other parts, as the ear, in connexion with sound, being formed of a similar fabric. It consisted of many parts, as it was to be elongated, shortened, widened or narrowed. The gristles were to be held together; this was effected by bands of an inelastic nature, by which means displacement was prevented; the parts were acted upon by groups of muscles (the moving powers of the body); the muscles (as waste took place upon any movement) were well supplied by arterial or nourishing blood, the refuse being returned by the veins into the circulating system again to undergo purification in the lungs. The muscles were put into action by the nerves; these emanating from the brain and upper part of the spinal marrow, and thus under the control of the will. The connexion of these nerves with those of respiration, the heart, lungs, and stomach was described; and an especial ganglion (dissections of which from various animals presented by the late Sir Astley Cooper to the lecturer were exhibited) giving exquisite sensations to the opening to the larynx as an entrance to the lungs was, from its great importance, particularly dwelt upon. A set of vessels, called absorbents, removed the effete materials of the organ. Internally the larynx presented a smooth membrane, having the power of secreting a fluid of a glairey nature for the purpose of preventing injury to the more delicate parts from the passage of the air to the lung cells. At the upper part of the larynx, beneath the mucous membrane, four vocal cords were described, two upon each side; these bounded the cavity of the ventricles leading to the sacculi of the larynx. Upon the action of the vocal bands depended the pitch of voice. All sounds emanating from the larynx were simple, the larynx being with regard to the voice what the reed is to the hautboy or clarionet. Many experiments were shown proving that the primitive sound was produced by the vocal bands forming the edges of the glottis; and the peculiar baa-ing of the lamb was imitated by an apparatus contrived and attached to the larynx and windpipe of a dead lamb. Other points in connexion with the subject were illustrated by numerous specimens upon the table, and a new instrument kindly lent for the occasion by Mr. Wheatstone. The damper in this instrument was particularly described as illustrating the action of certain muscles in the human body upon the thyroid gland; thus presenting the continued vibration of one sound into another,—Sir Charles Bell's theory being revived by the lecturer, and sup-

ported by allusions to comparative anatomy. Attention was drawn to intensity of voice, capacity, and also the tones in the male, female, and boy. Articulation and speech were described as modifications of voice and produced by the action of the pharynx, the nasal cavities, the tongue, and muscles about the cheeks and lips. A child before it had cut its teeth could only utter labial words, such as *papa*, *mama*, *baby*, or in humble life *daddar* instead of *father*, the tongue being then pressed against the palate. Dr. Pettigrew then alluded to the manner in which ventriloquism was performed; which was illustrated by Mr. Brook, who imitated a man in the chimney ascending and descending. Mr. Richmond was then introduced; who performed two airs, each as a duet, synchronously. After a very careful examination, assisted by Dr. Macdonald, Prof. Bowman, and M. Garsin, the lecturer had arrived at the conclusion that the two tones were thus accomplished; the voice was of course simple and produced in the larynx; the current of vibration was split, as proved by the flame of a candle,—the bass notes being modified in the upper part of the pharynx and nasal passages, the treble being produced by the tongue forming with the arched roof of the palate a tube, open by a very small aperture in front, the tube being altered in length by the nicest adjustment of its muscles, these latter acting more perfectly from the fixature to the os hyoides and the roof of the mouth.

3. *The Aneroid Barometer*, (from the Mining Journal, xix, 123.)—This elegant and truly philosophical instrument, which is proposed as a substitute for the Torricellian tube, is the invention of a French gentleman of scientific attainments, named Vidi; and the public are much indebted to Mr. Dent, of the Strand, for the publication of a pamphlet, entitled "A Treatise on the Aneroid Barometer, with a short Historical Notice on Barometers in General—their Construction and Use." The introduction of this new barometer has been entrusted to this eminent chronometer-maker, which alone is a guarantee for the excellence of the principle, and the perfection of the mechanical construction. Mr. Dent commences the work with an historical description of the common barometer, which, although sufficiently common to form a general piece of furniture, is by no means generally understood; from the period when Galileo first discovered the cause of water rising in a pump from the exhaustion by the sucker 32 ft., to be the pressure of the atmosphere, describes the experiments on mercury by his pupil Torricelli in 1643, and the subsequent construction of the common barometer; then proceeds to the wheel and dial barometer, the invention of the late eminent philosopher, Dr. Hooke, which is now the one generally in use, except for marine purposes, and concludes with a description of the sympiesometer, also the invention of Dr. Hooke. This latter kind of barometer consists of two tubes—one containing spirits, the other colored water, and shows not only the atmospheric pressure, but its temperature also. On the subject of a vacuum vessel, to take the place of the mercurial tube for barometrical measurement, we learn that M. Conté, Professor of the Aërostatical School at Meudon, near Paris, was the first to call attention to the subject, as in his balloon ascents, during the war in Egypt, he found the ordinary barometer subject to so much oscillation as to be useless; he,

therefore, constructed an instrument, somewhat in shape of a common watch. It consisted of a bowl of strong iron, or copper, upon which was a domed cover of very thin sheet steel, the edges fitting with great exactness. Springs fixed in the bowl keep the cover at a proper elevation; the air is pumped out, and as the resistance of the springs is uniformly the same, the cover plate rises, or falls, as the atmospheric pressure varies, and these variations are shown by means of a hand, securely fastened, passing backward and forward on a divided plate. M. Conté, however, was compelled to reject the instrument, on account of the prejudicial influence which change of temperature had upon it. It was left to Mr. Vidi's ingenuity to construct an instrument on scientific principles, in which he has been most completely successful, and in which he has adopted most ingenious means for correcting the variations of temperature—viz.: by the introduction of gas into the vacuum vase of the instrument; and, on its capacity being diminished by heat, the gas contained within it is, by the same cause, expanded, and resisting the compressing force of the atmospheric weight upon the diaphragms, keeps them separated at a due distance, and effects the compensation. The Aneroid barometer consists of a vessel of the shape

1.



and size of a chronometer—the internal arrangement of which is shown by *fig.* 1. D, D, is the vacuum vase; C, C, a lever, resting on its fulcrum B B, and spiral spring S—to the end of which is attached a vertical rod, 1, which serves to connect the lever C C, with the levers 2 and 3. These are connected by a bow piece, 4; and two square-headed screws, at *e*, *b*, admit, by screwing or unscrewing them, such an alteration of the distance of leverage, as to allow the hand of the Aneroid to move over a space corresponding with the scale of a standard mercurial barometer; to the end of lever, 3, is attached a light rod, terminating with a piece of watch chain, attached to a small roller. On the axis of this roller, the hand is fixed, and kept in its position, by means of a spiral spring—the outer coil of which is seen attached to the axis. M is the socket, which, being pulled by the pin, K, places the vase in a state of tension, whereby it offers resistance to the pressure of the external atmosphere; and the diaphragms are kept

2.

separate after exhaustion, by fixing the pin K, to the lever C. The surface of the top of the vase D, is formed of fine corrugated metal. F is the orifice, where the exhaustion is effected.

To set the hand of the Aneroid to correspond with any other Barometer.—A, the head of the screw, *fig.* 1, to be considered as at the back of the case. This screw, when screwed or unscrewed, alters the position of the hand, and is not to be touched *for any other purpose.* It acts in a piece of brass, seen at P, *fig.* 1, which is prevented from turning round the spring S, by means of a pin inserted in the plate. When the screw A, is turned, it raises, or depresses, the lever C C, whence motion is communicated to the hand.

To Register the Variations of the Aneroid.—A nut, as seen at O, *fig.* 2, projects through the centre of the glass, to enable the observer to move the gilt index, W, beneath it. By this gilt index, the registration of the hand *b*, is effected. The gilt hand being placed over the steel one, should the latter have subsequently deviated from W, either to the right or left, the difference will be the result of increased or diminished atmospheric pressure. *Fig.* 2, is a representation of the outer case, with a Fahrenheit's thermometer attached. In the *Mining Journal*, of Feb. 3, Dr. Murray has borne his testimony to the sound scientific principles on which this instrument is based, and the vast utility it will prove to the seamen, aëronauts, and those engaged in mountain travelling—indeed, to aërostatic science generally.*

4. *Gold at Port Phillip, South shore of Australia,* (Athen., No. 1132.)—Newspapers to the 9th inst. have come to hand from Melbourne. The most important intelligence is the following, which we copy from the *Argus* of the 31st ultimo.—" Port Phillip a Gold Mine !—We hasten to apprise our readers of the important discovery of an extensive gold field in this province, yielding the virgin metal in such quantities as, to all appearance, will throw California into the shade. The particulars of the discovery, as detailed by one of the parties, are as follows :—A shepherd called some weeks since upon Mr. Brentani with a specimen of metal which he had found in his wanderings, and which immediately struck Mr. Brentani as being fine gold. He applied for a more accurate assay to Mr. Duchene, who at once pronounced it a fine specimen of the precious metal. Mr. Duchene proceeded with the shepherd to the spot, in the neighborhood of the Pyrenees, and found indications of the metal in great abundance, and extending over a large space. He returned to Melbourne with ore sufficient to yield 100*l.* worth of pure gold. He describes the gold as being abundant, and the quality as better than any he has hitherto seen worked. The quantity contained in the mine visited by them was incalculable :—indeed, he says there is a tract of territory at least five miles in extent which furnishes everywhere abundant indications of the existence of gold. Mr. Duchene picked up one piece of the metal weighing 2 lb. 3 oz. which contained upwards of 90 per cent. of virgin gold ; in fact, it presented the appearance of a lump of molten gold, interspersed with a few quartz pebbles. We have seen it as picked out of the earth ; and Mr. Duchene

* We believe that the value of the Aneroid barometer cannot yet be considered as fully established.—Eds.

has kindly left a specimen at the *Argus* office for inspection. It is therefore indubitable that gold has been discovered."—This extraordinary news has produced quite a mania throughout the Port Phillip district, and hundreds are stated to be proceeding to the new El Dorado. Some of the papers disbelieve the whole story; others are equally firm as to the truth. That gold has been found there appears to be beyond doubt,—but the quantity is questionable.

5. *The Tin Mines of Banca*, (Mining Journal, xix, 178.)—The period of the discovery of the tin deposits of Banca is not so remote as is generally imagined. From 1700 to 1720 the first workings commenced, which were then insignificant; but as the prolific nature of the strata became known, the produce rapidly increased. Attracted by the prospect of gain, numerous Chinese miners and adventurers resorted to Banca, and, as one source of ore failed, gradually explored and removed to other districts, spreading successively over the island, and selecting the most favorable spots, where a rich store of ore was in the vicinity of a stream of water, to facilitate their labors. After a lapse of thirty or forty years a gradual diminution of produce was observed in many of the working districts; others were entirely exhausted, and new situations attempted. The most prosperous period of the island, both as regards the supplies of tin obtained, and the general condition of the inhabitants, was during the reign of Sultan Achmád Nádjá Mudin I, or between the years 1750 and 1775: 60,000 piculs, or 120,000 ingots, is but a moderate estimate of the aggregate produce of the mines during this period, and by most persons considered competent to judge, it is supposed to have been much greater. Since the year 1780 a decrease has become more evident, and 30,000 piculs were rarely produced in one year. During the last fifteen years the annual quantity has further decreased: the position of the mines elucidates this in a great degree; the ore is deposited in horizontal beds, at a short distance below the surface, which, in former times, were immensely productive; but the inquisitive shrewdness of the Chinese directing them to the most profitable spots, extensive surfaces may be observed in the western and northern divisions of the island, which have been turned up and drained of their wealth, exhibiting the remains of former mines and aqueducts. The process of mining is very simple; it consists in the formation of a pit or excavation, of a square or oblong form, perforating the ground perpendicularly to the beds containing the tin, which are rarely far below the surface, and in the proper application of a stream of water to facilitate the labor and for washing the ore. When once perforated, the miners continue to dig pits in succession from the same surface until the whole is abandoned, in consequence of the exhaustion of the ore; thus in travelling through the country, surfaces of several square miles are observed, which have been turned up by the process of mining. When a sufficient quantity of ore has accumulated, and been properly washed and dressed, it is subjected to the smelting process, which operation, in favorable seasons, is performed twice a year—in the usual seasons only once, between the months of February and April. It is performed in a spacious open shed, about seventy-five feet long, thirty-five feet broad, and twenty-four feet high in the middle—the upper portion of the roof being separated from the lower by an opening of about two feet, to prevent ignition. The

central portion of the shed contains the furnace, while the ends are the receptacles for the fuel, ore, and various requisites in the process. The furnace is ten feet long, four feet high, and four feet wide; the fireplace occupies the middle portion, descending three feet into the body of the furnace, and beneath is a basin-shaped receptacle, for the refined metal.

The bellows is a large wooden tube, formed out of a single tree, and a piston being worked backward and forward keeps up a continuous stream of air. The sand moulds are placed near the furnace, and when sufficient metal has run, the moulds are filled, sixteen ingots being cast at one time, and generally 44 to 45 in a night's work—the work being carried on at that period of the twenty-four hours, in consequence of the extreme heat of the day. The smelting of the ore, and the preparation of the coals, each requires habit and experience, and are performed by persons who make a regular profession of the business; the smelters are paid by the night, and the coal burners by the basket of coals employed. The facility, however, with which the ore is collected, and the simplicity of the methods of mining, require, as compared with other mining countries, little assistance from machinery; besides, the implements in general use are neither numerous nor difficult to use, and hence few artificers are required at the mines.

6. *Navigation of the Arctic Regions*, (United Service Gazette; Athen., No. 1122.)—Commander Joseph West, an officer of long standing, has proposed a plan of fitting a steam-vessel with ice hammer and ice saws, to be worked by a shaft of the engine, for the purpose of navigating the polar regions. The projection is applicable to either screw or paddle-wheel steamers, and is thus explained:—A semicircular cogged plate is fixed on the shaft, which connects itself with an elevating bar, fixed to the end of a sway beam, the fulcrum being in a crank on the bow of the vessel, at the fore end of the sway beam, where the ice hammer is hung, which by the connection of the cogs, is raised eight feet at every revolution. It is thrown out of gear when they disconnect, the hammer then falls, and is again raised when the cogs connect. The hammers are from fifteen to twenty hundred weight, working alternately on each side before the stem, and are capable of breaking through ice four or five feet thick; thus enabling a vessel so fitted to approximate much nearer to the supposed position of Sir John Franklin's ships than can be done by the present means,—as the above application can be fitted to any steam vessel at a trifling expense compared with the object to be obtained. The invention is simple as it appears to us to be practicable; and we trust that the Admiralty will appreciate the value of the plan, and the motives which actuated the gallant projector, by despatching a vessel so fitted at once on the perilous track of the almost despaired-of northern navigators.

7. *Type Manufacture*, (Athen., No. 1127.)—The Earl of Rosse gave his third Soirée as President of the Royal Society on Saturday last. There were several models and inventions exhibited:—the most remarkable amongst the latter being a machine for manufacturing printing types without fusing the metal and pouring it into moulds. The inventor, M. Petit, effects his process by the use of steel dies and matrices which by means of powerful pressure impress the letters, &c. on copper fashioned into quadrangular strips of indefinite length wound

round a cylinder. The hardness of ordinary copper over type metal is in the proportion of 100 to 1. A London firm employed to print stamps for the Government is in the habit of using raised copper surfaces for the purpose:—no less than 125,000,000 impressions have been taken from one of their plates. The density of the copper used in the manufacture of type is considerably increased by the compression which it undergoes by the machinery of M. Petit. The machine produces thirty-two types per minute; and it would be difficult to exceed the typographic neatness of the character. Specimens of the type and printing were distributed among those present.

8. *New Mode of copying Engravings;* by M. Niepce, (ibid.)—An engraving is placed in a box containing iodine at such a temperature that a small portion is vaporized. The ink of the engraving condenses a much greater proportion of the vapor than the mere blank paper; so that when after a few minutes the engraving is taken out, exposed a moment or two to the air, and then laid on a film or two of *starch*, part of the iodine becomes detached from the engraving, and is transferred to the film of starch, producing a very delicate and beautiful copy of the engraving. As may be supposed, there are many niceties required which M. Niepce only can practice with perfection. It is necessary to inclose the film of starch between two glass plates in order to preserve it.

9. *Herbaria of New England Plants.*—The extensive collections of New England Plants, made by the late Wm. Oakes, Esq., have been distributed into sets, and the specimens named with printed labels. These are now offered for sale for the benefit of his family. The labor of a life and large pecuniary sums have been expended in the formation of these collections, which were designed to illustrate and form a basis of an elaborate Flora of New England. The numerous botanists, to whom the lamented Mr. Oakes generously imparted his specimens during his life time, do not need to be told that they are remarkable for their perfection and beauty. The specimens now distributed fully sustain this character, and they are for the most part very copiously supplied to the sets. Nearly one-half the number, of which the fullest sets comprise six hundred species or varieties, are alpine or subalpine plants of the White Mountain region, which Mr. Oakes has so sedulously explored for many years; and among the rest will be found most of the rarer plants of New England, such as are in the hands of few botanists. They consist entirely of Phænogamous plants, and Ferns; the Musci, Hepaticæ and Lichens, if not otherwise disposed of, will be hereafter distributed.

It is thought that literary institutions as well as botanists would be glad to obtain such a New England herbarium, one which can only be formed at an expense of time, labor, and indefatigable research, which probably will never be again devoted to this object. It is not expected that the actual cost of preparing these collections will be reimbursed by their sale. But, to secure immediate though inadequate returns, they are offered at an extremely low price; namely, the sets that contain 570 to 600 species or varieties, at twenty-four dollars, those of about 550 plants at twenty-two dollars; those of 500, at twenty dollars. Application may be made (post paid) to Charles R. Thayer, Merchant, of Boston, or to Professor A. Gray of Harvard University, Cambridge.

A. Gr.

10. *British Museum*, (Athen., No. 1130.)—The total amount expended on the new building and fittings of the British Museum, and for ornamental sculpture, from the commencement of the re-building in 1823 up to the 31st of March, 1849, amounts, as shown by a Parliamentary return, to 696,995*l*. The total amount of expenditure that will be required for further buildings and fittings is estimated at 56,500*l*.

11. *Platinum and Diamonds in California.*—The existence of Platinum in the gold sands of California has of late been often announced. Specimens from the region have recently been seen by the editors of this Journal.—We also learn from a reliable source that the diamond occurs at the placers. The writer—Rev. Mr. Lyman—describes a crystal seen by him, of a straw-yellow color, having the usual convex faces, and about the size of a small pea. He saw the crystal but for a few moments, and had no opportunity for close examination: but the appearance and form left little doubt that it was a true diamond.

12. *W. Lassell.*—The Royal Society of London has presented to Mr. Lassell a medal for the discovery of the planet Metis, of one at least of the Satellites of Herschel, of a Satellite of Neptune, and of an eighth Satellite of Saturn.

OBITUARY.

13. George W. Whistler.—We had hardly received the announcement of the decease of our old friend, commemorated in the last number of this Journal;—ere we were called to grieve for the loss of another; who, a man of science applied in a different walk, has been the means of extending in another hemisphere the reputation of not only his own but of the American name. We sorrowfully pay the due tribute to worth like his, thus cut off in the midst of usefulness and before attaining the zenith of fame to which he might justly have looked, by furnishing the following notice of the principal epochs of his life and works; prepared by one, who at an earlier period served with and under him.

George Washington Whistler was born in May, 1800, at Fort Wayne in the present State of Indiana, but then part of the Northwest Territory. This post was commanded by his father, Major Whistler; then and till after the war of 1812, an officer of artillery. He was one of the younger of a numerous family of children; of whom none now survive, except Col. William Whistler, of the 4th regiment of infantry.

Upon the reduction of the army after the war, Major Whistler, the father, was among those not retained; from the circumstance of his having already two sons in the service. But he accepted the post of military storekeeper at Newport, Kentucky; whence he was transferred to St. Louis, and died in a good old age. The family had indeed been removed to Newport, while Whistler was still in childhood; and he received there his early education. But still earlier education and continual association had inspired him with a taste for military life, to which other circumstances were not adverse, and accordingly we find him entered as a cadet at West Point in 1814.

A change in the regulation of the Academy after his entrance, gave him the advantage of a longer course there than is now required. He remained five years as a cadet; and graduated in 1819. He did not then quit the Point; but remained under orders as Assistant Professor, for which his attainments in descriptive geometry and his artistical taste and skill in plans and drawings peculiarly fitted him. This fitness, indeed, extended itself to the fine arts generally; his aptness for the arts of design was associated equally with a predilection for music, which upon more than one instrument raised him to the first rank of amateur performers. It is remarkable that such tastes should have co-existed with an almost irresistible fondness for the associations of a military life; whose results (at least in time of war) are rather those of destruction than of creation. It is not less remarkable that they should have continued to be developed till past the meridian of life, amid all the pressure of graver employments and momentous exertions.

His employment as Professor continued for nearly two years. In 1821, although commissioned in the artillery, he was detailed on topographical duty under Major (now Colonel) Abert; the present chief of the Bureau of Topographical Engineers. For such service, the taste and attainments just spoken of peculiarly fitted him; and they were recognized and still farther usefully applied the following year, when he was detailed as Draughtsman to the Northern Boundary Commission.

It was in the interval between these two engagements, that he contracted another in the marriage with his first wife, the lovely daughter of the late Dr. Swift, U. S. A. Death dissolved this tie in 1828.

His labors with the surveyor, connected with the Boundary Commission, between the Lake of the Woods and Lake Superior, continued for four years; extending from 1822 to 1826. And subsequent duties in the Cabinet of the Commission employed nearly two years more.

About this period, the stimulus which the interest manifested by the general government in internal improvements had given to works of that character, created a new demand for the services of persons competent as surveyors and engineers; which the class of such persons existing in civil life was not able to supply. To the army, therefore, whose officers had had opportunity for the requisite education, and especially to those who had already been familiar with topographical duty, frequent applications were made.

Among others, the Baltimore and Ohio Railroad Company, one of the earliest corporations for such a purpose in this country, had been successful in obtaining the aid of several officers who were then eminent or have since become so. The names of Doctor Howard, who though not a military man, was yet attached to the Corps of Engineers of the Army, of Lt. Col. Long, and of Capt. McNeill, appear in the proceedings of that company as Chiefs of Brigade; and those of Fessenden, Gwynn and Trimble among the assistants. In Oct., 1828, this company made further special request for the services of Lt. Whistler; and this, it may be supposed, from his known capacity and the company's need, not so much for general purposes as for particular aid. The directors had resolved upon sending a deputation to England to examine the characteristics of railroad undertakings there; and no one could have been better calculated to serve on such a mission than Whistler. The other members were Capt. McNeill and Jonathan Knight, Esq.

Leaving this country in Nov., 1828, directly after being joined by Whistler, they returned in May, 1829. In the course of the following twelvemonth, the organization of the road (a part of which had already been constructed under the immediate personal superintendence of W.) assumed a more permanent form; this allowed of the transfer of the Military Engineers to other undertakings in a more inchoate state, where similarly beneficial services could be rendered with those that the Baltimore and Ohio Railroad had already enjoyed.

Accordingly in June, 1830, Capt. McNeill and Lt. Whistler (he had, in 1829, been promoted) were detailed to the Baltimore and Susquehanna Railroad; for which they made the preliminary surveys and definitive location. It is perhaps, at least in a financial aspect, to be regretted that their advice was not followed in the general direction to be given to the line. Instead of its penetrating northward to drain the freights of the Upper Susquehanna, it would have been carried more eastwardly to intercept those freights at or near the mouth of that river, and to attract besides the passenger travel from Philadelphia, the distance between which and Baltimore it would so materially have shortened. In point of fact, it would have anticipated the realization, consummated not till nine years afterwards, of the present Baltimore and Fort Deposit railroad; and would have stimulated, at the most favorable period, the normal development of these constructions as thoroughfares of travel more than channels of trade.

However, these topics need not be discussed here. They are only referred to at all as an early manifestation of that prompt sagacity to which it may be presumed Whistler contributed his proper share; for since their connection in 1828, these two subsequently so distinguished engineers appear identified by an intimacy, if possible, more than fraternal.

In the latter part of 1831, Whistler went to reside in New Jersey in furtherance of the Paterson and Hudson railroad; a work then recently commenced: and from his various residences in that state, at Paterson, at Aquachnonk and at Belleville, he attended to the construction of this and the Boston and Lowell railroad—both in progress at the same time.

In 1833, he resigned his commission in the Army of the United States; not so much from choice as from a sense of duty. And at this epoch and possibly from this event, there seems to have been a turning-point in his character. Hitherto, his pursuits as an Engineer appear to have been more in the aspect of an employment than of a vocation; he prosecuted his undertakings diligently, to be sure, as it was his nature to do, but without much anxiety or enthusiasm; and he was satisfied in meeting the difficulties as they supervened with a sufficient solution. Henceforward, he handled his profession more *con amore;* he labored that his resources against difficulties of matter and space should be over-abundant; and if he was before content with the sure-footed tact of observation, he now added the luminous aid of study. How luminous and how sure these combined became, his subsequent works tell best.

In the fall of 1834, he left New Jersey and went to New London to superintend more conveniently the inception of the Providence and

Stonington railroad; a work intended as the complement of the Boston and Providence railroad, then almost completed. Not long after, in 1835, he yielded to the urgent solicitations of friends and parties interested (in both classes of whom may be mentioned, for instance, the late Patrick Jackson,) and assumed the position of Superintendant and Engineer of the machine shops, principally for the construction of locomotives which the Locks and Canal Company of Lowell had recently established. Here he remained for two years or more, to the advantage of the Company, and to the increase of his own stores of mechanical knowledge. We observe throughout his life, but perhaps most prominently in these very engines built under his direction, the self-denial with which he excluded novelties of his own, the caution with which he admitted those of others, and the judgment which he exercised in selecting and combining the most meritorious of existing arrangements.

This preference for what was simple and had been tried, did not arise from a want of originality, but pure self-command. On the contrary, those who have been associated with him can recollect how ready he was at all times with devices for facilitating the execution of work, or remedying contrarieties and disasters as they occurred. His simplification of the method of running curves on the ground may be taken as an instance, occurring when he happened to be visiting a work of great importance under the charge of an eminent brother engineer. The heads of the long wooden piles that were being driven became always shattered, and though ferruled with a ring, split under the blows of the driver. Whistler immediately suggested the interposition of a loose sheet-iron plate, to be placed on the head of the pile and to answer the purpose of equalizing and dispersing the forces. It is hardly necessary to add that the expedient was successful.

After a while, in 1837, the condition of the Stonington railroad became such as imperatively to demand his presence and attention; and he removed for the purpose from Lowell to Stonington. At the same time he was called to take part in conjunction with McNeill and Swift in the location and construction of the Western railroad. In these connections he remained until 1840; when he found it more convenient, in behalf of the last named railroad, to remove with his family to Springfield. There he still was, when in 1842 he was invited in a manner highly gratifying to himself and honorable on the part of the Emperor of Russia, to assume the charge of certainly the most gigantic undertaking of the age, the Petersburg and Moscow railroad. This position was offered to him, not so much because he was an American, as for his own high qualifications. A deputation of Russian engineers who had visited America the year before, had occasion to remark his extraordinary abilities and made report accordingly upon their return; and this led to the invitation. This fact need detract nothing from our national pride. Whistler, *the man*, after his transferal to another continent became eminently *the American;* and his abilities thus advanced the reputation of his country beyond any thing that could have been predicted of it before.

The general direction and intent of this great railroad had been determined upon before he was called in; and the executive control of it had been vested in a Commission consisting of high officers of state, and among them, persons of large scientific attainments. Of this Commission, Whistler was shortly made a member; the minute surveys, the location of the line, and it may be even said all particulars in its construction, which could properly come under the purview of executive consideration, were directed or approved of by him. And in those points where his experience or reflection suggested an opinion different from that of his colleagues, he had the fortunate tact to win golden opinions from those even whose views he did not sustain. We believe that we only state the simple truth in saying, that year by year he rose in the estimation of those with whom he was engaged.

The difficulty of his task, arising from the very grandeur of the undertaking apart from any local or physical obstacles, is not to be judged of by anything in the professional experience of any other engineer, living or dead. A road of four hundred and twenty miles, with a thirty feet base, a road way of four hundred feet in width, a double track of seventy pound rails on a five feet gauge, with an equipment of one hundred and sixty-two locomotives and more than two thousand six hundred cars, for whose manufacture the place and means had to be as it were created amid those Sclavonic plains—all to be opened and furnished almost simultaneously, at an expense of forty millions of dollars in the short space of seven years—constitutes an undertaking that might have paralyzed many a stout and self-relying heart. Fifty thousand men—a force to subvert a kingdom or establish an empire—worked together at once to force the Earth's reluctant materials and products to submit to the forms of a severe geometry. Upon one man, rested in great measure the responsibility of the issue of this large number of hands. Such and so great was the task that awaited him.

The progress made in its completion was such that in March, 1847, the Emperor with his suite was able to travel over a part of the road and inspect the shops where all the immense machinery was being fitted. Upon this occasion, which seems to have been regarded as a sort of celebration, divers promotions were made among the native officers connected with the work; and the Cross of the Order of St. Anne was conferred upon the American Engineer as a token of the estimation in which he was held.

Honorable tokens of another kind were not few. Besides the appropriate work of his functions on the road, enough to try the energies of one man, (who, whatever might be his abilities, could not make more than twenty-four hours in a day, nor be in two places at once,) various other calls were at times made upon Whistler; implying a seeming belief in his universal knowledge. Thus, not long after commencing the great work in 1843, he was consulted upon the project of the docks and fortifications at Cronstadt where his ideas received—no mean praise—the imperial approval. Then the plans for improving the Dovina at Archangel, and the construction of a permanent bridge across the Neva, where the difficulty arises not so much from the width (only eight hundred feet) as the depth and rapidity of current, were successively submitted to him. The design of an iron roof of a riding-house at St. Petersburg which exceeds the enormous span (two hundred and thirty-five feet) of that at Moscow, was entirely left to him. Finally his last appointment was that of Engineer of the Naval Arsenal at Cronstadt; a work which, had he survived, would doubless have been executed with the success that attended his other undertakings.

In the midst of all this activity and usefulness, his seven years' engagement having expired to a month, the railroad so far complete that it could be delivered over without much urgency in twelve month's time, just as, with his family (for, as we should before have said, he had married, in 1832, the accomplished sister of his friend McNeill) he was about to revisit for a brief interval his native country—death called him away from his labors. His health had not been so robust as usual for several months past; and an attack of sickness supervened, from which, however, there appeared no cause to apprehend a disastrous issue. But on the 6th of April, there came a sudden crisis; he gradually sunk and expired peacefully on the morning of the following day.

Every mark of respect, we are informed, was paid by the government; and the direct condolence of the Emperor with the bereaved lady will be remembered with melancholy pleasure. It is to be presumed that our own government, which has recently so readily and honorably responded to the appeal of an anxious British wife, will not be backward in testifying proper respect to the remains of one who has done so much to sustain the American character abroad.

A few more words, and this notice must be closed. As an engineer, Whistler's works speak for him. He was eminently a *practical* man; though hardly in the sense in which that phrase is frequently used. For it is not going too far to say that no American cotemporary at least possessed more of the theory of his profession or of the science of engineering, which unfortunately in this vehement age is too often considered secondary to the impulses of, so-called, genius; while it is forgotten that *science is genius taught by experience*—experience, not one's own alone, but that of others, too. With such views, Whistler had no affinity. Accustomed to study his combinations, until he could with prophetic science (so to speak) almost divine their issue, none of his results are to be classed among the happy crudities or fortuitous successes of the mere practical man: the end was foreseen from the beginning, and the beginning calculated for the end.

As a man, his character may be traced in the words—truth and modesty. A blameless youth had been succeeded by a manhood of deep religious feeling and piety unfeigned. Though we cannot but sorrow at parting with an old friend, and regret his being cut off ere he had attained the ripest maturity of power and performance, we yet bow at the inscrutable decrees of a beneficent Providence; for our sorrow and regret are mingled with the assurance that "the righteous is taken away from the evil to come." A.

14. Stephen Endlicher, (Athen., No. 1122.)—We have to announce the death of Dr. Stephen Endlicher, Professor of Botany at Vienna. He was well known in Europe, both as a botanist and as an accomplished philologist,—and held the situation of Librarian to the Imperial Library at Vienna. One of his earliest contributions to botanical science was his 'Flora Posoniensis'—which was published in 1831. The plants were arranged in this 'Flora' according to the natural sys-

tem; and throughout the whole of his botanical career, Professor Endlicher has paid great attention to the systematic arrangement of the vegetable kingdom. In 1836, he published his great work entitled 'Genera Plantarum, secundum ordines naturales disposita.' At the time when it was published, it was undoubtedly the most important work on systematic botany since the 'Genera Plantarum' of Jussieu. In this work he proposed an arrangement of the vegetable kingdom which has had a considerable influence on more recent systems. He also published several works containing descriptions and drawings of new plants. Those brought from Peru and Mexico by Poeppig were described by Endlicher. In 1837, he commenced the publication of a work containing descriptions and drawings of new species of plants, under the title, *Ατακτα Βοτανικα.* The drawings for this work were from the pencil of the celebrated Ferdinand Bauer; who died at Vienna in 1826,—and who, like his brother Francis in England, left behind him a great number of drawings of plants such as had never been equaled during their lives and have scarcely been surpassed since. Endlicher published a Flora of Norfolk Island in 1833; consisting of descriptions of plants which were collected by Ferdinand Bauer in 1804 and 1805. In addition to these systematic works, in conjunction with Unger, Endlicher published a work on structural and physiological botany. This work is interesting as containing a statement of its author's views of structure upon which his systematic arrangements are founded:—but it was not in this department that Endlicher obtained his reputation as a botanist. It was reported that the death of Endlicher was caused by his own hand:—but this appears to be untrue.

V. Bibliography.

1. *De Candolle's Prodromus Regni Vegetabilis: Pars XIII, Sectio Posterior.* Paris. pp. 468. May 5, 1849.—This half volume has appeared very nearly at the date announced for it, last autumn, when the twelfth was published. It is the *second* part, anticipating the first, which is to contain the *Solanaceæ* and the *Plantaginaceæ*, two families which will finish the Monopetalous series, as this begins the Apetalæ or *Monochlamydeæ.* It comprises the *Phytolaccaceæ*, *Salsolaceæ* (Chenopodeæ), *Basellaceæ*, and *Amarantaceæ*, elaborated by Moquin-Tandon of Toulouse, and the *Nyctaginaceæ*, by Prof. Choisy of Geneva. Of *Phytolaccaceæ* we have, in the United States, only Petivera alliacea which grows in Florida (probably not in "Carolina"), Rivina lævis, (to which we are surprised to see R. portulacoides, *Nutt.*, joined,) and Phytolacca decandra, which last is now so widely dispersed over the world that its native country is uncertain.

The large family of *Salsolaceæ* comprises 72 genera, disposed nearly as in Tandon Chenopodearum Enumeratio, in two suborders and seven tribes, most of which are further divided into subtribes. Our genera of the Cyclolobeæ (those with the embryo nearly annular) are *Aphanisma*, Nutt., a Californian plant discovered by Mr. Nuttall; *Teloxys aristata*, which is credited to us because Linnæus referred his Chenopodium Virginicum to C. aristatum, but it is doubtful if we possess the genus; *Cycloloma* (Salsola platyphylla, *Michx.*); *Chenopodium*, to which Tandon now reunites the greater part of his Ambrina, (C. ambrosioides, C. anthelminticum, &c.,) leaving in *Roubieva* only the original species, recently illustrated in this Journal by Mr. Carey ; *Blitum*, to which the author now refers, as a section, his former genus, *Agathophyton* (Chenopodium Bonus Henricus, *L.*) ; *Monolepis*, Schrad. (Blitum chenopodioides, *Nutt.*) *Atriplex*, of which too many of the older species are credited to the United States ; *Obione*, Gærtn., of which nine species are North American, including (apparently with sufficient reason) the Pterochiton, *Torr.; Grayia*, Hook. and Arn., of a single species ; *Eurotia ;* a doubtful *Kochia ;* a *Corispermum* (which Tandon seems not to know as also a native of this country) ; *Salicornia*, in which we have S. herbacea ? S. Peruviana (Caro. Fraser), and S. Virginica, to which last he evidently would refer S. mucronata, *Bigelow*, a name unknown to him (and he has also dropped, apparently by accident, the homonym of Lagasca, so that the point in which we are interested is not elucidated) ; *Arthocnemum* (A. ? ambiguum = Salicornia ambigua, *Michx.*) being still kept distinct. Of the SPIROLOBEÆ we have in North America, *Chenopodina*, a genus newly founded for the Chenopodium maritimum, L., which was formerly referred to Suæda, besides which species Tandon also gives us C. linearis (the Salsola linearis, *Ell.*, which however he thinks may be a variety of C. prostrata, which again he thinks may not prove distinct from C. maritima), and C. depressa (Salsola depressa, *Pursh*) ; of *Shoberia*, we have S. calceoliformis (Chenopodium calceoliforme, *Hook.*), which is stated also to be found " near New York ;" of *Salsola*, we have S. kali only. The singular genus *Sarcobatus* of Nees, (the *Fremontia* of Torrey in the Reports of Fremont's first and second journeys,) is enumerated among the *Genera exclusa*, and said to be "*dubiæ sedis.*" Probably the author had not seen the figure of the fertile plant published by Dr. Torrey. *Acnida*, following the aspect and inflorescence, is here referred to the Amarantaceæ.

The order *Basellaceæ*, familiar to us only by the Boussingaultia baselloides, which is cultivated as an ornamental climbing plant, contains six genera, entirely of tropical plants.

The order *Amarantaceæ* includes forty-five genera, arranged under three tribes. There are credited to this country, *Celosia*, one Californian species ; *Amarantus* about nine species ; *Mengea*, Schauer, a Californian species which has much the aspect of Amarantus Blitum ; one or more species of *Euxolus*, Raf., (Amarantus lividus, *L.* &c.) ; *Acnida*, in which A. rusocarpa appears to be mixed up, in a manner that requires much investigation to unravel, with Amaranthus tamariscinus, *Nutt.*, which again, though entirely distinct from Acnida itself, nearly accords in character with Moquin-Tandon's section Montelia ; *Banalia*, a new genus, one section of which includes an Oregon species (Halomocnemis occidentalis, *Nutt. ined.*) ; an obscure *Polycnemum ; Gossypianthus*, Hook, two Texan species ; *Iresine*, two species ; *Alternanthera*, one species (Achyranthus repens, *L.*), besides the A. (Cladothrix, *Nutt.*,) lanuginosa, which Lindheimer and Wright find abundantly in Texas, and which will certainly stand as a separate genus, if a striking peculiarity in respect to its fruit, observed by Dr. Torrey, proves to be a normal condition. *Telanthera* ficoidea and polygonoides appear to be only introduced plants along our southern coast. *Frœlichia* (Oplotheca, *Nutt.*) has three North American species. *Phyllepidium* of Rafinesque is not identified, and probably never will be.

The remaining family, *Nyctaginaceæ*, includes eighteen genera, in three tribes. Of *Mirabilis*, though no species are credited to us, we have one or more in Texas, as well as the three species of *Nyctaginia*, Choisy. Of *Oxybaphus*, six North American species are indicated; and the Peruvian *Alliona incarnata* comes also from California. Four species of *Abonia* are described, besides A.? (Tripterocalyx) micrantha, *Torr.*, which Dr. Torrey has since raised to the rank of a genus. *Pisonia aculeata* is found on Key West. *Boerhaavia* furnishes us three or four species; and there still remain some undescribed Texan representatives of the family. A. Gr.

2. *Catalogue of Plants, Native and Naturalized, collected in the vicinity of Cincinnati, Ohio, during the years* 1834–1844; by Thomas G. Lea. Philadelphia. pp. 77, 8vo. 1849.—The circumstances under which this posthumous publication has been made, from materials which, had Mr. Lea's life been spared, would have assumed a more extended and important form, are thus briefly stated by Mr. Sullivant, in the preface.

"Few botanists have more thoroughly investigated the vegetation of their immediate vicinities than did the late Thomas G. Lea that of Cincinnati. This is apparent not so much in the large number of plants here enumerated and determined with singular accuracy, as in the copious and valuable observations attached to the specimens in his Herbarium. These observations, had life and health been spared to complete them, would have appeared in the form of a local Flora—a work for which years of assiduous study of the plants of Southwestern Ohio had well fitted him.

"The following Catalogue, however, is all that he left ready for publication; with the request that Mr. J. Carey, of New York, or myself, should see it through the press. In the Phænogamous portion no changes have been made other than in the nomenclature, rendered necessary by the advance of the science since the period of his decease. During the last three or four years of his life, Mr. Lea was zealously devoted to the study of Fungi: and his collections in that department will be found a highly valuable contribution to the mycology of the United States. Mr. Lea died of an autumnal fever, on the 30th of September 1844, at Waynesville in this State, where he had been passing a few weeks, making, as these pages will attest, many new and rare collections in the adjacent valley of the Little Miami river. In accordance with his wishes, all the specimens of Fungi were submitted to his correspondent, the Rev. M. J. Berkeley of England, by whom alone they have been determined and prepared for this Catalogue."

The Phanerogamous plants, Ferns, Mosses, and Hepaticæ, appear in the form of a naked Catalogue. The account of the Lichens, prepared by Mr. Tuckerman, is enriched by some critical remarks by this skillful Lichenologist, and by the characters of three new species of Lichens proper, namely *Verrucaria subelliptica*, *Parmelia Leana*, and *P. hybocarpa*, and of a Collemacea, viz., *Leptogonium corticula*, to which an extended note is appended. But far the most valuable part of Mr. Lea's collection consists of the Fungi, which he long made the objects of special study. The catalogue of this family, prepared by the Rev. Mr. Berkeley, is a most important and timely contribution to our knowledge of an obscure and neglected branch of our botany, from one of the most accomplished Mycologists of the age. It comprises the characters of fifty-three new species of the order. A. Gr.

3. *The Elements of Botany*; by M. Adrien de Jussieu: *Translated by* James Hewetson Wilson, F.L.S., &c. London: Van Voorst, 1849. pp. 750, 18mo.—We are glad to have an English translation of this invaluable elementary work, which was briefly noticed in this Journal soon after the publication of the first edition of the original. It is without doubt the best compendious treatise on the subject that has appeared in any language; and appears to be, on the whole, well rendered into English by Mr. Wilson; and the excellent cuts are accurately copied. It is to be hoped that many copies will find their way to this country. A. Gr.

4. *A Manual of Botany; being an Introduction to the study of the Structure, Physiology, and Classification of Plants*; by John Hutton Balfour, M.D., F.L.S., &c., Professor of Botany in the University of Edinburgh. Illustrated by numerous wood-cuts. London: I. Griffin & Co. 1849. pp. 641, 12mo.—We have here an original English introduction to Botany, but modeled evidently upon the plan of Jussieu's, all of whose wood-cuts (from the English edition) have been borrowed, as well as several others from different sources. In extent, it is about the proper size for a class-book, being intermediate between the terse "Outlines" of Henfrey and the large octavos of Lindley. Indeed it aims to cover the whole ground of Dr. Lindley's series of works, only half the volume being devoted to Vegetable Anatomy, Organography, and Physiology; while the systematic portion gives with considerable fullness the characters of families and the properties and uses of plants; and the part upon Geographical Botany comprises an excellent digest of that interesting department, brought up to the present state of the science. To this is added a brief account of Fossil Botany, and a short appendix, on the use of the Microscope in botanical researches, and on the mode of collecting, examining, and preserving plants. The index is also made to serve as a glossary, in the manner with which we are here familiar. The work is well executed, and the materials judiciously selected, so as to give a good summary view of almost every topic which pertains to the science. A. Gr.

5. *Circular prepared by direction of the* Hon. Wm. Ballard Preston, *Secretary of the Navy, in relation to the Astronomical Expedition to Chile*; by Lieut. M. F. Maury, U. S. N., Superintendent of the National Observatory. 34 pp. 4to, with Charts and Tables. Washington, 1849.—This circular gives a brief history of the important expedition to Chile, under Lieut. Gilliss, and of its outfit in Astronomical Instruments, besides Charts and Tables to facilitate observations. We cite the following, by Lieut. Maury, from the second page of the pamphlet:

The Series of Astronomical observations, in which the coöperation of other observers is more especially invited, will consist of differential measurements, during certain portions of the years 1849, '50, '51 and

'52, upon Venus and Mars, with certain stars along their paths. The observations upon Venus which will most command the attention of the Expedition, will be differential measurements upon that planet, in the morning and evening, while it is near the inferior conjunctions of 1850 and 1852. In like manner, Mars will be compared with its neighboring stars near the times of opposition of that planet in 1849 and 1852. The object of these observations upon this planet, is a more accurate determination of its parallax.

To facilitate the observations and to secure concert of action, so that the coöperators, in whatever part of the world, may, in observing the planets, always use the same stars of comparison, Lieut. Gilliss has prepared the accompanying charts and tables. Charts No. 1 to 5, inclusive, refer to Venus; 6 and 7 to Mars. They show the approximate places of the planets from day to day relatively to the stars, down to the tenth magnitude, near their path. In some parts of the paths of the planets, along which published catalogues do not afford proper stars of comparison, special observations have been made with the large Refractor of the National Observatory; the stars, whose approximate places have been thus obtained, are mapped down along the planet's path. Tables 1 and 2 contain the Ephemeris of the planets, and the stars of comparison. They give the star of comparison for each day, and quote its magnitude with its approximate mean place only. The stars marked W. C. are from the unpublished observations of the Washington Catalogue; as they have not undergone their final reductions, their declinations are only given to the nearest 10″. The other stars are designated by the initials or name of the Catalogue from which they are taken. In the Ephemerides of the two planets and their neighboring stars, the mean places of the stars for 1st January of the year for which the Ephemerides are calculated, are given. The object of such Ephemerides is to give the place of the star with accuracy sufficient merely to leave no doubt as to the identity of the particular star, which all observers are requested to use during the observations for the day thereby provided for. It is requested that those who may have the goodnes to coöperate in these observations will observe the planets also, both for R. A. and Dec., at their meridian passage.

The order of observations, proposed by Lieut. Gilliss, is this:—During the term of the Ephemeris of Mars, differential measurements upon that planet, and the star of comparison for the day, will be commenced at two hours after the passage of the planet across the meridian of Greenwich, and be continued for one hour and a half after the star and planet shall have passed the meridian of Washington; observing and comparing with the star, the North and South Limb of the planet alternately.

Both the planet and star of comparison will also be observed, with the Meridian Circle, at their transit across the meridian of the Observatory in Chile. The same course is proposed to be pursued, at meridian transit, with regard to Venus and her star of comparison. Lieut. Gilliss proposes to commence the differential observations upon Venus and her star of comparison, as given in the Ephemeris, as early in the evening and morning, and to continue them as long, as the light of the

Sun and the conditions of the atmosphere may admit. Owing to the absence of stars of sufficient magnitude within 15° of the Sun, an omission is made in the Ephemeris during the time that the planet will be within that distance of the Sun. It is proposed, during such intervals, to rely exclusively on meridian observations, both at the Observatory in Chile and elsewhere.

The precise place in Chile, at which the Observatory is to be erected, will not be decided upon until the arrival there of the Expedition.

Those Astronomers, who are disposed to forward the objects of the Expedition so far as to coöperate with it in conducting an auxiliary series of observations, will perceive that the results of their labors will be enhanced by using, whenever practicable, the stars of comparison which Lieut. Gilliss has selected, and which are given in tables 1 and 2, and by following generally the plan of observations proposed by him and herein explained. Each co-laborer is requested to send annually, to the Superintendent of the National Observatory, at Washington, his observations, with an account of the instruments with which they were made, together with such other information in relation thereto as is necessary to a full understanding and appreciation of them and the results arising therefrom.

6. *Introduction to Meteorology;* by David Purdie Thomson, M.D., Grad. Univ. Edinb., Licent. Roy. College of Surgeons, Edinb. 486 pp. 8vo. Edinburgh and London. 1849, Wm. Blackwood & Sons.—The work on Meteorology by Dr. D. P. Thomson, ranges over the whole field of meteorology in its widest sense, including the general characters of the atmosphere, chemical and physical, barometric, thermometric and hygrometric, as well for heights as for the ordinary level, and for all zones. The causes of the distribution of temperatures are considered —the color of the atmosphere—various properties of light—clouds, rain and snow and all allied phenomena in their many details, even to "Dust-rains," "Fish-rains," "Frog-rains," and "Blood spots;"—also mirage, and lightning in all its varieties of action and effects;—meteors and their theories and supposed agency;—auroras, and other lights to the "ignis fatuus:"—winds and their theories; and descriptions of various instruments for meteorological observation. There is in some departments a want of system in the presentation of the facts and of discrimination in their selection and condensation, which interfere with the scientific value of the work,—a defect which may however increase its popular interest. The chapter relating to winds abounds in the wonderful, with too little true science. Various incidents are introduced by way of illustration that give variety to the subject treated, and an excellent literary taste pervades the work.

7. *A Memoir on the Geological Action of the Tidal and other Currents of the Ocean;* by Charles Henry Davis, A.M., Lieut. U. S. N. —From the Memoirs of the American Academy of Arts and Sciences, New Series, vol. iv, 40 pp., 4to, with three maps. Cambridge. 1849.— No observations at the present time can better promote the progress of geology than those relating to the tidal currents of the ocean and the distribution of material thus produced: and science owes much to Lieut. Davis for the exposition of this subject which he has made. Our coast affords facts of a most extended and varied character, and

we may hope that similar observations will soon be extended along its whole outline. The investigations here detailed were made about the Nantucket shoals and Long Island. The author exhibits in a strong light the action of the tides in the accumulation of the loose material constituting shoals, and in determining their positions and outline.

8. *Sixty-second Annual Report of the Regents of the University of the State of New York;* made to the Legislature, March 1, 1849. 392 pp. 8vo. Albany. 1849.—This Report, besides its fund of information relating to education in New York, contains, as heretofore, meteorological tables for the year, made throughout the state and various observations on different atmospheric phenomena. There are also some pages devoted to topographical and other information relating to portions of the state and even to other states, a part of which are valuable, and another part add nothing to the reputation of the Report.

9. *Reports, etc., of the Smithsonian Institution, exhibiting its Plans, Operations and Financial Condition up to January* 1, 1849. From the third Annual Report of the Board of Regents: Presented to Congress, Feb, 19, 1849. 72 pp. 8vo. Washington. 1849.—The objects and plan of the Smithsonian Institution have been noticed at length in a former number of this Journal. It is gratifying to learn that these plans, so noble and comprehensive, are in process of accomplishment under the supervision of its learned Secretary, Prof. Henry.

10. *A collection of Tables and Formulæ useful in Geodesy and Practical Astronomy, including Elements for the Projection of Maps;* prepared by order of the Topographical Bureau for the use of the Corps of Topographical Engineers; by Capt. T. J. Lee, Topographical Engineer. 96 pp. 8vo. Washington. 1849. No. 3 of Papers relating to the duties of the Corps of Topographical Engineers.—The Topographical Bureau of our Government, under the general direction of Col. J. J. Abert, is conferring a great benefit on the science of the country, by its recent publications. The work before us has more interest than pertains to a manual for Engineers: its utility will be appreciated by a wide range of readers. It presents in a perspicuous manner the various trigonometrical expressions, formulas and series used in calculations, commencing with the most simple; embracing equations for the circumference and arcs of circles—and for sides and surfaces of triangles:—next explains fully the standards of weights and measures, giving many tables, including long comparative tables of English and French measures, &c.: then passes to Expressions for Surfaces and Contents of Solids of various kinds—Formulas in Hydrometry—Expressions for Arithmetical and Geometrical progression—Force of Gravity—Tables and Formulas in Geodesy, drawn out with the fullness of detail required in the most thorough surveys, with extended tables for the various corrections, as of temperature, the earth's ellipticity, &c.—Tables of Corrections for Refraction in Trigonometrical altitudes—Table of Slopes for given ratio of altitude—Full rules for Barometrical determination of Heights, with several tables for corrections, and others for the comparison of different thermometers, and for French and English barometers—Rules for the Thermometrical Measurement of Heights—Formula for projection of Maps, with a number of valuable tables—Table of the lengths, in Nautical and Statute miles, of degrees

of Latitude and Longitude in different Latitudes—Tables of formula for Astronomical observations, and especially for determination of Time, Latitude and Longitude. Such a number of useful tables and formulas—and we have given but a partial enumeration of them—have never before been brought together in the same compass. Moreover we cannot commend too highly the clear typography of the volume, and the perspicuity of its arrangement, nor the apparent care and labor with which the work has been prepared by Captain Lee.

11. *Description of a System of Military Bridges with India Rubber Pontons, prepared for the use of the United States Army;* by Capt. George W. Cullum, U. S. Corps of Engineers.—Paper No. 4, from Papers on Practical Engineering, published by the Engineer Department, for the use of the Officers of the United States Corps of Engineers, pp. 274 to 414 and plates 18 to 22 inclusive. The valuable memoir whose title is here cited, is illustrated by full details, giving all the particulars required in the construction of Bridges with India Rubber Pontons.

12. *Transactions of the New York State Agricultural Society, with an abstract of the proceedings of the County Agricultural Societies.* Vol. viii. 1848. Albany. 1849. 8vo., pp. 975.—The able and industrious secretary of the State Society, has placed this huge volume in our hands. Its contents are various, but important and interesting—worthy of the state from whose public assembly this volume issues as a part of their legislative proceedings. Mr. Salisbury's memoir on the chemical constitution of Indian corn, forms a part of this volume. The addresses and proceedings of the Society and the agricultural returns of the several counties of the state, agricultural discussions on various topics by the members of the State Society, occupy a large part of the volume, which is concluded by an agricultural survey of Washington county, by Dr. Asa Fitch. Among the most important matters discussed in this volume is the subject of a Normal Agricultural School, to be established by the State government, for the proper promotion of agricultural education and research. This is a subject of commanding importance, and it behooves the state of New York to set a liberal and enlightened example in this respect.

13. *History and Chemical Investigation of Maize, or Indian Corn;* by J. H. Salisbury. Albany. 1849.—This research is a "Prize Essay," to which the New York State Agricultural Society have awarded their premium of $200, offered two years ago. This "Essay" forms part of the valuable volume of Transactions of the Society for this year, just published as above noticed.

Mr. Salisbury's research is very elaborate and extended. It is embodied in 206 octavo pages, a large part of which is taken up with closely printed tables of analytical results, and of calculations deduced from them. We have received this essay at the moment of going to press, and have had no opportunity to make a critical examination of Mr. Salisbury's methods or results. We have however, seen enough to know that great labor has been bestowed on this research, and that the author's attention has been devoted to a wide range of inquiry in reference to the chemical constitution of all parts of this great American staple grain, and of the soils and manures upon which it has been grown. It is also evident, that our knowledge of the chemical history of this grain, is greatly extended by Mr. Salisbury's labors. We promise ourselves the pleasure of again reverting to this memoir on another occasion, when we can have space to take it up somewhat in detail. We must now confine ourselves to the following table (Table 60 of the memoir) exhibiting the composition of the *ash* of the kernels of three varieties of maize.

	Ash of kernels of the Chinese tree variety.	No. 11. Ash of kernels of the Tuscarora variety.	No. 15. Ash of kernels of the R. Island sweet variety.
Carbonic acid,	trace.	trace.	trace.
Silicic acid,	1·700	0·775	1·125
Sulphuric acid,	1·075	1·275	0·550
Phosphoric acid and peroxyd of iron,	49·185	44·135	44·050
Lime,	0·620	0·395	0·335
Magnesia,	16·200	12·875	12·810
Potash,	12·930	14·240	12·867
Soda,	15·365	20·545	22·968
Chlorine,	0·440	0·450	0·270
Organic acids,	2·125	3·520	3·025
	99·640	98·210	98·000

14. *Notes on the Medical Application of Electricity;* by William F. Channing, M.D. Boston: D. Davis, Jr. and J. M. Wightman. 1849. 12mo, pp. 199.—This unpretending little volume emanates from a source which entitles it to great confidence as a faithful record of the present state of our knowledge of the application of electricity in the treatment of human disease. The subject is treated under the following heads. 1. Physiological relations of Electricity. 2. Forms of Medical Electricity. 3. Means of Application. 4. General application to disease. 5. Special application to disease. Dr. Channing treats each of these topics in a perspicuous manner, and the last two with special fullness. He gives a decided preference in a majority of cases, to electro-magnetism and magneto-electricity as a means of excitement in medical cases.

15. *Davis's Manual of Magnetism;* by Daniel Davis, Jr. 1848. Boston: 2d edition. 12mo, with 180 original illustrations.—Mr. Davis's Manual has long been a handbook with all teachers and many students of electrical science in this country. It is peculiarly an original and valuable work, and the forms of apparatus which it figures and describes, are now acknowledged to be the best which are in use for experimental illustration. Many minds have united to produce this result, and Mr. Davis has been peculiarly favored in having the advice and assistance in contriving his apparatus, of such men as Prof. Henry and Drs. Page, Channing and Bacon. Under the charge of the two latter gentlemen, the present (as well as the former) edition of this Manual has been principally prepared.

16. *Knapp's Chemical Technology*, vol. ii, illustrated with 246 engravings. Philadelphia: Lea & Blanchard. 1849.—The second volume of this work under the editorship of Prof. W. R. Johnson, has been some time in our hands from the enterprising publishers. The mechanical

execution of these works leaves little to be desired, and the wood-cuts are equalled only by the other volumes of the series of illustrated scientific works of which this is one. This volume is devoted to the detailed description of the process of Glass making in its various departments, and the manufacture of Alum, of Copperas, and of Oil of Vitriol, all of which are subsidiary to Glass making. Groupe III. is devoted to Clay wares, the manufactory of Pottery and Porcelain, including Bricks. Groupe IV. is devoted to Lime, Mortar, Gypsum, Magnesia, Barytes, and Strontia.

Dr. Knapp's happy union of scientific accuracy with a minute knowledge of practical details, renders his works of the greatest value to all who take an interest in the progress of the scientific arts.

17. *The Nautical Slide Rule;* by PAUL CAMERON. 2d edition. London. 1848. 12mo, pp. 58.—The author of this treatise is the inventor of an instrument for the use of navigators, which he calls a Nautical Slide Rule, and another which is called the Mechanical Sliding Rule. These instruments appear to be capable of solving instrumentally or by construction a large range of practical problems, alike in navigation and general mechanics, and withal to be of a very simple and practical character.

18. *Second Report of Experiments on Gunpowder, made at Washington Arsenal in* 1845, '47, *and* '48*;* by Brevet Major ALFRED MORDECAI, of the Ordnance Department. Washington. 1849.—Major Mordecai's former experiments on Gunpowder and Guns, are well known (see this Jour., i ser., vol. xlix, 180) as having added very greatly to the extent and accuracy of our constants in this difficult department of physical investigation. The following are the principal objects which were proposed in continuing the experiments with the ballistic pendulum :—

1. To ascertain the smallest calibre of gun which may be relied on to give satisfactory results, in using the ballistic pendulum as an instrument for proving gunpowder.

See "Report of Experiments on Gunpowder, at Washington Arsenal, in 1843 and 1844," p. 320.

2. To ascertain the initial velocities of balls fired from field guns and howitzers, with various charges.

3. To ascertain the charge of maximum effect, and also the relative force of a given charge, in guns of various lengths of bore.

4. To extend the experiments on the windage of balls, in order further to develope the law of variation of the force of the charge, with various windages.

5. To extend the experiments on balls of various weights, in order to compare the force of the charge, with different weights of ball, in its effects on the gun, as well as on the shot.

19. *Craig's Universal Dictionary of the English Language, embracing all the terms used in Art, Science and Literature.* 2 vols., 8vo. pp. 1053 and 1100. London. 1849.—Mr. CRAIG is Lecturer on Geology in Anderson's University, Scotland. This dictionary retains in its main features the peculiarities of Walker. Its definitions are full and accurate, being largely derived from Webster. The orthography and orthoepy of the work are of course deeply tinctured by the Old Eng-

lish (Irish ?) standard, which is chiefly its basis on these points. It is beyond our province to discourse upon lexicography, but our attention was called to this work by the arrival at a late hour of a copy from the author. It is certainly singular that Englishmen should again be indebted to a stranger for another dictionary of the English language. Thus in succession has an Irishman, an American, and a Scotchman, presented England with lexicons of their own language, compared with which their own works have been imperfect and unpopular.

Proceedings of the American Association for the Advancement of Science.—First Meeting, held at Philadelphia, Sept., 1848. 156 pp. 8vo. *Philadelphia,* 1849.

Report of the Eighteenth Meeting of the British Association for the Advancement of Science, held at Swansea in August, 1848. xl, 98 and 138 pp. 8vo. *London,* 1849. *John Murray.*

J. M. Gilliss: On the Longitude of Washington. From the Proceedings of the American Philosophical Society. *Philadelphia,* 1849.

J. Curtis, F.L.S. British Entomology, being Illustrations and Descriptions of the Genera of Insects found in Great Britain and Ireland. 16 vols. Roy. 8vo. 770 copper plates.—This work is about to be re-issued by Reeve, Benham & Reeve, at about half its original cost—£21 for complete copies to subscribers.

T. Moore: A Handbook of British Ferns. London. 5s.

Proceedings Bost. Soc. Nat. Hist. FEBRUARY, 1849. Epoch of the Mastodons; *H. D. Rogers, Mr. Foster, Desor.* p. 118. New shells of the Exploring Expedition under Capt. Wilkes, (Genera Trochus, Planaxis, Cerithium,) *A. A. Gould.* —MARCH. p. 122. Telluret of lead and gold from Virginia; *C. T. Jackson.*—p. 122. Structure of Glaciers, illustrating laminated structure of rocks; *H. D. Rogers.* —p. 125, same subject; *Desor.*—APRIL. p. 131. On the angles of Arkansite; *J. E. Teschemacher.* p. 132, on the inhalation of nitrous oxyd, chloroform and sulphuric ether; *C. T. Jackson.*—p. 133. Development of Syncoryne; *Desor.*—p. 137. Development of Aurelia aurita; *Desor.*—p. 140. New shells of the Exploring Expedition under Capt. Wilkes. (Genera Pleurotoma, Mangelia, Fusus, Triton, Phos, Murex.)

Bulletin de la Soc. Imp. des Naturalistes de Moscow, 1848; No. II. Insects of Southwest Liberia; *F. Gebler.* Elements for a history of Russian Malacozoology; *Th. v. Middendorf.*—On Spermatophora; *G. Gros.*—Fossil Crustacea of the Jura of Moscow; *A. Vosinsky.*—European species of the genus Corisa; *Fieber.*—On the Glycia virgata and the genus Blechrus; *Motschoulsky.*—Critical Remarks on Erichson's Naturgeschichte der Insekten Deutschland, &c.; *Motschoulsky.*—Decades quarta et quinta generum plantarum adhuc non descriptorum; *Turczaninow.*—On some fossil bones of the government of Orel; *Borissjak.* No. III. Insects of Southwest Liberia; *F. Gebler.*—Flora of Dahura; *Turczaninow.*—Fossil cephalopoda of Kalouga and Moscow; *Fischer de Waldheim.*—On the Saurians of the Zechstein of Russia; *E. Eichwald.*—New Russian Lepidoptera; *E. Eversmann.*—Decomposition of spathic iron by heat; *E. Glasson.*—On Saussurea Karelinii; *S. Stcheglêew.* Pelopœus destillatorius; *E. Eversmann.*—Botanic notices; *Steven.* No. IV. Anatomical investigation of the Galeodes aronoides and G. intrepida; *M. Kittary.*—Geological relations of the Governments of Orenburg and West Ural; *Wangenheim v. Qualen,*—New Cecindelæ and other insects of Russia; *Chaudoir.*—Fossils of Orel; *Fischer de Waldheim.*—Flora of Dahuria; *Turczaninow.*—Mines of Bieloussowsk; *Syranowzk.* —On the beaver; *G. C. Eigenbrodt.*—Analysis of Glaucolite; *Giwartowsky.*—1849, No. 1. Geology of Moscow; *C. Rouiller.*—"Staphylinen Fauna" of the Caucasus and the region beyond; *J. H. Hochhuth.*—On the Crioceras Voronzovii; *Fischer de Waldheim.*—New Siberian Coleoptera; *Mannerheim.*—Comet of August, 1847; *G. I. Schweizer.*—Two venomous spiders of Southern Russia; *Motschoulsky.* —On a Russian Daphne; *J. Kaleniczenko.*—Examination of several minerals; *R. Hermann.*

APPENDIX.

American Association for the Advancement of Science.—The annual session of the American Association was held at Cambridge in Massachusetts on the 14th of August, and the session continued until Tuesday, August 21st, being the longest session yet held by this body. A large number were in attendance from all parts of the country, and the arrangements of the local committee were ample both for the personal accommodation of the members, and for the sessions of the sections. The division into two sections, 1. Of General Physics, and 2. Of Natural History, took place on the second day, and before the close of the meeting, a farther subdivision was made into *four* sections.

The great improvement both in the quantity and quality of the matter offered over any previous year was very observable to those who have followed the sessions of this body from its origin in the Convention of Geologists at Philadelphia in 1840, to its present enlarged and comprehensive form of usefulness. It was obvious that the Association had now become truly national in character, and had taken deep hold of the feelings of men of science and investigators in all departments of knowledge. This manifestation is the best earnest of the future energy and prosperity of the Institution, and gives encouraging hope for farther progress and greater usefulness. Dinner was provided daily for the members in Harvard Hall, and on these occasions the ladies enlivened the hour by their presence—which was extended also to the meetings of the sections. Numerous invitations were received from eminent individuals and public bodies in the neighborhood to visit various objects of interest in science, and on the day after the session closed, several of the naturalists and others accompanied by ladies joined in a dredging excursion in Boston harbor.

The Local Committee and the officers of Harvard College exerted themselves in every way in their power to make the occasion one of pleasure and profit to their guests, many of whom found the most hospitable treatment at their hands, and all were so impressed with the proprieties of the occasion that they will not soon forget the classic shades of the University at Cambridge.

The next annual session of the Association is to be held at New Haven in Connecticut, on an invitation from the officers of Yale College. The President for 1850 is Dr. Alexander Dallas Bache, the Secretary Edward C. Herrick, Esq., and Dr. Ellwyn, Treasurer. The session takes place on Monday, Aug. 19th, 1850. There is also to be a semi-annual session, to be held at Charleston, South Carolina, in March, 1850.

We can give at this late moment only the list of memoirs read at this session, and in the order of the daily announcements.

Tuesday, Aug. 14.

1. On the Aurora Borealis, by Prof. Secchi of Georgetown, D. C.

2. On the Polar Plant, by Maj. B. Alvord, U. S. A.

3. On the Plants of Wisconsin, by J. A. Lapham, Esq., of Milwaukie.

4. The Fossil Crinoideæ of Tennessee, by Prof. G. Troost of Nashville.

5. A plan for the Diffusion of Human Knowledge.

Correspondence in relation to the Altona Observatory.

Structure of Coral Animals, by Prof. Louis Agassiz.

6. On the Fossil genus Mosasaurus and new allied genera in the United States, by R. W. Gibbes, M.D.

Wednesday, Aug. 15. *General Session,* 10 *A. M.*

1. On an American Prime Vertical, by Lieut. Charles H. Davis.

After the reading of this paper, the members met in two sections, when the following papers were presented,—

SECTION OF GENERAL PHYSICS.

2. On the Natural Classification of Curves, by Rev. Thomas Hill.

3. On Planetary Perturbations, by Prof. Benjamin Peirce.

4. On a Comparison of the Results derived in Geodesy from the method of least squares, by Prof. A. D. Bache.

5. On Boltonite, by William Seamann, Esq., M.D.

6. On Boltonite, and on Thompson's Bi-silicate of Magnesia, by Prof. Benjamin Silliman, Jr.

7. On the Moisture, Ammonia and Organic Matter of the Atmosphere, by Prof. E. N. Horsford.

SECTION OF NATURAL HISTORY.

1. On the Zoological Character of Young Mammalia, by Prof. Louis Agassiz.

2. On the Vegetable Character of Xanthidium of Ehrenberg, by Prof. Louis Agassiz.

3. On Valerianate of Morphine, a new medicine, by Dr. Morrill Wyman and Prof. E. N. Horsford.

4. On Footmarks in the Red Sandstone, by I. Lea, Esq.

5. On Volcanos not Safety Valves, by James D. Dana, Esq.

6. On the Remains of a Fossil Elephant, found in Vermont, by Prof. Louis Agassiz.

7. On the Existence of Remains of Mastodon angustidens in the United States, by Dr. J. C. Warren.

Thursday, Aug. 16.

SECTION OF GENERAL PHYSICS, CHEMISTY, ETC.

1. On the Relation between the Elastic Curve and the Motion of the Pendulum, by Prof. B. Peirce.

2. On the Second Recorded Comet of 1784, commonly called Comet of D'Angas, by Dr. B. A. Gould, Jr.

3. Remarks on Terrestrial Thermotics, by Lieut. E. B. Hunt, U. S. E.

4. On Indianite of Bournon and an American Mineral which has been distributed under the same name, by Prof. B. SILLIMAN, Jr.

5. On the so-called Picrolite and Slaty Serpentine of Texas, Lancaster Co., Pa., by Prof. B. SILLIMAN, Jr.

6. On the Chemical Constitution of the Gorgonia antipathes of Bermuda and the West Indies, by Prof. B. SILLIMAN, Jr.

7. On the Explorations of the Gulf Stream in connection with the U. S. Coast Survey, by Prof. A. D. BACHE.

8. On the Ribbon Structure of Glaciers, and its analogy to Slaty Cleavage, by H. D. ROGERS.

SECTION OF NATURAL HISTORY, GEOGRAPHY, &c.

1. On the Erratic Phenomena of the Central Alps, by Prof. ARNOLD GUYOT.

2. On the Circulation of Fluids in Insects, by Prof. LOUIS AGASSIZ.

3. On the Embryology of Ascidia and the Characteristics of New Species from the shores of Massachusetts, by Prof. LOUIS AGASSIZ.

4. Note on the Mirage on Lake Superior, by Dr. C. T. JACKSON.

5. Remarks on the distribution of Testacean Mollusca in Jamaica and the other West India Islands, by Prof. C. B. ADAMS.

6. On the Erosions of the Earth's Surface, by President EDWARD HITCHCOCK.

7. On the River Terraces of the Connecticut Valley, by President EDWARD HITCHCOCK.

8. Description of Certain Mineral Localities, chiefly in the Northern part of Worcester and Franklin Counties in Massachusetts, by CHARLES HARTWELL and EDWARD HITCHCOCK, Jr.

9. On the Structural Features of the Appalachians compared with those of the Alps and other disturbed districts of Europe, by Prof. HENRY D. ROGERS.

There was a general meeting at Lyceum Hall in the evening, when an address was presented :—

On the progress of the Survey of the Coast of the United States, by Prof. A. D. BACHE.

Friday, Aug. 17.

SECTION OF PHYSICS, CHEMISTRY, &c.

1. Report on the Progress of the Telegraphic Determinations of Difference of Longitude in the U. S. Coast Survey, by SEARS C. WALKER.

2. Experimental Determinations of the Economical Value of British and American Fossil Fuel, by Prof. W. R. JOHNSON.

3. On Leucine, by T. S. HUNT.

4. On the Mineral Waters of Canada, by T. S. HUNT.

5. On the Occurrence of Soda in Anthracite, by Prof. HORSFORD.

6. On the color of fused Sulphur, by Prof. HORSFORD.

7. A new form of Demonstration of the Parellogram of Forces, by Prof. PEIRCE.

SECTION OF NATURAL HISTORY, GEOLOGY, &c.

1. On the Trend of Islands and Axis of Subsidence in the Pacific, by J. D. DANA.

2. On new species of Myliobates, and on new fossils of the Cretaceous and Tertiary of the U. S., by Dr. R. W. GIBBES.

3. Fiords, evidence of a change of Level, by JAMES D. DANA.

4. On the origin of the Drift of the Lake and River Terraces of the U. S., with an examination of the laws of Aqueous Action connected with the enquiry, by Prof. H. D. ROGERS.

5. On some Fossil Remains of Broome County, N. Y., by J. S. REDFIELD.

6. On the Larva of Physocœlus inflatus, by S. S. HALDEMAN.

7. On the Habits of Amphiuma in a state of captivity, by J. L. LECONTE.

8. On some Curious Habits of a Species of Asilus, by J. L. LECONTE.

9. New species of Medusæ, Echinoderms and Crustacea, by Prof. AGASSIZ.

AFTERNOON GENERAL MEETING.—[4½ o'clock.]

1. On the Electricity of a Plate of Zinc buried in the Earth, by Prof. E. LOOMIS.

2. On an Electrical Phenomenon, by Prof. HENRY.

3. On the Supposed Association of Electricity with Cholera, by Prof. HARE.

4. A Letter on Medical Geology, by J. A. LAPHAM.

Saturday, Aug. 18, 10 *o'clock, A. M.*

SECTION OF PHYSICS, CHEMISTRY, &c.

1. On a newly discovered Analogy in the time of the Rotation of the Planets, discovered by Mr. Kirkwood, of Penn., by S. C. WALKER.

2. Phenomena attending Saturn's Ring, by GEORGE P. BOND.

3. On the Electro-dynamic Forces, by Prof. LOVERING.

4. On the American Climate and the Theories of its Storms, by Prof. HARE.

5. Upon the drift of wrecked material on the South coast of Long Island; and on recent changes in Cape Hatteras, by Lieut. DAVIS.

SECTION OF NATURAL HISTORY, GEOLOGY, &c.

1. Observations on some Tracks in the Sandstones of the *Clinton Group*, of New York, and their probable Origin; also upon some Trails in the surface of these Sandstones, by Prof. HALL.

2. On the Copper Mines of Lake Superior, by C. T. JACKSON.

3. Exhibition of some of the Bones of the Dinornis Novæ-Zealandiæ, with remarks, by Prof. CHASE.

4. On some new points in the Morphology of Cells, by Dr. W. J. BURNETT.

5. Some remarks upon Erratic Phenomena in the White Mountains, by Prof. GUYOT.

Monday, Aug. 20, 10 *o'clock, A. M.*

SECTION OF PHYSICS, CHEMISTRY, &c.

1. General Tables for the Reduction of the apparent places of Stars, by Prof. J. S. HUBBARD.

2. Notice of a Chronometric Expedition for ascertaining the difference of Meridians of Greenwich and Cambridge Observatories, by W. C. Bond.

3. Remarks on the Occulation of Aldebaran observed at Nantucket, by William Mitchell.

4. Determination of the Water contained in Crystallized Sulphate of Quinine, and a method for testing the purity of the commercial article, by Dr. C. Linck.

5. On a New Method of Observing Right Ascension and Declination, by Prof. Mitchell.

6. On the Fat of a large Sea Turtle, by Dr. C. Linck.

SCCTION OF NATURAL HISTORY, GEOLOGY, &c.

1. Observations on the Brachiopoda, &c., by Prof. Hall.

2. Remarks upon Graptolites, their duration in Geological Periods, and their value in the Identification of Strata, by Prof. Hall.

3. On the Geological Structure of Eastern Canada, by T. S. Hunt.

4. On the Mineral Region of Lake Superior, by James S. Hodge.

5. On the Sediment of the Mississippi, by W. Marr, U. S. N.

6. Letter on a New Cave in Kentucky, by L. Feuchtwanger.

7. On the Right Whale of the Southern Hemisphere, by Lieut. Maury.

8. On the plan of Structure and Homologies of Radiated Animals, with reference to the systematic position of the so-called Hydroid Polypi, by Prof. L. Agassiz.

9. On the Homologies of Acephala and Gasteropoda, with reference to the systematic position of Brachiopoda, &c., by Prof. L. Agassiz.

10. On the Differences between Sirenidea and true Cetacea, and the Embryonic Characters of the former, by Prof. L. Agassiz.

11. On the Difference between Embryonic and Prophetic Types in the succession of organized beings through the whole range of geological times, by Prof. L. Agassiz.

12. On Bone Caves of Pennsylvania, by Prof. Baird.

13. On the Genus Phalangopsis, by S. S. Haldeman.

14. On the Metamorphosis of the Urodelian Batrachians, by Prof. Baird.

15. On the Skulls of the smaller Mammalia of Massachusetts, by Dr. Wheatland.

GENERAL MEETING: EVENING SESSION, (in Lyceum Hall, 7½ o'clock, P. M.)

1. On Animal Morphology, by Prof. Agassiz.

2. On Linguistic Ethnology, with illustrations chiefly from the Aboriginal Languages of America, by S. S. Haldeman.

Tuesday, Aug. 21, 10 *o'clock, A. M.* [The last day of the Session.]

SECTION OF PHYSICAL CHEMISTRY, &c.

1. On Meteorological Instruments, by Prof. Guyot.

2. Remarks on a proposed Prime Meridian for American Longitude, by Prof. Holton.

3. On Ammonio-chlorid of Magnesium, by Dr. Linck.
4. Geometrical Interpretation of Analytical Notation, by J. Patterson.
5. On a Self-registering Anemometer, by James H. Coffin.
6. On a Curious Phenomenon relating to Vision, by Prof. Lovering.

SECTION OF NATURAL HISTORY, GEOLOGY, &c.

1. On some Characteristic Compositæ, by A. Gray.
2. On a Process for selecting the Remains of Infusoria in Sedimentary Deposits, by Prof. Bailey.
3. On Leptæna and Spirifer, by Prof. Hall.
4. On the Embryology of Cephalopoda, Aphides, Birds and Reptiles, by Prof. Agassiz.
5. On the Histology of Invertebrate Animals, by Prof. Agassiz.
6. On several points of Embryology in connection with Classification, by Prof. Agassiz.

GENERAL MEETING.—(Four o'clock, P. M.)

1. On the Application of the Principles of Acoustics to the Construction of Lecture-rooms, &c., by Prof. Henry.
2. On the Composition of Plant Phytons, and some Applications of Phyllotaxis, by Prof. Gray.
3. Mathematical Investigation pertaining to Phyllotaxis, by Prof. Pierce.

ERRATA.

Page 254, line 10th from top, for $\frac{(a^2c^2)x}{a^2y}$ read $\frac{(a^2-c^2)x}{a^2y}$

The next No. of this Journal will be published on the first of Nov.

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(*For remainder of Contents, see third page of Cover.*)

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THE

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OF

SCIENCE AND ARTS.

CONDUCTED BY

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AND

JAMES D. DANA.

SECOND SERIES.

No. 24.—NOVEMBER, 1849.

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Twelve copies of every *original communication*, published in this Journal, are if requested at the disposal of the author. Any larger number of copies will be furnished at cost. Authors should always specify at the head of their MSS. the number of extra copies they may wish to have printed; it is too late after the forms are broken up.

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

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

Our British correspondents are requested to forward all communications and parcels to Mr. T. Delf, Putnam's American Agency, 49 Bow Lane, Cheapside, London, who will forward all works of which notice may be desired in this Journal. It is also desired that all persons who may have works in progress, will send a notice of them, that they may be inserted among the accounts of new publications.

Persons having old numbers to sell, will please send us a list of the same and we will at once designate what we want, if any, and the price in cash which we can pay for them. Current numbers of Second Series will in some cases be given in exchange for old numbers of either Series.

April, 1849.

To the Banking Institutions of the United States.

THE attention of bank officers, and other holders of negotiable paper, and notaries, is desired to the late and important cases reported and published in the BANKERS' MAGAZINE; cases which affect the business of all monied institutions. The cases reported are upon the following subjects:—

I. NOTARIAL NOTICES OF PROTEST.
II. TRANSFER OF STOCK BY EXECUTORS.
III. GRACE ON SIGHT BILLS.

I. OF NOTARIAL NOTICES.—By recent decisions in the highest courts of England, confirmed by cases in the Supreme Court of New York, and the Supreme Judicial Court of Massachusetts, it will be found that many of the notarial notices of protest at present in use in New York, Maryland and other states, ARE INFORMAL AND VOID, as against endorsers.

It will be found by numerous banking institutions throughout the country, that their securities (so far as their endorsers are concerned) are of little value. The omission of important words in notices of protest, exposes holders of negotiable paper to great and unnecessary risks,—which could be obviated with a little care.

II. TRANSFERS BY EXECUTORS.—An equally important topic to all incorporated companies is the view taken by Judge Taney (Chief Justice Supreme Court U. S.) of the liability of corporations for stock improperly transferred by executors. This opinion was delivered by Judge T. in the Circuit Court of the United States, July, 1848, in the important case of *Lowry vs. The Commercial and Farmers' Bank of Baltimore*, the publication of which in the Bankers' Magazine has already changed the usage of several banks in regard to *transfers by executors.* In this case the bank (confessedly one of the best managed institutions in the country, and its stock above par for years past) permitted the transfer of two hundred and eighty-two shares of its stock by the executor of a deceased stockholder, without such an examination of the *Will* as would have forbidden the transfer.

"The bank is equally chargeable for the neglect or omission of duty by the officer to whom it had committed the superintendence of the transfers of stock, as it is for the neglect or omission of its president—and such officer is equally chargeable with implied notice of the *Will.*

"The bank was bound to take notice of the Will of the testator when this transfer was proposed to be made by one of the executors. It was negligence in the bank not to examine it: and if it was ignorant of its contents, and of the specific bequest of this stock, it was its own fault.

"Although it may not have actual notice of the contents of the Will, yet as it was dealing with an executor in his character as such, the law implies notice."

III. GRACE ON SIGHT BILLS.—The late decisions contained in this Magazine have induced many banks to be extremely cautious in their dealings with their correspondents, in reference to *grace on Sight Bills.*

A cashier of one of the Boston banks writes us as follows:—

"I am aware that a different *usage* has prevailed with the banks of New York and other cities, but I have always considered that they assumed a great responsibility, as it is well known that our courts never allow usage to take the place of an established principle of law, or to be pleaded as an excuse for its infraction."

The following articles in this Magazine are published in *no other periodical in this country*, and claim the attention of all bank officers:

1. Chief Justice Taney, Supreme Court United States, on Transfers of Stock by Executors.	*Vol.* III.
2. Chancellor Johnson of Maryland, on Transfers of Bank Stock, ...	" IV.
3. The Law of Grace on Sight Bills, ...	" III.
4. Late cases in the highest Courts of England, and in the Supreme Court of New York and Massachusetts, as to Notice of Protest, ...	" IV.
5. Baron Humboldt's last Essay on the Production and Supply of Precious Metals, (*translated for this work*,)	" III.
6. Opinions of Joshua Bates, Adam Hodgson, Horsley Palmer, and Messrs. Tooke, Gurnoy, Turner, Morris and Pease, upon the Commercial Crisis and the Bank of England, ...	" III.
7. Tables of Foreign Exchange for each month since 1822,	" III.
8. Historical Sketches of the Merchants' Bank in New York, Manhattan Bank, Bank of North America,	" III.
9. Treatise on Banking; by A. B. Johnson, Esq., of Utica,	" III.
10. List of all the Banks in England, Ireland and Scotland, and the Circulation of each, ...	" III.
11. Improvements in Bank Note Paper, for the prevention of forgery, ...	" III.
12. Weights and Measures of all Nations, as compared with those of the United States, ...	" III.

Complete copies on hand of Volume III, price $3, comprising twelve Nos., from July, 1848, to June, 1849, inclusive, 772 pages. The volume can be transmitted per mail to any distance within the United States—postage fifty cents.

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J. SMITH HOMANS,

Editor Bankers' Magazine, Baltimore, Md.

GEOLOGICAL

AND

MINERALOGICAL SPECIMENS.

Mr. KRANTZ, of Berlin, Prussia, begs leave to inform the scientific institutions and private collectors in this country, that he keeps constantly on hand the largest stock of minerals, fossils and rock-specimens, enabling him to make up collections of every extent and complete existing ones. This establishment, numbering the first cabinets in all parts of the world, and the most distinguished private cultivators of the mineralogical and geological sciences among its customers, has constantly, during twenty years, kept pace with the rapid progress of these branches of human knowledge; its travelers are constantly "en route" in all countries of Europe (one of them is now in the United States,) and all efforts are made to secure the acquisition of every thing new or interesting to collectors.

The list of *minerals* contains now about 800 species collected at more than 3000 localities, and forming a cabinet of 10,000 first rate specimens, unrivalled by any known private collection, and representing the state of the science at the very latest date with its most recent discoveries. Besides this standard collection, others of any desirable extent, and arranged in any prescribed system, can be furnished at prices as the adjoined catalogue shows.

For Lecturers the instructive collections for the demonstration of the physical properties of minerals, color, fracture, lustre, composition, etc., etc., are particularly useful. Scale of hardness, blowpipe minerals, etc.

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Orders for minerals and rock-specimens should always mention the size desired.

Fossils.—The number of species of fossil organic remains, amounts to about 8000, collected in all the principal localities of Europe and the United States. All these species are carefully determined as far as the present state of the science permits, and collections for the illustration of all treatises on geology, including the characteristic shells of all formations, can be furnished to any extent within the above number. Each specimen is furnished with a printed label indicating the locality, geological formation, and name; the collections are generally arranged according to the relative age of the formations; for special purposes zoological classifications are adopted if asked for.

A separate part of the catalogue contains prices of casts of rare and interesting fossils of larger size, painted in the colors of the original and forming a valuable complement for public cabinets.

The attention of scientific men is particularly called to Mr. K.'s collection of Saurians from the L. of W., surpassing in some pieces for beauty and completeness, those of the first Museums of Europe.

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Rocks.—About one thousand varieties of rock-specimens are on hand, forming a complete series of all the primary and sedimentary rocks which form the known solid part of our globe. All the specimens of each collection are of the same size and shape, so as to admit of being arranged in an elegant manner, without unnecessary waste of room in drawers or cases.

A few geographical collections of countries interesting to geologists, such as Saxony, the Hartz, Mt. Vesuvius, the Alps, Italy, Hungary, Norway and Sweden, Mexico, and some others are still on hand.

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CASTS OF FOSSILS, ROCK-SPECIMENS AND MINERALS,

FOR SALE BY

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39 *Brüderstrasse.*

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30. 40 species from the Permian System of Thuringia (Zechstein and Kupferschiefer), ... 9 00
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35. 100 species from the Devonian rocks of the Rhine and Eifel, . 12 00

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37. 300 species from the Palæozoic rocks of the United States of America, 70 00
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43. 300 species of Cephalopoda, including the genera Ammonites, Ancyloceras, Baculites, Belemnites, Clymenia, Conularia, Crioceras, Endoceras Gonioceras, Goniatites, Hamites, Lituites, Nautilus, Onychoteuthis, Orthoceratites, Ptychoceras, Scaphites, Toxoceras and Turrilites, ... 75 00

II. CASTS.

Persons wishing to purchase casts, can be furnished with two plates of engravings, representing them.

1. Mastodon giganteum, Pl. II, fig. 6.
   Lower jaw complete, 2¼ feet long; from the diluvium of the Missouri River, ... $6 00
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2. Megalonyx Jeffersoni, Harlan.
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5. Pterodactylus crassirostris, Goldf., Pl. II, fig. 7.
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   Head of a small sized specimen from the same place, . . 1 50
   The original is in the Royal Museum at Berlin.
9. Mystriosaurus species.
   Vertebral spine with extremities (?), same locality, . . . 6 00
10. Ichthyosaurus platyodon. Pl. II, fig. 2.
    Perfect head of a skeleton 60 feet long, ... 9 00
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17.	Pentacrinus subangularis. Pl. II, fig. 1. The best known specimen; stem 7 feet long; same locality, In A. Krantz's cabinet.	$5 00
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20.	Proterosaurus Speneri. Pl. II, fig. 11. Vertebral spine and extremities; from the cupriferous slate of Rothenburg, The original in the Royal Museum at Berlin.	1 25
21.	Holoptychius nobilissimus, Ag. From the Old Red Sandstone of Scotland, The original is in the British Museum.	5 00
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3000	" "	560 00

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100	different specimens,	$ 5 00	100	different specimens,	$ 9 00
150	" "	9 00	150	" "	15 00
200	" "	15 00	200	" "	27 00
300	" "	25 00	300	" "	45 00
500	" "	54 00	500	" "	100 00
1000	" "	135 00	1000	" "	265 00

C. *Minerals.*

Size 2 by 2 inches.			*Size 3 by 3 inches.*		
100	different specimens,	$ 5 50	100	different specimens,	$ 9 00
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300	" "	21 00	300	" "	35 00
500	" "	42 00	500	" "	72 00
1000	" "	105 00	1000	" "	155 00
2000	" "	260 00	2000	" "	375 00

THE

AMERICAN

JOURNAL OF SCIENCE AND ARTS.

[SECOND SERIES.]

Art. XXI.—*Notice of the Narrative of the U. S. Expedition to the River Jordan and the Dead Sea*, by W. F. Lynch, U.S.N., Commander of the Expedition; with Maps and numerous illustrations.

The Dead Sea so remarkable in sacred history and full of mysteries both to the popular and scientific mind, has at last been successfully explored. Its headlands have been mapped out, its bottom has felt the sounding lead, and boats from a country unknown to the ancient world have ploughed its sullen waters. Lieutenant Lynch, to whom the Expedition was intrusted by Government, in 1847 took command of the store ship *Supply*; and was provided for his explorations with two metallic boats—one of copper and the other of galvanized iron. Ten vigorous young American seamen "pledged to total abstinence" were enlisted as a crew for the boats; and to their temperance was attributed their recovery from the extreme prostration consequent on this hazardous service. Lieutenant Dale, an officer of high attainments and abilities, was associated with the commander: and it was with deep grief that we heard the announcement of his death soon after the explorations were completed: he was like Molyneux and Cortigan before him, a victim to the deadly influences that still hover over the old "cities of the plain."

They sailed from New York, Nov. 26, 1847, and landed at Beirut on the 25th of March following. On the 28th they left for St. Jean d'Acre, and took their departure for the lake of Gennesareth, from the river Belus. Their boats, which were made in sections for transportation, were placed on trucks brought for the purpose, and drawn by camels. The party numbered sixteen besides fifteen Bedawins, all well mounted. On the 6th of April they obtained the first view of the Sea of Galilee and the majestic mountains of Bashan beyond; "like a mirror it lay embosomed amid its rounded and beautiful, but treeless hills." It measures seventeen miles long by six broad, and is situated twenty-eight miles east of Acre, and forty-five north of Jerusalem. The depth was found to be 165 feet where greatest, and the hills around were 600 to 700 feet high. Its waters are sweet and transparent, and as of old, fishermen here throw their nets with success. The Jordan flowing from Lake Merom far to the north, passes through this sea and continues on south. The party reached Tiberias, "a walled town of some magnitude, but now in ruins from the earthquake of 1837 which destroyed many of its inhabitants." Near by they visited two baths, in one of which—about eighteen feet across and four feet deep—the water stood at 143° F.: it was saline and bitter, and gave off an odor of sulphuretted hydrogen. They rowed along the shores of the lake to the exit of the Jordan.

The divisions of service now introduced, were as follows:—First, a party by land, keeping as near to the river as possible; next, a party in the boats—the former with the camels, Arabs, &c., led by Lieut. Dale—the latter by Lieut. Lynch. Dr. Anderson was charged with the geology; Mr. Bedlow with the topography, scenery and events; Mr. Francis Lynch with the herbarium; Lieut. Lynch with the river and its productions; Mr. Aulick with its topography and a sketch of the river and its shores. A signal of two guns in quick succession from the boats was agreed upon to summon assistance from the land party in case of an attack on the boats, which was the danger most to be feared.

On the 10th of April they entered the river. The Bedawins,—thirty horsemen with their abas flying in the wind,—were armed with guns in European style. Eleven camels led the way; then followed the cavalry and all in single file, while Lieut. Dale and his officers in the Frank costume, brought up the rear, the whole making an imposing cavalcade. The scenery on leaving the lake was not particularly grand; there were abundance of flowers but no trees. The average breadth of the Jordan at this place was about seventy-five feet; the water was ten feet deep and clear, and where the current was strong they used the oars, only to keep them in the channel. Many wild fowl were frightened from their feeding grounds in the marshes as they descended.

They passed the ruins of the bridge of Semakh which were extremely picturesque, the abutments standing in various stages of decay, and the falling fragments obstructing the course of the river, save where the water runs in a sluice among the masses of stone.

The Jordan is full of rapids, some of which are extremely dangerous, and the boats shot down one after another with no small peril. The river during the day was twenty-five to thirty yards wide, current two and a half knots, water clear and sweet. No rocks cropped out on the banks, but large boulders of sandstone and trap were scattered over the surface. The land on which the party encamped is held upon condition that the Sheikh shall entertain all travellers with a supper, and barley for their horses, and they partook on this occasion of an entire sheep and buckets of rice.

The second day (April 11), the current at first was about two and a half knots, but soon became a foaming rapid, and below were five successive falls of about eighteen feet in all, with intervening rapids. With much labor and no small difficulty the boats were passed safely down, having been previously unloaded; the men plunged into the water to guide them, and ropes with grapnels were also used to let them down stern first in some places. Fishes were often seen in the transparent water, and white storks, ducks, and a multitude of other birds rose from the reeds and osiers or plunged into the thickets of oleander and tamarisks which line the banks.

On April 12, they were about three hours from the ruins of Gadara. They visited the place and found them to consist of columns, tombs, remains of walls, theatres, &c., indicating ancient magnificence; and tradition reports that from one of these tombs the maniac of the time of our Savior issued. A description of the ruins, by Dr. Anderson, is appended to Lieut. Lynch's narrative.

In their conflicts with the rapids of the Jordan, a wooden boat which they had secured at the sea of Galilee for the transportation of their tents had perished, and the party were obliged in consequence to abandon their tents; this much needed protection against the expected heat of the Dead Sea, they appear to have been provided with in some other way. No boats but those of metal could have survived the severe shocks to which they were so often exposed; it was with the utmost difficulty in one case, that they were saved and two of the Arabs rescued from drowning. Rapids continued to occur, proving that the Jordan, except for short and isolated distances, is entirely unfitted for useful navigation.

The Jordan, like most other rivers, has successive terraces upon its banks, and two are very distinct. From a hill 300 feet high, they had a view of the terraces; they were shaped on both sides by the winter rains into conical hills, pyramidal, cuneiform and tent-like—resembling a giant encampment—extending as far south as the eye could reach; the river sometimes glittering through the openings, or "clasping some little island with its silvery arms," or dashing in white foam by some projecting point.

They continued on with safety through the 13th, but not without difficulty. The rapids were most formidable obstacles, proving fully that the representations of the Arab sheikhs were not exaggerated.

In the course of the day, they passed patches of wheat and barley. A beautiful alluvial country succeeded, but without cultivation, and overgrown by thistles and wild grass; large flocks of storks gazed unheedingly upon the caravan. The heat became intense, without a tree or a shelter in the vast plain—the sun's rays beating on their heads and reflected from the gun barrels which were painful to touch or behold, and the whole atmosphere quivering as it ascended in heated currents.

With a current of four to six knots an hour, on April 14th, the boats shot along rapidly, and so great were the windings of the river, that in the course of a quarter of an hour they ran towards almost every point of the compass—as if the holy Jordan were lingering in the calm and silent valley, reluctant to plunge into the salt and bitter sea.

The scenery of the river through the day had little variety; sometimes the current washed the bases of sandy hills or passed along low banks fringed with trees and flowers, and occasional views were highly picturesque; then the river became a raging torrent. Now and then a gurgling rivulet came flowing in, mingling its pure waters with those of the muddy Jordan. The high limestone hills formed a barrier on the western side against the overflowings of Jordan and the floods of the sea of Galilee in the winter and spring, while the low eastern bank fringed with tamarisk and willow and occasional thickets of cane and tangled masses of shrubs and creeping plants, was almost a jungle. A fresh track of a tiger was seen in the mud where he had come to drink, and at another time a wild boar dashed through the thicket and told his course by the sound of broken branches. Birds in many places sung in the trees, the real nightingale ceased not her song, and the bulbul—the Syrian nightingale—when disturbed, flitted to another bower and renewed her melodies. Rapids and cataracts continued to occur, and it required all the address, courage and strength of the crews, not unfrequently jumping overboard and clinging to the sides of the boats, to prevent their being swamped; they always steered for the most rapid part of the torrent, as this was the deepest. As twilight came on, the rapids were numerous, and from the decay of the light, more dangerous.

The river was now falling rapidly,—at the rate of about two feet in a day,—and frequently the sedge and drift-wood were seen lodged on the branches of overhanging trees, higher than the banks, "which conclusively proves that the Jordan in its *swellings*, still overflows the lower plain and drives the lion from his lair as it did in ancient times."

The eroded hills on the upper terrace had a conical form; limestone and conglomerate were the prevailing rock, and it was evident that the whole had been under water. Boulders of quartz and conglomerate were numerous.

From the nature of the country the caravan was compelled to keep at a distance from the river, and the scouts were visible only occasionally upon the bluffs and crests of the hills. Being now in a dangerous region near where Lieut. Molyneux's party was attacked, the land and water parties reunited and formed an armed encampment. The camels were reposing in close proximity, and arms and fires and the people were all around. The caravan, repelled from the western, now crossed over to the eastern bank, while the scouts travelled on the west, to keep a lookout from the heights of land for the safety of the boats, which alone were in danger; the signal of two guns in quick succession from the boats was again agreed upon, that the land forces might close in to their assistance. Some of the party were exhausted by fatigue and by frequent vomiting during the day.

The river varied between thirty and seventy yards in width, the current from two to six knots, and the depth from two to ten feet. On April 15, the heat in the morning was 76°, and it soon became oppressive. The mountains towards the east had a gloomy aspect, being rough and verdureless crags of limestone reflecting a blinding light. In this dreary waste there was no sound, for every living thing had retired from the withering heat and oppressive glare; the wind sighed as it swept over the barren plain; there was no drapery of clouds—the gleam of dawn deepened at once into the intensity of noon. Day after day followed without change; there were no shifting clouds and sunshine, but a monotonous and wearisome azure. The mountains towards the west rose like islands from the sea, the peaks illuminated by the sun-light being strongly contrasted with the dark shadows; and although they were hours away, their deep scars and fissures were distinct, and the laminations of the strata resembled the leaves of some gigantic volume. The plain sloped from the base of the hills into conical mounds, and still lower, into the valley of the Jordan. The banks of the river were fringed with perpetual verdure—the stream winding in a thousand graceful mazes, a bright line in a cheerless waste, bright by contrast with the harsh dry calcined earth around. There were no elms, ash, hazel, linden, beach or aspen; no laurel, pine, or birch; still the lily and tamarisk, the oleander, the anemone and the asphodel adorn the Jordan, and the bulbul and nightingale haunt the copses.

On April 16, at *the Pilgrims ford*, conglomerate was rarely seen, but in its place banks of semi-indurated clay. The vegetation became more luxuriant, the oleander more abundant, the asphodel and acacia less so.

Higher up the river there was drift wood in the stream, and bushes and branches were lodged high up in the trees which lined the banks. The bounding hills were immense masses of siliceous conglomerate with occasional limestone, this being the geological formation of the Ghor from Lake Tiberias to the Dead Sea. Rapids were still of frequent recurrence.

They arrived at *El Meshra*, the bathing place of the Christian pilgrims. Tradition assigns this as the place where the Israelites passed over with the ark of the covenant, and where our Savior was baptized by John; and near it, is supposed to have been Bethabara, the Savior's place of refuge. Here also is said to have been the scene of the Savior's temptation, and the fountain healed by Elijah. Near by was Jericho, and fourteen miles on the other side was Heshbon where Sihon, the king of the Amorites, dwelt. The water and land parties united in pitching their tents just at the spot where the pilgrims passed.

April 18.—The pilgrims arrived at 3 A.M. Thousands of torch-lights with a dark mass of human beings, were seen moving rapidly over the hills, and they were on the ground almost before the tents could be struck and the place cleared. Men, women, and children, mounted on camels, horses, mules and donkeys, rushed impetuously down the bank as if they had been fugitives from a routed army. The Bedawin guard formed a cordon of defense, sticking their spears in the ground and mounting their horses, to prevent the American party from being run down—Moslems shielding one Christian band against another! The party which had arrived was only the van guard; at 5 o'clock A.M. the main body came over the crest of a high ridge in one tumultuous eager throng: "Copts, Russians, Poles, Armenians, Greeks, and Syrians from all parts of Asia, Europe, Africa and America." Many of the women and children were suspended in baskets or confined in cages: they dismounted, hurried forward, disrobed in haste, and threw themselves into the stream, regardless of observers. They took that plunge in honor of the Trinity and then filled a bottle from the river. They cut branches of the willow, dipped them in the consecrated stream and bore them away as memorials of their visit. The pageant disappeared as rapidly as it had approached and left the small party to their solitude. The number was said to be 8000, but probably this was an over estimate. All bathed, except a few Franks,—most of them reverentially, but a few with levity.

The course of the Jordan had been so tortuous, that in sixty miles of latitude, and four or five of longitude, the party had traversed at least 200 miles; and as they had descended twenty-seven threatening rapids besides many smaller ones, and at all times found a rapid current, it is not surprising that the Dead Sea is 1300 feet below the level of the Mediterranean. As they approached the Dead Sea, the river was forty yards wide and twelve feet deep, the bottom blue mud. A little further on, it was fifty yards wide and eleven feet deep, with muddy bottom, and low sedgy banks. The high mountains of the Dead Sea were in sight to the S. and W. A heron, a bulbul, a snipe, and many wild ducks were seen. The river now became seventy to eighty yards wide; and the water was still sweet: it was seven feet deep with a current of three knots. The *Dead Sea* was in view to the southward, with mountains beyond. A snipe, a heron, and a white gull were the only visible inhabitants of the region.

The mouth of the river is 180 yards wide and three feet deep; as they entered the sea a gale of wind compelled them to stand for the north shore, which they reached incrusted over with a greasy salt, and their eyes, lips, and nostrils smarting excessively. The sea subsided as quickly as it rose—its heavy waves in twenty minutes were stilled, and they went on, gliding over a placid sheet of water hardly disturbed by a ripple. A rain cloud which had enveloped the sterile Arabian mountains, now opened and disclosed their rugged outlines gilded by the setting sun; but above the still more sterile mountains of Moab, all was gloomy and obscure. The northern shore is an extensive mud flat with a sandy plain beyond, and is the very type of desolation. The line of high water was designated by trees, having their branches blackened or whitened by salt. The northwestern shore is a bed of gravel sloping from the mountains to the sea; the eastern is a rugged line of mountains bare of all vegetation.

The land party and the navigators were mutually embarrassed in their efforts to find each other. They pitched their camp "in a canebrake near a brackish spring, and wet, weary and hungry, reposed upon a bed of dust beside a fetid marsh—the dark mountains being behind and the sea like a huge caldron before, its surface covered with a lead colored mist." This solitude was relieved by the sound of the convent bell of Mar Saba, on the western side, informing them that Christian sympathies were near.

The shore party after leaving the Jordan, passed a sandy tract of damp ravines and slippery to the feet of the camels, succeeded by a plain incrusted with salt. The upper terrace of the Jordan, on which the party travelled, was generally about 500 feet above the plain, and the latter was mostly covered with trees and grass.

One of their encampments was under a cliff of crumbling limestone and conglomerate 1000 feet high, and near it was a spring of clear water at 84°; it was soft but brackish, and smelt of sulphur. Pebbles of bituminous limestone were very abundant. The vegetation being saline and acrid, the camels could not be sustained, and they and the Arabs who had attended the party were dismissed. Upon the beach there were no round stones, but only those that were angular, and they were of flint. Two partridges of a stone color, like the rocks, were started before them, and the note of a solitary bird was heard among the cane thicket: birds therefore can live upon the shores of the Dead Sea.

"But the scene was one of unmixed desolation; and the air tainted with sulphuretted hydrogen, gave a yellow hue to the foliage of the cane which is elsewhere of a light green." There was no vegetation except of the canebrakes; "barren mountains, fragments of blackened rocks," and a saline sea with dead trees on its margin, bore a sad and sombre aspect.

Near their camp, on the 20th of April, they saw a large brown stone-colored hare and a partridge. The temperature was 89° F. At 8 P. M., "the surface of the sea was one wide sheet of phosphorescent foam, and the waves, as they broke upon the shore, threw a sepulchral light upon the dead bushes and fragments of rocks." This is an interesting observation, and as far as we know it is original. We have never learned that any such appearance has been observed in the Caspian or any other internal saline water. The luminous appearance probably arises from animalcules, such as are phosphorescent in the ocean; mere salt-water, however strong the solution, has no such power. We have then another proof that life is not entirely excluded from this region.

Soundings were taken in a course directed towards the eastern or Arabian shore, a distance of nearly eight statute miles; the greatest depth was 696 feet and 540 feet within a fourth of a mile of the Arabian shore. Mr. Aulick reported a volcanic formation, and brought specimens of lava. "Another line of soundings running diagonally across to the S.E., disclosed a level plain at the bottom of the sea with an average depth of over 1000 feet all across; the bottom blue mud and sand with regular cubes of crystallized salt." The greatest depth on this line was 1065 feet, and the greatest observed anywhere was 1278 feet.

These operations were performed under a blazing sun, and the water, greasy to the touch, made the men's hands smart and burn severely. "By dusk, the sea rolled dangerously, the crests of the waves dashed into the boats, the men had a severe pull, and their clothes were stiff with salt."

In a chasm in the mountains, on the eastern side, they found a sweet and thermal spring which flowed into the sea.

The brook Kidron which in rainy seasons runs in the valley of Jehoshaphat at the foot of the mount of Olives, empties into the Dead Sea in the Wady en Nar (Ravine of Fire); the bed is a deep gorge whose sloping banks rise 1200 feet; the channel was now dry and filled with confused fragments of rocks. The horizontal stratified limestone of the mountains, was almost devoid of vegetation, presenting a scene of "utter and dreary desolation." At the foot of the cliff of Hathûral they observed narrow strips of cane and tamarisks—a luxuriant line of green—and almost the only verdant spot that had been seen for a long distance; a beach of coarse dark gravel below and barren brown mountains above bounding the prospect. Soda plants were found upon the shore. Sulphur picked up on the Jordan near the Dead Sea, was brought by an Arab.

The mountain at Ain Jidy (Engaddi) is 1500 feet high, and in its sides are many caverns excavated in former times, the mouths of some of which are now entirely inaccessible. It is a curious fact regarding the birds, insects and other animals of this region, that they are all of a stone color; this was the case with a cat-bird brought in by an Arab. Along the beach they saw a hawk and some doves, "all of the same color as the mountains and the shore." "Four young boars were brought in by an Arab; they escaped from him and ran to the sea and were caught, and because the Americans would not buy them they were killed." Sulphurous smells were not unfrequent, and sometimes the odor of sulphuretted hydrogen was perceived, probably from the springs and marshes along the shore.

On the 21st they made an encampment as a point of rendezvous for their surveys, and called it "Camp Washington." There is a peninsula on the southern side of the sea, for which they now steered, leaving a party at the camp for the purpose of triangulation. The peninsula is a broad bold promontory forty to sixty feet high, with a central ridge elevated some twenty feet more, and a foot of sand, salt, and bitumen; the vertical face extending all around had a coarse and chalky appearance. Dr. Anderson thought the peninsula to be one-third higher, and to consist of a calcareous marl; a part of it he found chalky, with flints. "There were a few bushes, their stems partly buried in the water, and their leafless branches encrusted with salt," which with the dead trees, standing and prostrate, were the only vestiges of vegetation. The mind cannot conceive a more dreary scene, or an atmosphere more oppressive. The distance from the point of the peninsula across to the western shore was ascertained to be about nine statute miles, and the greatest depth of the water 1128 feet. All the party were affected by drowsiness while crossing the water, and on the land the oppressive heat and sulphurous odors produced sickness.

They now made an expedition around the southern shores. There was a "perpendicular isolated cliff called Sebbeh or Masada, 1200 to 1500 feet high, and on its summit a line of broken walls with an arch, constructed as it is said, by Herod; it had a commanding but dreary prospect, overlooking the deep chasm of this mysterious sea." Near the south end of the sea they observed other ruined walls and remains of architectural structures. Bitumen was seen upon the beach; it had a bright smooth surface like a consolidated fluid.

The weather was intensely hot; the awnings of the boats erected for tents on land afforded no adequate protection, and at midnight the sirocco, although from the N.W., raised the thermometer to 86° and 88°. The people lay in the open air upon the pebbly beach of this desolate sea. In the morning a young quail was found nested by the side of the commander, as a refuge from the hot wind.

The salt mountain of Usdum or Sodom was near at hand. It is perfectly isolated but has no appearance, externally, of being a mountain of salt. Seetzen saw this salt mountain in 1806, and says that he never before beheld one so torn and riven. On the eastern side of Usdum is a lofty, round, detached pillar, which on examination, was found to be composed of solid salt, capped with carbonate of lime. The upper or rounded part is about forty feet high, resting on an oval pedestal from forty to sixty feet above the level of the sea. It is slightly conical, crumbles at top and is crystallized throughout in spiculæ. A kind of buttress connects it with the mountain behind, and it is covered with debris of a light stone color. Josephus and his cotemporary Clement state that they had seen a pillar of salt which they believed to be identical with Lot's wife, and this may be the one to which they had reference.

Large specimens of the salt were brought away in the boat. The water was so shallow that they could not approach within 200 yards of the beach; throughout the southern part of the lake the depth was rarely over two feet, and frequently less than one foot. The foot prints made by the party on landing were on their return encrusted with salt. Mr. Dale landed, and his feet sank twelve inches in slimy mud, then through a crust of salt, and then another foot of mud before reaching a firm bottom. The beach was so hot as to blister the feet, and when one of the men attempted to carry Mr. Dale, both sunk down, and they were obliged to run as they could—it was like running over burning ashes, and when they plunged their feet into the slimy brine at 88°, the sensation of comparative coolness was delightful.

The scene around them was one of unmitigated desolation. On the south stood the rugged and water worn salt mountain and pillar; on the east the lofty and barren mountains of Moab, in a cave in which Lot is supposed to have taken refuge; on the south the high hills of Edom half surrounding the salt plain, the scene of Israelitish victories; and to the north the calm and motionless sea curtained with night. The atmosphere was difficult of respiration; the air oppressively hot, the temperature being 97°, and that of the water 90° twelve inches below the surface.

Lieut. Lynch named the northern extremity of the peninsula Point Cortigan, and the southern, Point Molyneux, in honor of "the two gallant Englishmen who lost their lives in attempting to explore this sea." Near the base of the peninsula there is a range of hills 2000 feet high; the cliff called *Little Tiger* consists of horizontal strata of brown and rose colored limestone.

At 3·50 P. M., a hot hurricane struck them, temperature 102°, and with severe exertion they gained the shore, exhausted by hard pulling of the oars, and the commander's eyelids blistered by the hot wind. The men had great difficulty to protect themselves, some in the ravine, some under the awnings of the boat; the metal of their spectacles burned the face, and their buttons the hands; and the folds of garments next to the body were coolest.

They found an old millstone upon the beach and huge boulders of sandstone in the ravine, strata of sandstone above in horizontal layers and limestone upon it. Bathing in a pool of fresh water afforded a momentary relief, but in an instant the moisture was evaporated, and the surface was dry and parched.

The wind rose to a tempest; the heat increased after sunset, and at 8 P. M. was 106°; it was more like the blast of a furnace than the living air. Drinking did little good, for without any sensible perspiration the fluid was evaporated as fast as received. Musquitos tormented them almost to madness, and they passed a miserable night. When the water was exhausted and all were too weary to go for more, they threw themselves upon the ground, eyes smarting, skin burning, lips and tongue and throat parched and dry, and some garment wrapped around the head to avert the stifling heat. At midnight thermometer 98°.

Flocks of birds were seen and storks in the early dawn of April 27. A miserable tribe of Arabs gathered on the shore to see them depart. A glassy undulation indicated the coming of a hot gust of wind, and with some difficulty they reached the shore before the sea was all in a foam. The night was passed where there was no fresh water, but they had the luxury of a beach of pebbles far preferable to the mud and dust of their late sleeping places. They picked up pieces of sulphur and saw the track of a panther in a cave. They found the Arabs of this region indispensable auxiliaries; they brought them food and drink; they acted as guides and messengers, and in the absence of the adventurers, carefully guarded their camp. A decided but courteous manner wins their respect and good will.

The tendency to drowsiness upon the sea was now extreme: all slept except the men at the oars who pulled with half closed lids, and the steersman who was the commander, was little more awake. On the 28th they received news from home announcing the death of John Quincy Adams, and it was hard in their dreary solitude to divest themselves of the idea that there was nothing but death in the world and they alone alive. They picked up large pieces of bitumen on the sea shore. A breeze from the west passing over the marshes brought with it a nauseous smell.

Till the 30th, with a single exception, all had been well; but now dropsical appearances began—"the lean had become stout and the stout almost corpulent; the pale faces had become florid, and the florid ruddy; the slightest scratch festered, and pustules followed—the sea water irritated the sores excessively; yet all had a good appetite." Except the smell from the marshes, and from thermal springs, there were no indications of malaria, the sea itself being perfectly inodorous. The appearance of the men was distressing. Some with their bodies bent and arms dangling slept profoundly, but with a flushed and feverish sleep; others with heads thrown back and lips cracked and sore, seemed, even in sleep, to be worn down by heat and fatigue; others from reflected light looked ghastly, their limbs twitched, and they would start suddenly from sleep.

Prudence therefore demanded a return, although they were reluctant to leave any part of the work unfinished. Partly for recreation, they accepted an invitation from the Christian sheikh Abd 'Allah, to visit Kerak, on the mountains of Moab, seventeen miles east of the Dead Sea.

While the party were waiting for horses, they "dined *sumptuously* with the Arab Christians, on wild boar's meat, onions, and the last of their rice." Their horses arrived, and with them, Muhammed, the son of the Muslim sheikh, and also Abd 'Allah the Christian sheikh himself, the latter residing in Kerak, and the former chiefly in black tents about half a mile from Kerak. Muhammed being about to mount his horse, ordered one of the Fellahin (a common Arab) to stoop, and "placing his foot upon the abject creature's back, he sprang upon his horse;" his countenance and manner were insolent and overbearing, while Abd 'Allah, the Christian sheikh, his senior by twenty years, was mild and even meek.

The boats excited great surprise, and both the Muhammed and Christian Arabs were indulged in an excursion by rowing upon the sea. "They stuck plugs of onions in their nostrils to counteract the malaria they had imbibed from the water." They call it "the sea accursed of God," and thought it madness for men to remain so long upon it. The party consisted of fourteen besides the interpreter and cook, and the escort of twelve mounted Arabs and eight footmen, besides a number who had gone ahead. They crossed a plain of tertiary formation, ferruginous and friable limestone, marls, &c.

They passed up the Wady Kerak, the path extremely steep and difficult, and the scenery very wild and grand; on one side a deep chasm, on the other high overhanging cliffs, and a fierce thunder-storm which soon came on poured a powerful torrent along the gorge, bearing rocks before it that made the region resound with their collision. Excepting a single palm bending in the tempest, they had not seen a tree or shrub since they turned up the ravine, but only mountain ruins of naked rocks piled up in wild grandeur along a zigzag path. They saw much of the scarlet anemone, also a blue flower resembling the convolvulus, and partridges, hawks and doves, were their attendants. The cavalcade wound up along a circuitous ascent, and limestone, some of it fossiliferous, accompanied them quite to Kerak.

A little after noon they came upon the brow of a hill 3000 feet above the Dead Sea, at the N.E. angle of the town. They passed along a wall and by a tower, and entered the town under an arch cut in the solid rock thirty feet high by twelve wide; a partly effaced Arabic inscription was over the gateway; they proceeded through a passage eighty feet long, and found the town to be a collection of stone huts built without mortar. They were from seven to eight feet high (from the ground floor ?), the ground floor is about six feet below, and the flat terrace roof about two feet above the streets, and the people were assembled on the dirt-heaps and roofs to see the strangers pass. The council-house is the Christian school-room, and there is a work-room below. A Christian church was building; it was seventy-four feet by forty, and twelve feet high.

The room for the travellers had a naked stone floor and a mud roof supported by rafters, two windows without glass or shutters, and a door without fastenings. Their food was eggs and milk, three eggs for each for a dinner. There was only one shop, and that contained thin cakes of dried and pressed apricots, and English muslin. The huts had neither windows nor chimneys, the inside was smoked, and the women and children were squalid and filthy. The population of Kerak is about 300, three-fourths Christian, and the entire Christian population here 900 to 1000.

The castle was originally a vast and magnificent structure, partly excavated from and partly built upon the mountain top; the architecture is a mixture of Saracenic, Gothic and Roman, but its history appears to be obscure.

On the 3d of May the party, not without danger from the Muslim Arabs, made their way back to their boats. They now commenced their return along the eastern or Arabian shore. Mountains of red sandstone variegated with yellow were passed, with white cliffs in the background. The next day the shores presented boulders of trap, and the mountain appeared to be composed of scoria and lava. The scenery was grand and wild. A stream, called Zerka, the outlet of some hot springs, had formed a deep ravine; the walls were 80 to 150 feet high, of red and yellow sandstone in vertical cliffs. The party slept on the gravelly beach; the thermometer from 70° to 68°, and they suffered from the cold.

On May 5th, in crossing the sea to Ain Turâbeh, at two furlongs from land, the water was 138 feet deep; five minutes after it was 1044 feet, gradually deepening to 1308 feet, the bottom brown mud with crystals of salt. They continued on their course, and on the 9th made arrangements to leave the Dead Sea. A large float was moored in eighty fathoms water, with the American ensign flying. Sickness was already appearing among them, and two seamen were sent to the convent of Mar Saba.

This sea, according to Dr. Robinson, is about fifty miles long and ten broad. The specific gravity of the water is 1·13, while that of the Atlantic in lat. 25° N., 52° W. long., was 1·02. The boats, when afloat on the sea, drew one inch less of water than when on the Jordan. No animalcules or animal matter were detected in the water by a powerful microscope.

The party had now passed twenty-two nights upon the Dead Sea. They had carefully sounded its depths, ascertained its geographical position, the topography of its shores, and the depth, width and velocity of its tributaries, as well as the winds, currents, weather, &c.; and numerous specimens had been obtained.

Remarking upon the character of the region, Lieut. Lynch observes, that the extraordinary nature of the soundings appears to sustain the inference from the Bible, that this entire chasm was a plain sunk and overwhelmed; for the bottom of the sea consists of two submerged plains, one averaging thirteen feet, and the other thirteen hundred feet below the surface. Through the latter or northern one, runs a ravine corresponding with the bed of the Jordan and with another ravine, Wady el Jeib, at the south end of the sea. Many other considerations are mentioned, tending to shew that the basin of the Dead Sea is a sunken plain. Those of the party who were skeptical when they entered on the examination, appeared to be convinced that the Mosaic account was true.

On the 10th of May, they took leave of the Dead Sea, casting a farewell look at its waters as they wound up the ravine and encamped at an elevation of 1000 feet. Their boats were sent in sections to Jerusalem. They were now in a most dreary country of barren hills and valleys, without tree or shrub, and as still as the Lethean sea which they had just left. This was the wilderness of Judea, where God conversed with Abraham, where John the Baptist preached, and at the head of the next ravine is Bethlehem, which stands in full sight of the Holy city.

Passing the brook Kidron on the 15th, they found a large cistern hewn in the rock, twenty feet long, twelve wide, and eighteen deep; the water was only four feet deep and was covered with a green scum, and two Arabs were bathing in it; yet the whole party, men and animals were, nevertheless, constrained to drink of it.

The whole region is one of entire desolation from the Mediterranean to the Dead Sea, except where water redeems here and there a patch in a ravine or valley for crops or verdure; a small patch of tobacco in a narrow ravine was guarded by an Arab with a long gun, and there was wheat and also barley in a valley skirting the base of the hill. Lieut. Lynch finally came in sight of the Holy City, elevated, as was ascertained by his levelings, 4000 feet above the Dead Sea.

On the 29th they planted their spirit level on the bank of the Mediterranean, one mile and a half south of Jaffa, having carried a line from the Dead Sea through the desert of Judea over mountain ridges, ravines and precipices, and most of the time under a scorching sun. It was conducted by Lieut. Dale, and corresponded with the triangulation of Lieut. Symonds, R. N. They "found the depression of the surface of the Dead Sea, below that of the Mediterranean, about 1300 feet: the height of Jerusalem above the Dead Sea is about three times this amount; and that height is almost the same multiple of the depth of the sea."

Their work being accomplished, they were hospitably received at the country house of Mr. Murad, the American Consul, which was placed at their disposal; and here they remained till June 6, busily employed in posting up and digesting their observations.

On June 7, they left Jaffa for St. Jean d'Acre, a land party under Lieut. Dale, and the remainder of the party with Lieut. Lynch, in a chartered boat. At Acre they re-embarked their effects brought over from Tiberias, and prepared for an excursion to Nazareth and the source of the Jordan.

June 10.—They left Acre and arrived at Nazareth by the way of the valley of the Winds, a place secluded among mountains, and containing about 5000 inhabitants. They ascended Mount Tabor, the reputed scene of the transfiguration. From the summit is a magnificent view of the plain of Esdraelon, bounded by Carmel on the west, and Gilboa on the south. N.W. is Nazareth, N.E. the sea of Galilee and the snowy peak of Mount Hermon. They again visited the lower source of the Jordan, and passed along the western bank of the Dead Sea to Bethsaida on the north, and ascending the high hills they enjoyed a good view of the rapid and turbulent Jordan rushing down in one line of foam, and thus they went on to L. Merom, and beyond it to Cæsarea Philippi, and still farther on they came to the real source of the Jordan, a fountain or several streams bursting from the side of a hill. The river gushes out copiously from a rock about forty feet high, forming the principal feature of a very picturesque landscape.

On the 17th, Lieut. Lynch and Lieut. Dale visited the valley of the Leontes or Litany, running near the Lebanon range. They saw in this region pits of bitumen; there are five in all, but only two were in operation, one sixteen and the other twenty-five feet deep.

On their way to the plain of Damascus, Jan. 19, they passed over Anti-Libanus. The lower parts were terraced and covered with vineyards and olive and mulberry orchards, above were oaks, then heath and fern, lichens and moss, and at the summit limestone and boulders of quartz. They crossed in a gorge between Mount Hermon and the next peak to the south. The two crests and many clefts on both sides were covered with snow. The summit of Mount Hermon is estimated to be about 9000 feet above the sea level.

As they descended, the limestone disappeared and gradually gave place to sandstone, and trap and serpentine appeared lower down. The prevailing rock, the next day, was granite with metallic veins and quartz. They passed rapidly from wintry cold to summer heat. Damascus is situated at the foot of Anti-Libanus. We shall not attempt to recount the description of Damascus—its bazaars, its cafès, its lazy smoking population,—its baths—its narrow streets and innumerable dogs over which the stranger stumbles. The population is estimated at 115,000. It was very gratifying to the travellers to meet their countrymen, the Rev. Dr. Paulding and Rev. Mr. Barnet, of the American mission, to whose hospitality and kindness they were much indebted. As many of the party were threatened with illness, they hastened on to Beirut; they seemed to have imbibed the disease which had heretofore prostrated all who had ventured upon the Dead Sea.

On the night of the 29th, after they had encamped, (it was in the cold mountain air 4000 feet above the sea,) Mr. Dale was attacked with the same symptoms as the other sick persons. At eleven o'clock the next day, Beirut and the sea were in sight, but the sick were ready to fall from their saddles; happily they met Dr. DeForest of the mission, who prescribed promptly.

July 1.—Lieut. Lynch, Mr. Dale and two seamen, required immediate medical attendance, and all hands were nearly sick.

This interesting narrative closes with the death of Mr. Dale, who, despite of all the care and kindness of the American missionaries and physicians and their families, sunk beneath the fever, and was buried at Beirut with military honors.

In leaving this work which has afforded us much instruction, we add a word to express our estimation of its value. It does honor to the zeal, intelligence, and moral feeling of the author; and his brave companions are entitled to the thanks of their fellow men. We think, however, that it is susceptible of improvement, and that in another edition it will receive some condensation and pruning, that will render it still more graceful and impressive. Its moral tendency is excellent, and no believer in the truths of the Bible can peruse the volume without feeling his mind much enlightened and his faith invigorated.

SEN. EDITOR.

Art. XXII.—*Second Memoir on the Conducting Power of Solid and Liquid Bodies;* by Ed. Becquerel.*

M. Peltier, as is well known, showed that the elevation of temperature at the point of junction of two conductors of different metals conducting a current, differs according to the direction of the current, that of other parts of the circuit remaining unchanged, and that when the current passes from antimony to bismuth,† an elevation of temperature takes place at the point of junction and a depression when it passes in the opposite direction.

The author concludes from his researches that generally the thermo-electric current generated by heating the point of junction of two different metals in a circuit, tends to produce a depression of temperature at that point of junction. In other words, the state of inequality of temperature produced by an electric current in a heterogeneous circuit is the inverse of that by which the current itself would be produced. Hence a certain portion of the heat employed to generate a thermo-electric current is consumed by the latter, and must be replenished by the heating source in order to maintain the current. This view it may be important to remember in the arrangement of thermoscopes for certain purposes.

He concludes farther, that resistance to conduction, in a heterogeneous circuit, as might be anticipated, does not seem to change with the direction of the current except so far as it may be a consequence of the change of the temperature induced by reversal of the current.

Resistance to the passage of the electric current between solid and liquid conductors.

This, technically termed by the author "*resistance to transit,*" is universally attributed to the chemical affinities that must be dissolved by the passing current, nor are we inclined to believe any part of it is to be attributed to a distinct force classed by the

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* This article is an abstract of Becquerel's second memoir, prepared for this Journal by Mr. Jonathan H. Lane of the Patent Office, Washington.

† The reverse order is stated in Becquerel's article, but this we presume must be an oversight.

author and referred to *heterogeneity of the circuit.* He does not appear to decide on the actual existence of such a force. In considering the chemical force the term *polarization* of the electrodes is used throughout in a manner seeming to imply that the polarization is an absolute obstacle to the decomposition and the passage of the current, so that the latter meets with greater resistance to transit than it would with electrodes that were perfectly neutral in their relations to the elements set free and evolved them at once as gas without attracting a particle of them to their surface, the electrolyte itself being supposed also to have no attraction or solvent power for the gaseous elements. Whether this be the author's view does not seem certain, but to us it appears that in proportion as the electrodes become perfectly coated with the films of oxygen and hydrogen evolved by a passing current, water being the electrolyte, the more nearly will the forces encountered by the current approach identity with those which with the neutral electrodes just mentioned, it would have to encounter from the first instant of its passage. In this latter case the oxygen and hydrogen from the first instant of decomposition will be set free in the absence of any body for which they have any sort of attraction, and it is only in such case that their separation by the current is opposed by the whole force of their affinity for each other. But if the electrodes or the fluid or both have an attraction for the oxygen and hydrogen to be separated, such attraction facilitates the separation and diminishes the electro-motive force required to effect it, and it is not till after the electrodes have become completely coated and the adjacent films of fluid saturated with the oxygen and hydrogen respectively, that we approach that state of the forces that is presented by *neutral electrodes* and in which each element is *set free.*

If it be objected that the attractions for the oxygen and hydrogen are equal at each electrode and ought to balance each other, it may be replied, that they act with reference to the alternative whether they shall be satisfied not at all or shall be satisfied in the only way in which they can be, that is, by giving the oxygen to the positive electrode and the hydrogen to the negative. This *alternative*, it will be seen, has reference to the case in which the electromotive force is just insufficient of itself to produce the decomposition and is supposed to do so by aid of the attractive forces in question.

If this view be correct, it seems probable that the amount of electromotive force necessary to carry on the decomposition after the polarization is established and the elements are all evolved as gases, is precisely that which is competent to the separation of these elements with electrodes having no action on them, unless it be a merely catalytic action, so that the elements assume the gaseous form in contact with them with the same readiness as in contact respectively with the polarized platinum plates. It is true that on the cessation of the polarizing current the polarized electrodes are capable of generating a reverse current, but that only results from the continued action of the same affinities which have to be dissolved by the primary current, either in the case of the *polarized* electrodes or the hypothetical *neutral* ones.

The principle we would venture to suggest for estimating the resistance to transit in any case may be stated thus. Each of the affinities concerned, viz., those dissolved or those satisfied, may be considered equivalent to a definite electro-motive force; let the sum of such forces belonging to the affinities dissolved be represented by F, and of those belonging to the affinities satisfied by F′; all affinities that do not take effect, either in the separation or the combination of elements being neglected, and including under the term affinity all attractions that are capable of modifying the form or chemical action of a body, attributing also a definite force to the catalytic action of the electrode in facilitating the evolution of the element when that takes place,—then representing the resistance to transit by E, we have $E = F - F'$.

We are not aware indeed that any systematic experiments have been made to demonstrate this principle; but we think it sufficiently probable in the present state of our knowledge on the subject. We have seen something like this hinted at by some authors, but do not recollect to have seen it definitely laid down.

In the first experiment noticed by the author under the present head, the current was passed through a solution of sulphate of copper and positive electrode of copper and negative of platinum. The resistance to transit being accurately measured apart from the resistance to conduction, proved to be actually null or at least within the probable errors of experiment. Here the affinities dissolved on one side are satisfied on the other, reproducing, so far as we know, precisely the same state of things, so that $F - F' = E = 0$.

Mr. Smee mentions a curious circumstance respecting the action of compound batteries that very beautifully illustrates the same thing. If the exciting acid of one pair of the series be saturated with the zinc before that of the other pairs, the solution of the salt of zinc in that pair is electrolyzed and the zinc deposited on the negative plate, and this process extends from pair to pair of a series of twelve or more until the zinc is deposited on the negative plate of every pair except one, the action remaining in the last pair being sufficient to decompose the salt of zinc with zinc electrodes in all the other pairs.

In cases where gases were evolved from one or both electrodes, the general result obtained by the author is, that the *apparent* resistance to transit, i. e., all resistance over and above the simple resistance to conduction due to the liquid and other parts of the circuit, is nearly constant, and does not, like mere resistance to conduction, increase in the ratio of the quantity of current. A trifling increase with an increase of the quantity did uniformly manifest itself, but this we imagine is to be attributed rather to increased mechanical obstruction from the gas than to any increase in the energy of the chemical forces. It may however be in part due to the solution of part of the evolved gases in the liquid, this solution being proportionally less with the stronger currents.

When in the electrolysis of water acidulated with $\frac{1}{20}$ of its volume of sulphuric acid the positive electrode was of copper, the resistance to transit was only from ^{1} to $\frac{1}{6}$ of what took place when platinum formed the positive electrode. With the positive electrode of platinum the *apparent* resistance to transit was nearly the same whether the negative electrode were of platinum or copper, being apparently a very little greater in the latter case than in the former. In comparing these two cases by the numbers given by the author, due allowance must be made for the different size of the electrodes used, or we should be liable to overrate the difference fairly attributable to the results. This slight difference of action between the platinum and copper as negative electrodes, (the affinities brought into play in the two cases being the same,) may be referred to the different catalytic action of the polarized platinum and the polarized copper plates in causing the evolution of the hydrogen as gas with greater ease in one case than in the other. Even a greater or less degree of roughness of the surface of the electrode appears, according to Mr. Smee, to produce a difference of this kind appreciable without the aid of the nice measures of Mr. Becquerel. Or the difference may on the other hand have been due to difference of temperature or some other circumstance.

ART. XXIII.—*Ko Doü Dzu Roku, or, A Memoir on Smelting Copper, illustrated with plates.* Small folio, pp. 20. Translated from the original Japanese.*

THE *Ko Doü Dzu Roku*, which we present our readers in an English dress, is a thin pamphlet of twenty leaves, fourteen filled with plates and explanations written in the Japanese hirakana character, and six with Chinese writing. There is neither preface nor exordium to the work, which being a very commendable example, we shall follow, premising that throughout the translation, the original is indicated by marks of quotations. We will, however, just add a record of our hesitancy in presenting this performance to our readers. The natives who have acted as

* From the Chinese Repository, 1840.

our teachers, are sailors or tradesmen, persons in ordinary life and of common education, and who in their own country would probably have never attempted to read a book on metallurgy. They know but little more than how to read simple works, or write mercantile letters.

PLATE I. *Of digging the ore.*—This plate is in two compartments; the first represents a miner entering the mouth of the pit, carrying a lamp in one hand, and a pick in the other, with an empty basket swung on his back. At the entrance, he meets a second miner just coming out with a basket of ore. The second shows the same person reaching the extremity of the mine, where is a third workman engaged in cleaving the ore from its bed.

This, and all the succeeding plates are painted; the colors are everywhere laid on in an artist-like manner, though the cheapness of the work apparently forbade much labor.

"The copper, as it comes from the hills, is undoubtedly in the form of ore; the ore is the effluence of the copper, and in a serpentine vein it rises and appears upon the top of the hill. There are many sorts of ore; that which is of a reddish black color, soft and not very heavy, and taken from veins running from east to west (or horizontally), is the best. The overseer of the mine examines and assorts the ore. Rafters, planks, joists, pillars, &c., are used to uphold and prevent the mouth of the mine from caving in. When commencing, the rock is worked with hammers and chisels; the [barren] stones are thrown away as they are dug, and the ore is brought out; by degrees the hill is penetrated, and the hole thus formed is called a mine. A lamp made of a shell is used as a light, and the quarried stone, put into baskets, is carried out on the back. Wherever the quarrying has been done, rafters, planks, and pillars are set up to restrain the overhanging rocks lest they fall. There are many kinds of both good and bad ore. When the mine has been dug deep, the air does not permeate it, and the lamp goes out; therefore, in places above the mouth of the pit, holes are cut down reaching to the mine, opening into it in many places, and secured by planks, rafters, &c.; they are called *shiyaku hachi* or flute-holes. Thus the wind is made to circulate. The whole is called *fuki mawashi* or wind-ventilator."

PLATE II. *Assorting the ore.*—This plate exhibits a company of women, with hammers in hand, pounding the ore, and separating the barren stone; one of them has her child strapped to her back. A copper tea-pot stands hard by, and one old dame is enjoying her pipe while plying her hammer.

"Among the ore there are both rich and poor kinds, combined with the plain rock; the poor is separated from the stone, which is then thrown aside, and called refuse stone. This is the employment of old men and women."

Plate III. *Draining the mine.*—In this plate, we have a section of one of the "flute-holes," and three lifting-pumps represented, emptying into each other by means of water-boxes placed on shelves cut in the rock, where also the laborer stands to work the pumps. The lifting-pump is not known to the Chinese, and we were not previously aware that the Japanese were acquainted with it. How invaluable would be the gifts of a steam-engine to the Japanese miners, toiling day and night to raise water from the deep mine, and of a safety-lamp to him who now works by the light of a shell-lamp! The darkness or the depth of the mine is intimated by lamps placed near the pumps; and the painter has very cleverly represented the light proceeding from them by leaving a circle of white around the flame, the surrounding rock being a light umber color.

"In obtaining the ore, as the mine descends deeper and deeper, and the digging is low down, the water bubbles up, making the labor difficult. Therefore wood and bamboo, prepared in pieces about thirteen feet long, are placed one above the other, and these tubes (or pumps) are inserted into water boxes; several tens or hundreds of strokes are required, according as it is deep or shallow. They are worked uninterruptedly, day and night, to draw the water to the surface. In this manner of operation, there is a great consumption of the strength of the workmen, and they cannot progress very fast; wherefore proper spots are selected for raising the water. Below, in the mine, several perches intervene between them, and there they are also guarded from caving in; they are cut down to those spots in the mine where the water collects, and are called *midzu nuki*, or water-drainings. In all of them the wind circulates. The expense of making them in this manner is exceedingly great; the miners construct them according to their own ideas, and they are indispensable. From thirty to fifty years are occupied in making them."

Plate IV. *Roasting the ore.*—In this plate, the artist has apparently endeavored so to foreshorten his drawing, that the roof shall appear high above the kiln; if such was his intention he has rather failed, for the roof is drawn so near to the fire bursting from the kiln, that it would soon be consumed, were it so built. The kiln appears to be built in a solid and permanent manner, but without the covering of straw mentioned in the text.

"To roast the ore, a kiln must first be built, having vent-holes in it, through which the draft will pass to the fire. Faggots are spread upon the bottom of the kiln, and the ore laid upon them in rows, and thus alternately, faggots and ore, until the kiln is full. A covering of matting, straw, thatch, and other similar things, is then placed over it, and sprinkled with water, and the fire lighted at the mouth. Generally it burns thoroughly in about thirty days, and when cooled is taken out."

Plate V. *Smelting the ore to extract the coarse metal.*—The furnace, in this plate, is represented as sunk in the earth, and the smelter is standing over it with a long shovel in his hand to manage the fire. The bellows, which is separated from the furnace by a wall, is made like the Chinese *fung seäng* or wind box, of which a description is given in the Repository, vol. iv, page 37.

"The ore being roasted, is put into a furnace, where coal is employed to melt it; the scoria having flowed off, the coarse metal is taken out; it is copper imperfectly purified."

Plate VI. *Taking out the copper when the coarse metal is fused.*—This plate is intended, as supplementary to the last, to exhibit the mode of taking out the copper, after a second melting of the coarse metal. The fire having gone down, a workman stands over the furnace with a broom, with which he sprinkles the metal as a second workman takes it out on the end of a hooked pole; a third is represented as having just thrown a mass of metal into a pool of water.

"When the coarse metal is melted in the furnace, and the scoria has flowed off, the copper is taken out."

Plate VII. *Of fusing silver and copper together.*—This plate resembles the preceding, but is intended to represent the taking out of metal after a second melting, when the silver is still alloyed with it. In this plate, a bellows is drawn on each side of the furnace, in lieu of the double-handled single one in the preceding plate. While one workman is engaged in sprinkling and taking out the copper from the furnace, a second is plunging a large mass into a tub of water. The title of the plate literally means "together blown," and is rather a second purification of the copper ore than alloying it with silver.

"The silver which is mixed up with the copper is melted, and the scoria taken out; it is therefore called *mabuki doü*, or alloyed copper."

Plate VIII. *Casting the bars.*—Here we have a large sinewy man represented pouring the melted metal out of a large crucible into a wooden pool full of water, while another opposite to him holds a pair of pinchers to take out the bars. The exhibition of muscular tension in the drawing of the gigantic man who holds the crucible is creditable to the artist.

"The alloyed copper is put into an earthen crucible and fused, and then poured into molds to form the bars of copper. These bars are sold to foreigners, and are as excellent as if for imperial use. That which natives buy is smelted in the same manner, but the mode of casting and the molds are different; therefore these are in all sorts of shapes; one is made by pouring the copper into a bamboo stuck in the ground."

Plate IX. *Fusing lead with the copper.*—In this plate, one workman, his face muffled and his legs guarded from the fire of the furnace by a mat, has just taken out a mass of copper, and placed it in a trough, while a second, with a spade-like tool, is assisting him in working it.

"When silver is combined with the copper, lead is added to it and they are melted together; it is then called *aïbuki doü*, or combined-melted copper."

Plate X. *Separating the lead from the copper.*—In the previous plates, the form of the furnace has been the same, that of a caldron imbedded in the ground even with the surface of the earth, having the bellows placed on the other side of the intervening wall, and the blast carried into it below its level. No covering is represented, and the flame ascends into a cowl chimney. In this plate, the form of the furnace is oblong, with a curved facing in front; a fender kept in its place by a rod attached to a post, guards the liquid metal from running out, except at a small orifice, which the workman manages with his spoonlike rod.

"The 'combined-melted copper' is put into the furnace and heated almost to liquifying, when the workman holding an iron tool upon the surface of the copper, restrains it from flowing, but allows the melted lead to run off. The copper is called *shibori doü*, or wrung out copper, i. e., pure copper. By this process the silver and lead contained in the copper are extracted, whence it is termed 'the wrung-out (or purifying) fusing;' the rules for the process were derived from foreign countries, and it is on this account also called 'the fusing of the southern foreigners.'"

Plate XI. *Separating the silver from the lead.*—The furnace in which the cupellation is performed resembles a cupola furnace, rising about three feet, and having the fire somewhat below the surface. The assayer is stooping over the fire, intently watching the metal.

"The lead previously extracted is put into an ash furnace, and slowly melted by a coal fire; the lead sinks to the bottom among the ashes, and the pure silver appears coming out of the centre. It is called *hai-buki gin*, or 'ash-melted silver.'"

Plate XII. *Of rinsing and sifting.*—Here we have two tubs of water, at which are women rinsing the pounded scoria; troughs stand by them for receiving the metallic portions, and a workman is shoveling the heap of scoria.

"Within the earthen crucible, used in melting copper, there is an earthy residuum, which, with the scoria, is put into a stone mortar, pounded fine, and afterwards rinsed. As the water in the bowl flows off, the earthy particles being light also run off as useless. The cupreous portion, being heavy, remains in the bowl, whence it is taken."

Plate XIII. *Fusing lead.*—This plate is supplementary to those on copper, introduced probably on account of the frequent mention of lead when speaking of copper. The furnace is represented as distinct from the crucible or caldron in which the lead is melted; the fire is underneath it, and communicates with the bellows below the surface. The fire is pictured as having gone down, one workman is lading lead into small oblong molds, while a second is cooling them in a tub of water, and a third cording the bars of lead into small faggots.

"The ore of lead comes from the hills; it is fused in a crucible; and afterwards poured out into copper molds to form bars of lead."

Succeeding these thirteen plates are as many more, representing the implements used in smelting copper and lead and specifying their names and uses. To the professed metallurgist, this would be a very interesting part of the work; but it will be neither entertaining nor profitable to our readers to be detained with a minute description of them. There are one hundred different drawings, representing the iron ladles, rods, forks, skimmers, pincers, &c., with the sieves, brooms, tubs, crucibles, molds, mortars, weights, &c., employed in the various stages of the smelting. The last page is occupied with diagrams of the bellows.

The remainder of the volume is filled with an account of the process connected with extracting copper from the ore, written in Chinese, and corresponding in the main to the Japanese. It is explanatory of the former, and renders the whole account much more complete than it otherwise would be. It is drawn up in excellent Chinese style, and is a good specimen of the capabilities of that language to describe even the most technical operations. The Japanese writer has added the terminations of the cases, the prepositions and other grammatical marks by which a native of that country is enabled to read Chinese with much more facility and accuracy than he otherwise could do. In the translation, we have introduced the Chinese characters along with the names of places, in order that the means may be afforded for ascertaining their native names by those who have access to educated Japanese. These, in many instances, are so different from the sound of the characters themselves, as to afford no clue whatever to the names of the places designated, if the reader does not happen to know the very characters employed to write that name. Thus, the three great cities in the empire, Yedo, Ohosaka, and Kioto (or Miyako), are severally written *Keänghoo*, *Taepan*, and *Kingtoo;* the last is a descriptive term, meaning the imperial city; it is where the dairi or kubo resides. This being their mode of using the Chinese character in writing proper names, we have thought it would be best to introduce them; the same remark applies to names of individuals, officers, and indeed every use of the Chinese. A few sentences occurring in the preceding paragraphs will be met with in these, but being embodied in the original, they could not very well be omitted, and the whole is translated as it stands.

Memoir on Smelting Copper.—"The places in this country where the most copper is obtained are Besh-shi in Yo, Nanbu in Aü, and Akita in U; next to these places are Sonsau in U, and Shiöya in Tan; and the poorest are Ginsan and Sheükoku in Sheki, Kitsukaü in Bi, Beïwa in Ki, Kinsan in Sa, Taiya in Yetsu, Taten in So, and some others. From some of these places, there is at times much, and at others little, produced; the mines are sometimes open and sometimes shut. Besides these there is so large a number which produce but little, that they can hardly be enumerated. Now the productive veins have limits, and the branching offsets cease midway; some of them will not repay the outlay; others, the owners are unwilling to dig; and again there are others which are not worked on account of the labor attending them: of all these there are many.—The copper ore sometimes contains both silver and lead, and at others it is pure without any admixture; it is also alloyed with zinc. The rules for smelting are also dissimilar. There is some copper which is wrought by hammering, and some which is cast by fusing; generally speaking, that which contains silver and lead is softer, and is hammered into sheets, or drawn out into wire. That which is alloyed with zinc is very solid and hard, easily fractured if hammered, and unsuited either for sheets or wire; but if the soft and hard be fused together, there is no danger of its fracturing. If lead or tin be intimately blended with it, the alloy is very sonorous, well adapted for mirrors and bells. However, each has its own rules; and if [the reader wishes to read] the rules for quarrying, smelting, &c., they are briefly explained in the following pages.

Sec. I. *Of the ore.*—"All copper localities produce ore accompanied with earth and barren rock. When the mine contains copper ore, its evidence will always be found on the top of the hill, of a reddish black hue, coloring both the earth and stones. It forms a connected vein, either long or short, broad or narrow; either deep or shallow, rich or poor, according as the ore is much or little; for it is the effluence of the copper which steams up and forms it, and the miners diligently examine its aspect in order to judge whether the copper will be much or little, good or bad.

Sec. II. *Of digging the ore.*—"When the appearances on the top of the hill betoken good ore, [the miners] dig several perches into it in a circuitous manner; as they penetrate, setting up posts and joists, and laying boards and rafters upon them, stopping the empty interstices with stones and dirt, in order to prevent the pit caving in. The miners carry a lamp made from a shell, as they work the ore and fill their buckets. The number of days or months required to penetrate ten or twenty perches cannot be determined. Sometimes ore will be, and sometimes it will not be, met with; and when it does occur, the lode will suddenly stop, and again be resumed; at times it will continue on without faults; there are lodes which grow smaller and narrower, the further they are followed; others suddenly contract, and as suddenly enlarge; some diverge, and others are without any branches. The rock which envelopes the ore varies in its aspect. The barren rock is thrown aside as of no further use. The ore is of many sorts, yellow, black, reddish and gray, brilliant and dull, some of it contains much, and some of it little. Indeed, the nature of the mine is not uniform, nor is it possible to obtain the ore alike in order to average the good and bad. When dug out, the ore is broken to fragments, and the process of selection and throwing away the barren stone is called *kaname* (or examining the ore). Generally, the best ore produces one tenth of copper, and the poorest, one twentieth.

Sec. III. *Of roasting the ore.*—"Whenever ore is roasted, a kiln is built under a shed. Faggots are spread upon the bottom and ore laid upon them; a layer of faggots and one of ore alternately are piled up to the brim. A vent-hole is cut in the bottom of the kiln for the draft to be free. The smoke is so sulphureous as to suffocate one, and the fire cannot be approached. When the fire has burned ten days, and gone out, the whole is cooled and taken out, but the ore has undergone but little change. These are the general outlines (of the mode of roasting).

Sec. IV. *Extracting the coarse metal.*—"Whoever extracts the coarse metal, constructs a wall in a building, and [on one side of it] makes a large furnace, having a trough leading out of it; on the other side of the wall two large bellows are placed. The roasted ore is then put into the furnace upon the coal, and two tall men pull the bellows, while a third, holding a long iron rod, stands before the furnace to separate and level the mass. When the fire has reached its strength, and the liquid metal has risen and filled the furnace, the earthy scoria floats upon the surface, and little by little flows off into the trough; as it flows out, it is suffered to cool, or else water is sprinkled upon it, and it is taken out and thrown aside. When the ore is all melted, more is added and additional coal placed upon it, until the furnace is full of good metal, when the earthy scoria and coals are all pushed off. Water is then sprinkled upon the top of the furnace, to cause the liquid metal to separate from the cold, and form a crust which can be raised up. An iron pole is employed to peel it off and take it away; first sprinkling and peeling, until all is taken off, when there is found at the bottom of the furnace a mass of copper; if, however, the ore is poor, there may be none.

Sec. V. *Of extracting the copper.*—"The rules for calcining the coarse metal, and extracting the copper, are for the most part like those for melting the ore and extracting the coarse metal. But when the furnace is full of liquid metal, the top is luted with clay, leaving a small hole in it in which to put the coal and blast the charge. If there is any scum take it out immediately, and wait till the whole mass is thoroughly fused; then open the furnace, and entirely remove the ignited coal and earthy slag, after which, wait till the heat has abated a little, and then, sprinkling the surface, take it out in the same manner as when taking out the coarse metal.

"All the operations described above, from quarrying the ore out of its bed to the first making it into pure copper, are done at the mine. The officers' orders are that no copper shall be privately sold, but that it must all be carried to the Riau-kwa foundry; where the superintendents direct the founders to smelt and cast it, then assort the various qualities and affix their corresponding prices. That which is delivered at Nagasaki and Kwashi is from Besh-shi, Akita, and Nambu. That which is brought to market for ordinary purposes of manufacture is all produced from other places besides these three. The number of founders is likewise fixed; they cannot be lightly increased or diminished, lest malpractices should arise. That copper which contains silver, and that which contains zinc, and the pure metal, must not be mixed. There are these two operations carried on in the foundry.

Sec. VI. *The second smelting.*—"Every district which produces copper has it smelted a second time in a foundry furnace. When fused, take off the slag and the coals, and then work the bellows a second time until it is liquified; wait till the heat has abated a little, sprinkle water upon it to concrete it, and then take it out with an iron rod. This is re-smelted copper or fine metal. [The mass] is about a cubit broad, and half a cubit thick, being a little smaller than the bottom of the furnace. The process is for the most part like that of extracting the coarse metal. Generally speaking, about 250 catties can be melted in the furnace at once, and there are three fusings in a day.

Sec. VII. *The third smelting.*—"The twice smelted copper is put into an earthern crucible, placed in the furnace and melted. A tub of hot water is set near at hand and a square wooden pool made, into which the molds are placed; and over them a thick hempen cloth spread. When the copper is melted, the scoria taken off, and the fire reduced, hot water is poured into the pool (not very hot), until it is almost level with the molds; then the smelter, firmly grasping the crucible with a pair of large iron pincers, pours [the metal] into the molds, which are previously sprinkled with warm water lest the mold should crack.* Afterwards, water is sprinkled upon the bars to cool them, and they are taken out with a pair of iron nippers. Each casting produces ten or more bars; they are seven or eight inches long, and

* "If cold water is indiscreetly sprinkled [upon the molds], or if the crucible is cracked, in both cases an explosion will take place; and because the lives of persons are endangered by such an accident, great care should be used to guard against it." Note in the original.

weigh about ten taels (i. e. nearly a pound av.) each. The copper is all poured off in about ten times, and the crucible is fused ten times in a day. In this manner are made the copper bars which are brought to Nagasaki and Kwashi.*

"The above are all the rules for smelting pure copper; there are others for taking the re-smelted copper, fusing and casting it into square, or round, or other shaped molds, as will be presently explained, and these are, in the main, similar to those for making copper bars.

"Copper was first brought to this country by eastern people. According to the Memoir on Copper, the year was between the reigns of Genki and Tenshei. For about a thousand years, the metal from every district was chiefly of the third quality, as they had not learned how to extract the silver; so that they could be called deficient in manipulation. For this is known from the fact, that if broken copper utensils, made in the reign of Tenshei and before him, be smelted, silver can always be extracted from them. The silver used in those days was all obtained from mines. At the end of Tenshei's reign, certain foreign merchants came to Sakai in the country of Shen, and taught the mode of extracting silver to Sumitomo Zhiyusai; this was in the year 1591. In the reign of Tsungching of the [Chinese] Ming dynasty, from that which was produced at Soü-yoü-shei, the furnaces of Tenkoü and Kaimutsu became skillful in extracting the silver, though the mode of operation was different. Teënching reigned the fortieth year after this, in 1631. From Sumitomo Zhiyusai and after, the family has followed the occupation of mining and smelting copper; the fourth in succession was called Sumitomo Tomoyoö, and he discovered a copper mine in the department of Yo (or Yo shiu), while Genroku reigned, which he desired leave to open; it has yielded not less than 7,000,000 catties of copper annually, while it has been constantly worked up to the present time, more than a hundred years. For seven generations past this family has superintended the Raükwa foundry; and because the designation of the foreign merchants was Shiromidzu they have joined the two characters to form Shen their present mark. He who first in this country extracted silver from copper was undoubtedly Sumitomo Zhiyusai, but people generally did not know this fact, and therefore this explanation has been introduced.

Sec. VIII. *Of alloying copper and lead.*—"When silver and zinc are combined with the copper, lead is added and placed on top of the furnace, and the whole mass fused. When the earthy

* Thunberg says the "copper, after being roasted and smelted at the smelting house, is refined and manufactured at Miyako, where also all the coin is struck." Vol. III, page 141. The foundry of Raükwa, mentioned in this account, may be at Miyako, but we have no means of ascertaining.

slag and hot coals are removed, an iron pole is used to take it out by adhesion; its appearance is that of broken tiles, and it is called *awashe kane*, or alloyed copper. Generally there are 8 parts of copper and two of lead; but the lead is according to the quantity of silver, if there is much then more is added, if little the lead is reduced.

SEC. IX. *Of separating the lead and copper.*—"The alloyed copper is put into a Namman furnace (so called because the southern foreigners introduced it; it is built of earth), and coal added by degrees as the bellows is worked. A crooked iron rod is used to stir the metal about in the clay, but it must not be allowed to become melted so as to run. When the lead is fused, it will flow off, carrying the silver in combination with it. If the zinc is also ready to run off, the workman with his iron rod stops and turns it off so that it may not mix with the lead; it usually remains just between the lead and copper. When the lead has all run off (i. e. that combined with the zinc), then scoop the zinc up and take it out; and when both the lead and zinc are separated, sprinkle water and take out the copper; it is called *shibori doü*, pure (*lit.* wrung out) copper. The lead in the hollow place cools and forms a round mass (called *shiyuts shiyo,* or extracted lead); it still combines silver with it, which does not show itself. Truly this process of separation must be regarded as very elegant!

SEC. X. *Sinking the lead to extract the silver.*—"The first thing in cupellating the silver is to construct an ash-furnace; the foundries of Tenkoü and Kaimutsa call it an ash pool, it is made of sifted ashes placed on the earth, having a depression about a cubit wide, and a hollow place in its middle. When the lead is in, coal and fire are put on, and a defense formed of wet ashes like a wall or dyke is built around, leaving a hole in front to work the bellows (as well as to see the state of the fire), on the top of which a cover of a broad tile is closely luted with wet ashes. The bellows is then gradually blown until the fire attains its strength, causing the lead to drop into the ashes, where it forms a mass upon the bottom. The lead is called *ruikasu,* and is afterwards purified from the ashes. The silver floats in the middle as a small round cake, and is called *haibuki gin* or ash-melted silver. Such are the rules for extracting the silver.

SEC. XI. *Supplement of rinsing the scoria of the copper and zinc.*—"The separated copper is of the same quality as the re-smelted; it is melted and made into copper rods, and into ingots for hammers and nippers. That cast into square sheets is used to tile houses, the round is made into cups, the oblong pieces are employed in constructing eave-troughs, and the long rods are for making wire. If the lead and zinc are not completely separated the copper will split and crack when hammered; it is consequently very important that at the time of smelting it be perfectly purified. Zinc is only used as an alloy in making mirrors and warming stoves and bells; if it is combined in the copper, that metal will not stick to the molds, but when taken out, the engravings and ornaments will be distinct and clean.

Sec. XII. *Of the washing and rinsing.*—"The fragments of copper taken from the refining furnace which adhere to the scoria, and that from the crucible, are beaten in a mortar, sifted and then rinsed in water in order to obtain the copper.

"Written by Mas'tadzuna (or Soü ten-boü) a pupil of Sumitomo Zhiyusai in Raükwa."

When Thunberg accompanied the Dutch embassy to Yédo in 1776, the party after much intreaty were allowed to see the operation of casting the copper bars at Ohosaka, which he thus describes. We introduce it as the testimony of an eye-witness to corroborate the native account.

"The operation of smelting of copper was one day performed particularly for us, and merely on purpose that we might see it, in consequence of the importunate intreaties both of our chief and our conductors. This was done with much greater simplicity than I had imagined. The smelting hut was from twenty to twenty-four feet wide, and a wall like a niche was built up, with a chimney on one side of it. At the bottom of this, and level with the floor, was a hearth, in which the ore, by the assistance of a hand-bellows, had been smelted before our arrival. Directly opposite, on the ground, which was not floored, was dug a hole of an oblong form, and about twelve inches deep. Across this were laid ten square iron bars, barely the breadth of a finger asunder, and all of them with one of their edges upwards. Over these was expanded a piece of sail-cloth, which was pressed down between the bars. Upon this was afterwards poured cold water, which stood about two inches above the cloth. The smelted ore was then taken up out of the hearth, with iron ladles, and poured into the above described mold, so that ten or eleven bars, six inches long, were cast each time. As soon as these were taken out, the fusion was continued, and the water now and then changed. That the copper was thus cast in water, was not known before in Europe, nor that the Japanese copper hence acquires its high color and splendor. At the same time I had the good fortune to receive, through the influence of my friends the interpreters, a present of a box, in which was packed up, not only pure copper cast in the abovementioned manner, but also specimens taken from every process that it had gone through, such as the crude pyrites with its matrix, the produce of the roasting, and of the first and second smelting. * * *

"After this we saw a quantity of cast copper, not only in the abovementioned form of bars, as it is sold to the Dutch and Chinese, but also cast in larger and smaller, round and square, thicker and thinner, pieces, for other purposes, according as they may be wanted for the fabrication of kettles, pans, and other utensils."

The copper exported by the Dutch is, according to Thunberg, packed in long wooden boxes each containing one pecul. A cargo consists of six or seven thousand chests. The bars, he says, "are six inches long, and a finger thick, flat on one side, and convex on the other, and of a fine bright color. Each bar weighs about one third of a pound." One of the bars now lies before us. It is nine inches long, flat on one side and convex on the other, the upper side much blistered, of a dark carmine color, and weighs 11 taels, 3 mace, and 8 candareens, or 15·12 oz. avoirdupois.

Art. XXIV.—*Caricography;* by Prof. C. Dewey.

(Appendix, continued from vol. vi, 2nd ser., p. 245.)

No. 237. *Carex ignota*, Dew.

Spicis distinctis; spica staminifera unica gracilis longo-pedunculata squamo-bracteata cum squamis oblongis obovatis subobtusis; pistilliferis ternis oblongis laxifloris erectis exserto-pedunculatis foliaceo-bracteatis, inferiore longo-pedunculata; fructibus *tristigmaticis* elliptico-triquetris utrinque teretibus alternis subconico-rostratis ore integris subrecurvis, squama ovata acuta cuspidata membranacea paulo longioribus; culmis foliisque subpubescentibus.

Culm 18–24 inches high, erect, rather slender, triquetrous, leafy towards the root; leaves short and lanceolate, striate; bracts sheathing, leafy, shorter than culm and enclosing the peduncle of the upper pistillate spike; staminate spike single, erect, exserted from the upper sheath, with oblong or obovate obtusish scales; pistillate spikes three oblong, filiform, erect, loose-flowered, the two lower long pedunculate, and all sheathed; stigmas three; fruit elliptic-triquetrous, tapering to both ends, conic-rostrate, slightly recurved at apex, with orifice entire, alternate and smooth; pistillate scale ovate, acute and cuspidate, shorter than the fruit; culm, leaves, and sheaths, slightly pubescent, pale green.

From Louisiana through Dr. Sartwell, and a few years since it came to me from Dr. Hale of the same state. It resembles slightly *C. anceps*, but the fruit is much longer and more conic, and appears a distinct species.

No. 238. *C. vulpina*, L., Schk., No. 23, Tab. C, fig. 10.

Spica decomposita, sæpe ramosa; spicis *distigmaticis* ovatis obtusis coarctatis densis superne staminiferis, interdum sparsis interruptisque; fructibus ovatis apice teretibus subrostratis divergentibus bidentatis margine subscabris, squamam ovatam acutam subpaulo superantibus.

Culm 1–3 feet high, erect, wide-triquetrous and acute on edges, sometimes small and slender and with a few scattered spikelets; leaves lanceolate and rough on the edges, subradical; spike often long and large and more than decompound with densely aggregated spikelets, staminate above; fruit ovate, broadish, tapering into a beak, two-toothed, subscabrous on the margin; stigmas two; pistillate scale ovate acute, narrower and a little shorter than the fruit.

A well known species over Europe, and very different, though resembling our *C. stipata*, Muh.; but it was not detected in our country till a few years since by Mr. Sullivant in Ohio, and later by Dr. Mead and Dr. Vasey in distant localities in Illinois.

No. 239. *C. scabrior*, Sartwell in literis.

Spica composita vel decomposita arcte ramosa, interdum non ramosa; spiculis ovatis parvis dense aggregatis raro bracteatis superne staminiferis; fructibus distigmaticis latis convexis rostratis bidentatis margine perscabris serrulatis, squama ovata acuta vix duplo longioribus; foliis culmisque margine perscabris.

Culm two feet high, erect, stiff, rather slender for its height, triquetrous, very scabrous on the edges, leafy on the culm towards the root; leaves linear, flat, striate, sometimes long as the culm, scabrous on the edges, long acute; spike compound, sometimes interrupted, two inches or more long, and oftener decompound with many dense spikelets on the branches below and dense also towards the apex of the spikelets; stigmas two; fruit broad ovate, convex, rostrate, bidentate, on the margin serrulate; pistillate scale ovate, acute, less than the fruit and about half as long; the bract scale under the spikelets ovate, cuspidate, surpassing the fruit; plant rather dark green.

Found by Dr. Sartwell near Penn Yan some years ago, but not determined till lately; it may possibly be the true *C. vulpinoidea*, Mx., to which has been credited *C. multiflora*, Muh. It differs much from the latter, but is nearer *C. setacea*, Dew., which is clearly distinct from both. It has not been confounded with *C. multiflora*, and the absence of the *setaceous* bracts, as well as other characters, separates it from *C. setacea*. It is far different from *C. vulpina*. L.

No. 240. *C. platyphylla*, Carey.

Spica staminifera unica subclavata brevi-pedunculata cum squamis oblongis acutis, pistilliferis ternis gracilibus paucifloris (3–6) exserte pedunculatis folioso-bracteatis laxifloris erectis; fructibus *tristigmaticis* ovatis utrinque acutis triquetris ore integris apice subrecurvis, squamam ovatam acutam vel aristatam multo superantibus; culmis demum subprostratis, et foliis radicalibus patulis nervosis.

Culm 3–8 inches high, erect, triquetrous, at length nearly prostrate with sheathing leafy bracts shorter than the culm, and with broad radical leaves distinctly three-nerved: staminate spike clubform, short, short-pedunculate, with oblong acute scales; pistillate spikes two, or three often, few and loose-flowered, exsertly pedunculate a little, and a little shorter than the leaf of the bract; stigmas three; fruit ovate triquetrous, *smooth* and nerved, acute at apex and turned slightly one side; pistillate scale ovate, acute or cuspidate, white on edge, shorter than the fruit; leaves pale green.

Open woods over the country, but has been placed under *C. plantaginea* and *C. anceps.* By Muh. both these were blended together, though far different. By Schk. they were only half distinguished, as he placed the wide leafed *C. anceps* under *C. plantaginea*, while he gives a correct figure of the latter on Tab. U, fig. 70, and of the former (*C. anceps*) on Tab. Kkkk, fig. 195, and of the narrow leafed *C. anceps* on Tab. Fff, fig. 128, as they have been for years understood. These two need to be separated; and I propose to call the wide leafed *C. anceps*, *C. patulifolia*, leaving to the narrow leafed its proper name as described by Schk., and not confounding it with *C. conoidea*, Muh., the *C. blanda*, Dewey.

C. platyphylla was properly separated by Mr. Carey and published in Prof. Gray's *Botany of the Northern States*, and placed in the section with *C. plantaginea*, Lam., and *C. Careyana*, Dew.

Note.—*C. alopecoidea*, Tuckerman, var. *sparsi-spicata*, Dew., has scattered spikelets, forming a compound spike three inches long, and not an aggregated head of spikelets.

In Washington, Mich.—*Dr. Cooley.*

C. intermedia, Good., is found by Dr. Geo. Vasey in Ringwood, Ill.

C. fœnea, Muh., has been found abundantly by Mr. Olney in Cumberland, R. I.

Art. XXV.—*On the Diurnal Variations in the Declination of the Magnetic Needle, and in the Intensities of the Horizontal and Vertical Magnetic Forces;* by William A. Norton, Professor of Mathematics and Natural Philosophy in Delaware College.

(Continued from p. 226.)

We have seen in a former part of the present paper, that the secondary nocturnal variations of the horizontal magnetic intensity of a place, correspond, in respect to time and direction, with the deviations in the nocturnal loss of temperature from uniformity, and that the cause of these deviations is therefore, in all probability, either identical with or closely related to the cause of the variations in question. It follows therefore from the conclusions which have just been obtained, that the probable cause of the secondary variations of the horizontal force is to be found in the varying quantities of dew deposited at night; from one hour to another, and from one season to another. It is to be observed, however, that it is not essential that the unequal losses of temperature at night should be attributable entirely to the thermal influence of dew, to enable us to draw this inference. We have seen that the results of observation and experiment conduct us to the conclusion that the tendency of this influence is to produce the inequalities which have been under consideration. This furnishes sufficient ground for the inference; but if the entire amount of the inequalities of the decrease of temperature be not due to this influence, there is room to doubt whether the secondary variations of the horizontal force might not be attributable to the action of the other unknown cause or causes tending to produce unequal variations of temperature at night. In this event also, in estimating the effect of the dew upon the horizontal force, we could not be positively certain that the entire variations of temperature at night were attended by corresponding variations in the amount of heat in the stratum of variable temperature below the earth's surface: unless, at least, it should be admitted that the unknown cause must consist in some relation or phenomenon external to this stratum.

Having thus arrived, inductively, at the probable cause of the secondary nocturnal variations of the horizontal force, let us see how it applies itself to the detailed explanation of these variations. It is abundantly evident, from what has gone before, that the continual accumulation of dew, or condensed vapor, at the earth's surface from evening till morning, must tend to diminish the rate of decrease of the horizontal force; and that the increase in the quantity of dew that falls, from hour to hour, must tend to make this diminution greater and greater, and that it is not improbable that towards morning the effect of the increased quantities of dew may prevail over the effect of the loss of heat, and thus that the horizontal force may begin to increase. (See the July No. of this Journal, p. 40, figs. 1 to 5.) The actual variations of the horizontal force, it will be observed, are the result of two antagonistic causes: the tendency of the uniform loss of heat, from radiation, is to make the horizontal force decrease uniformly during the night; the tendency of the dew is to augment this force, but it acts unequally, producing the greatest effect towards morning, when it ordinarily prevails over the other cause. The dew tends to augment the horizontal force in two ways; by furnishing a certain amount of heat to the earth, and thus diminishing the loss of heat, and by adding to the amount of magnetic matter at the earth's surface. The joint effect of these two opposing causes should be different in different seasons. From the vernal to the autumnal equinox, the dew is less in amount and the nocturnal fall of temperature is greater, and therefore the height of the morning maximum of horizontal force ought to be less, than from the autumnal to the vernal equinox—a conclusion which accords with fact. (See as above.)

To obtain a theoretical estimate of the relative height of this maximum in these two periods, we have only to seek for the amount of the diminution of the horizontal force during the night, that would result from radiation alone, and then allow for the proportionate effect of the dew, both thermal and directly magnetic. Now it appears, on an examination of the curves of the daily variation of horizontal force, that the diminution of the horizontal force at sundown, which must be chiefly due to radiation, is about one-half of one of the division-spaces in the diagram: according to this, the tendency of the radiation is to diminish the horizontal force, during a night of twelve hours, (from 5 P. M. to 5 A. M.,) the amount of six of these spaces. We have obtained for the proportionate amounts of dew on a single night during the two periods above mentioned $0^{in}{\cdot}024$, and $0^{in}{\cdot}04$. These numbers bear to each other the ratio of 6 to 10, or 3 to 5. Now, the curves of the daily variations of the horizontal force for the middle quarters of the year show that during these periods the morning maximum is about one division and a half below the evening maximum. According to this the tendency of the entire effect of the dew must then be to increase the horizontal force 4½ divisions. Increasing this number in the proportion of 10 to 6, we have for the effect of dew during the first and last quarters of the civil year, (or from the autumnal to the vernal equinox,) 7½ divisions: which makes the morning 1½ divisions higher than the evening maximum. This is a close approximation to the actual state of the case, as shown by the curves. The effect of the dew is partly attributable to the heat evolved, diminishing the loss of heat and of surface temperature, and partly to the direct magnetic action of the dew. If the continual diminution in the loss of temperature at night, from hour to hour, could be partially attributed to any other external cause, the effect of the dew in augmenting the horizontal force would only have to be diminished in the same proportion.

It remains for us now to consider the secondary variations of the horizontal force which occur during the forenoon. We have already seen that the horizontal force decreases from 4 or 5 A. M. to 10 A. M., although the temperature increases; and have attributed this fact to the evaporation of the dew and rain that fall during the night. This explanation involves the supposition that, in the average of months, the amount of the evaporation is greatest early in the day. That this is really the case may be inferred from the following considerations. In the first place the dew deposited at night is evaporated during the morning hours. In the next place the greater part of the evaporation of the rain that falls during the night and the latter part of the day, will have place during the forenoon of the following day; except when the rain is a heavy one, or the ground was previously quite wet, in which case, in the same state of the sky, the evaporation will be most abundant during the warmest part of the day. The average amount of rain that falls during a single night is considerably greater than the average amount of dew. The average quantities of rain that fell during the different quarters of the year, at Philadelphia, according to the observations for the years 1842–3–4, vary from five inches to sixteen inches, which is equivalent to from $0^{in}\cdot03$ to $0^{in}\cdot09$ (nearly) in a single night. It is to be expected, therefore, that, if the morning decrease of the horizontal force be really attributable to evaporation, there will be variations in the amount of the decrease connected with the variations in the quantity of rain. That such a connection really exists will be manifest on consulting the following table, showing the quantities of rain, and the average decrease of the horizontal force for the different quarters of the years 1842–3–4.

	1842.		1843.		1844.	
	Rain.	Force.	Rain.	Force.	Rain.	Force.
1st Quarter,	6·3	3			7·3	2
2d "	10·6	4	10·3	3·25	5·2	2·5
3d "	11·4	5·75	15·7	4·75	10·8	3·5
4th "	7·8	3·75	8·7	2	8	3

The following table of averages will make the connection in question still more evident.

	Rain.	Ratios.	Force.	Ratios.
1st Quarter, ...	6·8		2·5	
2d "	8·7	1·3	3·25	1·28
3d "	12·6	1·45	4·66	1·43
4th "	8·2	·65	2·92	·63

The correspondence between the ratios is remarkably close, and would seem to indicate that, in the average of years, the diminution of the horizontal force in the morning is mainly due to the evaporation of the water that has fallen in rain and is but slightly effected by the variations in the rise of temperature, and in the amount of dew.

Diurnal Variations of the Vertical Magnetic Intensity.

According to our general theory the vertical intensity is proportional to the difference of temperature of two places situated at equal distances to the north and south of the station of the needle, and on a line perpendicular to the isogeothermal line. We have then to enquire whether the diurnal variations of the vertical intensity are proportional to the diurnal variations of the difference of temperature of two places thus situated. The theory strictly requires that the difference between the average temperatures, at any time, of the ground near the surface should be taken, but there is little reason to doubt that the laws of the variations of this difference, at any one season, will be very nearly the same as of the variations of the difference of surface temperatures. Whatever errors may result from taking the latter difference instead of the former will probably be simply errors of quantity.

Although I am not in possession of the precise data demanded for a minute prosecution of the present inquiry, still the meteorological observations made at Philadelphia and Washington will furnish differences of temperature, which will doubtless, in the average for weeks and months, differ little from the differences demanded. Let us then compare the curves showing the mean diurnal variations of the vertical intensity for the different quarters of any one year, 1841 for example, with the curves showing the mean diurnal variations of the difference of temperature of Washington and Philadelphia for the same periods of time. (See figs. 13 to 20.) On examining these curves it will be seen that the maximum of vertical intensity, at all seasons of the year, is not far from the hour of maximum daily temperature (between noon and 4 P. M.) and the minimum toward midnight, and that the same is true of the differences of temperature. The curves of vertical intensity, for the other years, conform to the same general law, and the calculations of difference of temperature, so far as

Curves showing the Mean Diurnal Variations of the Vertical Force, for quarters of years.

Fig. 13. Jan., Feb. and March, 1842.

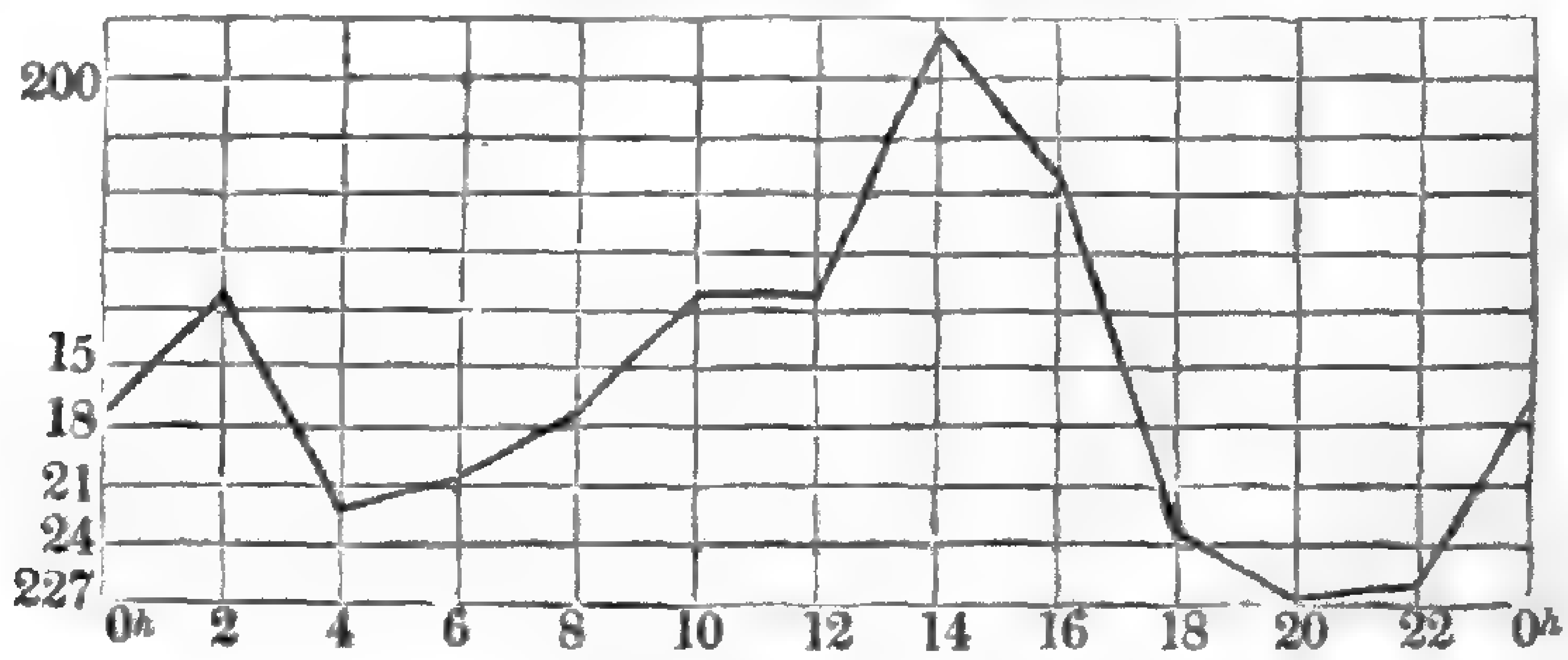
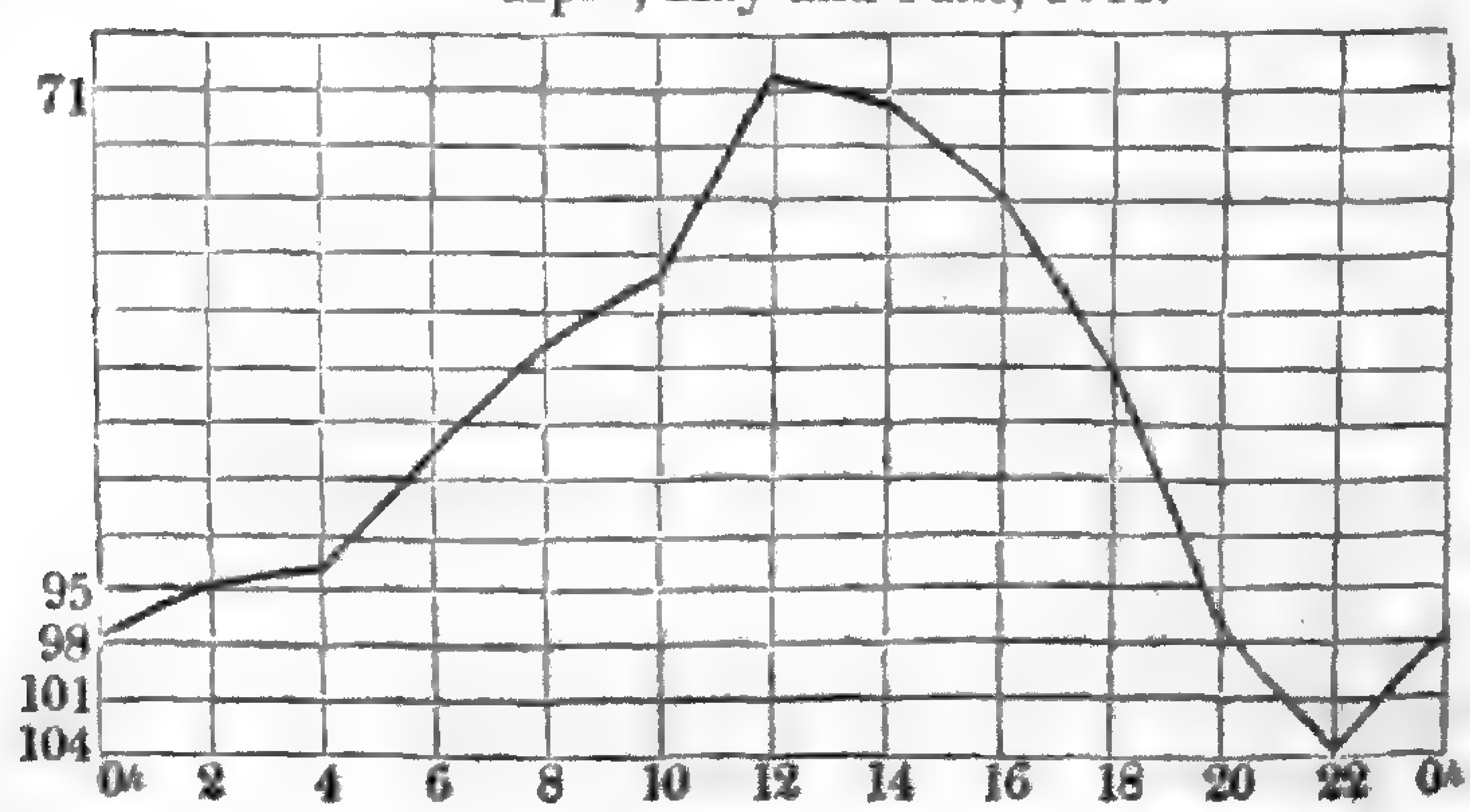


Fig 14. April, May and June, 1841.



Curves showing the Mean Diurnal Variations of the Vertical Force, for quarters of years.

Fig. 15. July, Aug. and Sept., 1841.

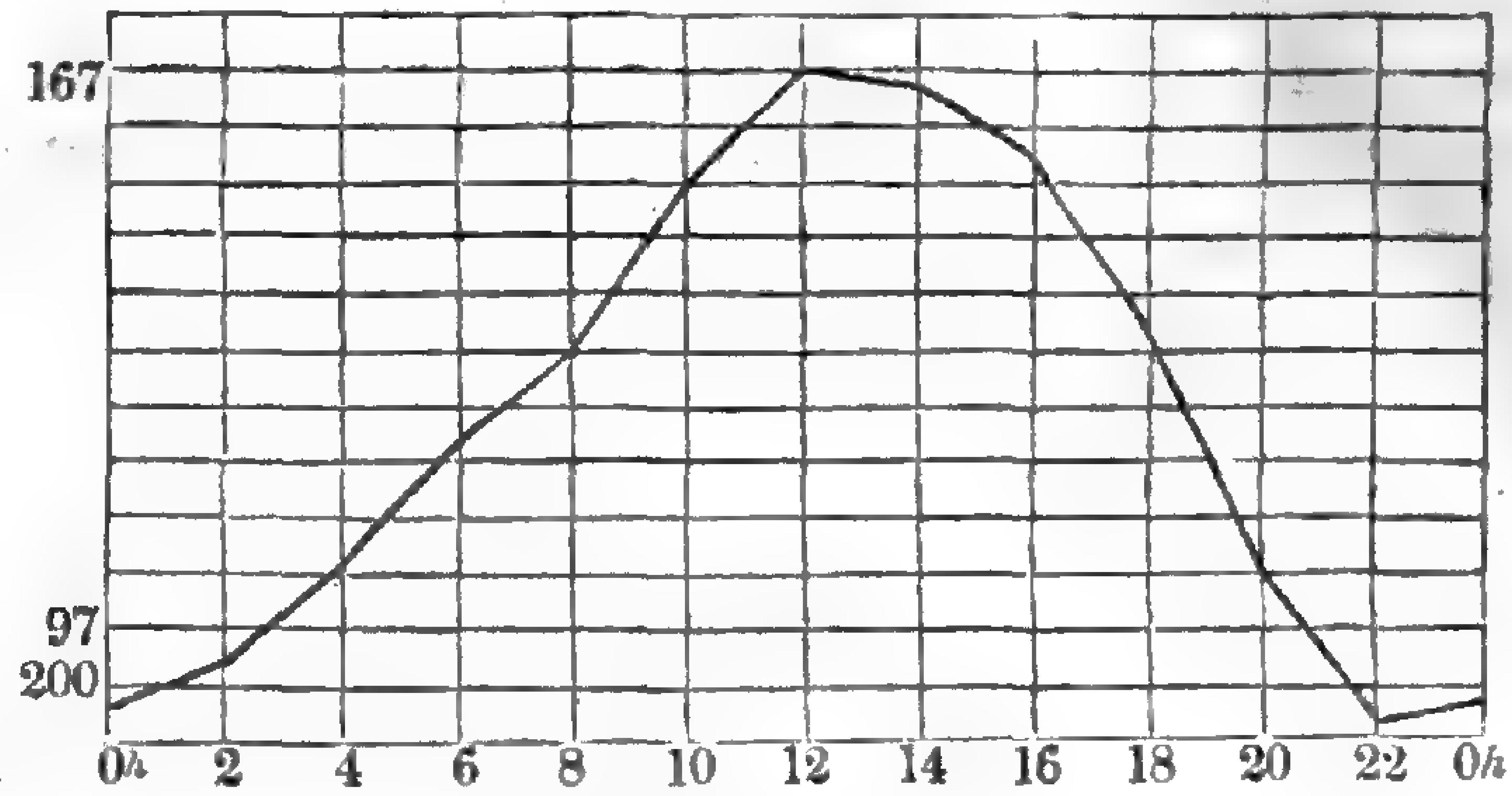
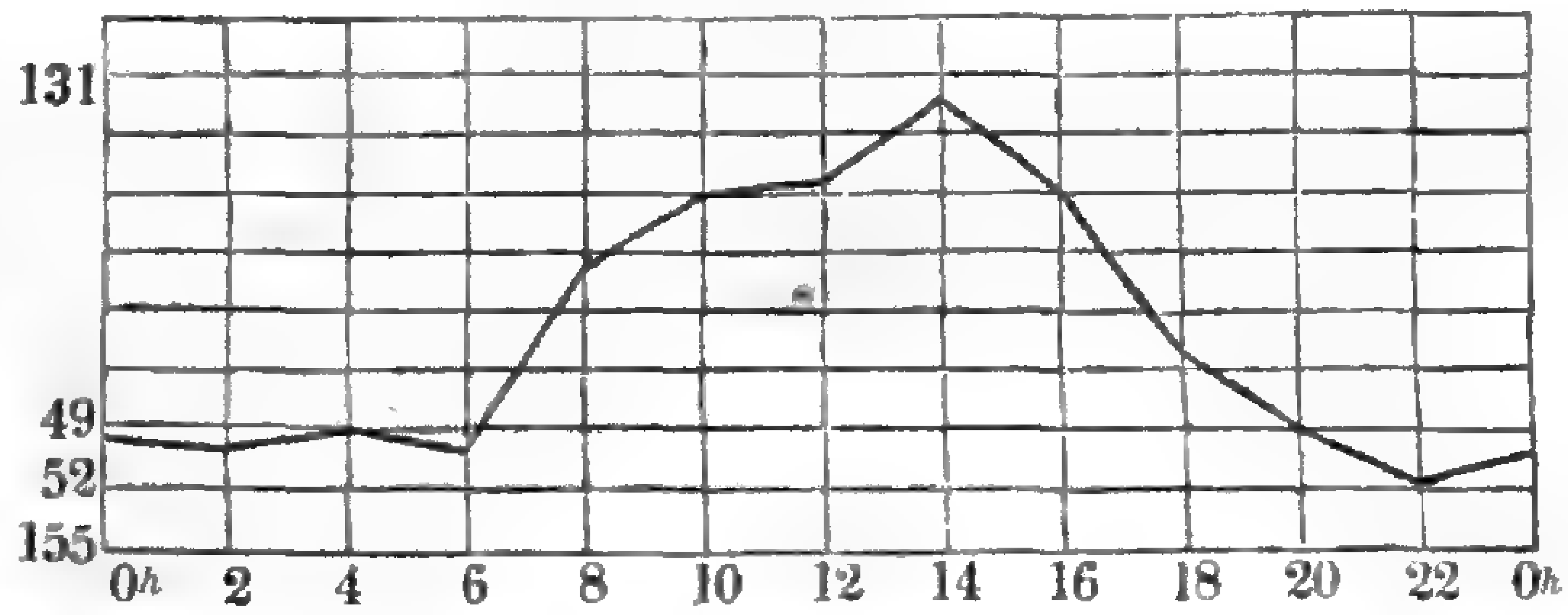


Fig. 16. Oct., Nov. and Dec., 1841.



One division of magnetometer scale = ·000033 vertical force.—Increase of numbers corresponds to decrease of force.

Curves showing the Mean Diurnal Variations of the Difference between the Temperatures of Philadelphia and Washington, for quarters of years.

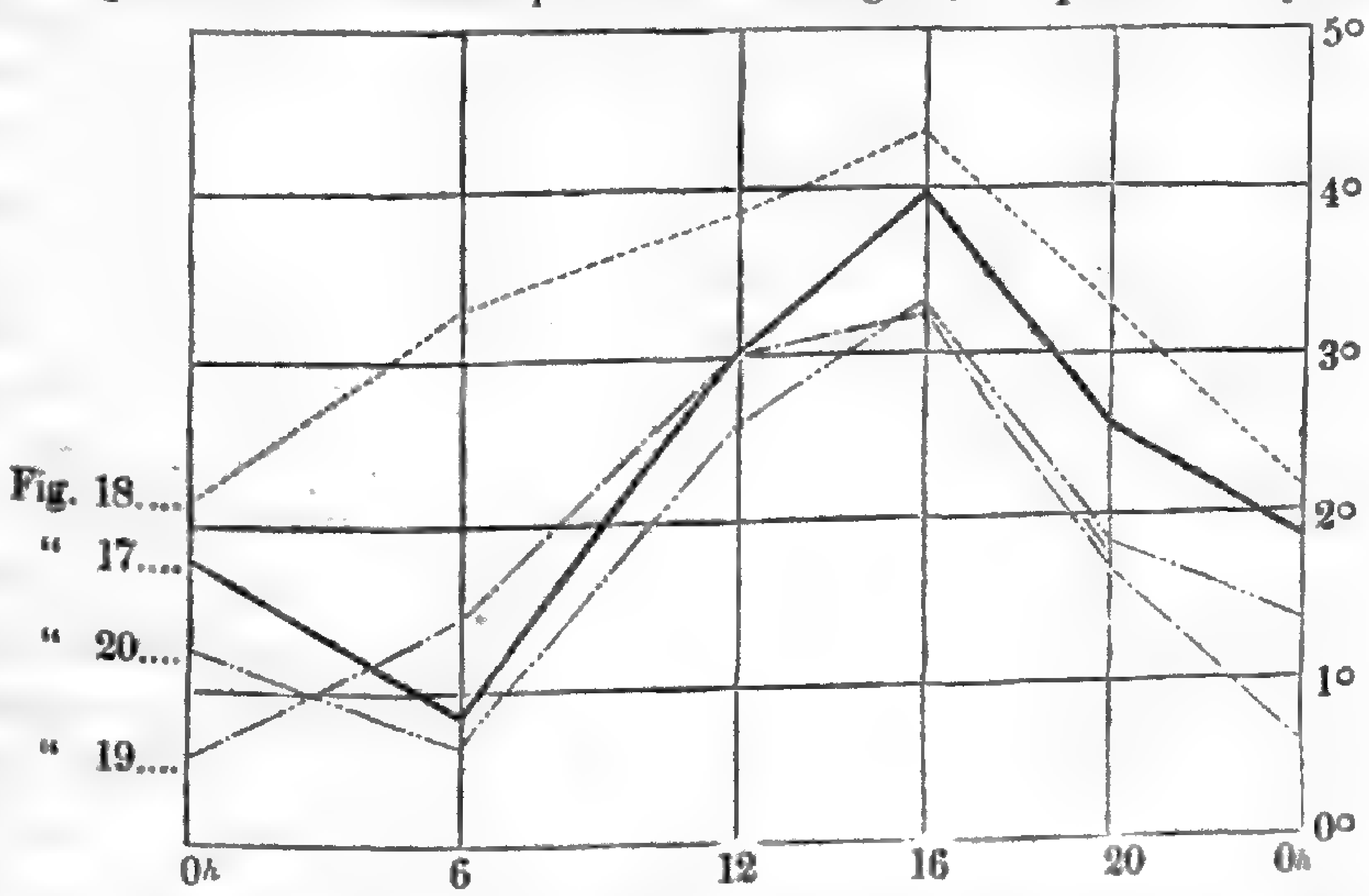


Fig. 17, Jan., Feb. and March, 1842.—Fig. 18, April, May and June, 1841.—Fig. 19, July, Aug. and Sept., 1841.—Fig. 20, Oct., Nov. and Dec., 1841.

they have been carried, serve only to confirm the conclusion that it is a general law that the difference of temperature, like the vertical intensity, is greatest between the hours of noon and 4 P. M., and least about midnight. I conclude, therefore, that the diurnal variations of the vertical intensity must be at least approximately proportional to the diurnal variations of difference of temperature.

If now we compare the curves of vertical intensity for the different quarters of the year 1841, and other years, we find that the variations are generally less for the first and last than for the other two quarters of the year. But, so far as the calculations of difference of temperature have been made, there does not appear to be an equal proportionate difference in the curves of difference of temperature. It is barely possible that this apparent discrepancy may be attributable to the fact that the data are not precisely those which the theory calls for, and that the variations of the vertical force are really the joint effect of the variations of the difference of temperature of all places situated on lines drawn through the station of the needle and at equal distances from this station; but, in all probability the principal cause is to be sought elsewhere. The first inquiry that naturally arises is whether it may not be found in the fact that, instead of taking the difference between the temperatures at the earth's surface, we should take the difference between the average temperatures of the stratum just below the surface, which is subject to a daily variation of temperature. In fact it is easy to see that if we make this correction, the vertical force ought to be less for the same difference of temperature, during the cold than during the warm months; for, the daily variation of temperature being then less, the stratum of sensible daily variation of temperature will be of less thickness. The freezing and thawing which take place in the colder months will also have the effect to diminish this thickness; since when the earth freezes at night sensible heat will be given out, which will make the cooling less than it otherwise would be, and when it thaws during the day sensible heat will be absorbed, which will have the effect to diminish the rise of temperature, and these effects are not confined to the surface of the earth, but extend to a certain depth below it. The rising and falling of vapor during the twenty-four hours will have little or no sensible effect upon the intensity of the vertical force, (unless we suppose that the vapor acts magnetically only when it is in contact with the earth's surface,) since it is chiefly the matter at a distance that is concerned in the vertical action upon the needle, and the tangential force of any particle of matter thus situated will be sensibly vertical for considerable distances both above and below the needle. The evaporation which has place during the day, and the deposition of dew during the night can have then (except upon the above supposition) little or no sensible effect upon the intensity of the vertical force, in any other way than by the heat evolved and absorbed; and this has already been tacitly allowed for, for the actual difference of temperature depends upon the deposition of dew and the evaporation, as well as upon the heating power of the sun and the radiation into space and the atmosphere.

Whether the variations in the thickness of the stratum of daily variations of temperature are sufficient to make the discrepancy above noticed, entirely disappear, must be left for future consideration. In fact, it will doubtless be necessary to have recourse to direct observations before this question can be definitively settled, and a complete explanation of all the details of the variations of the vertical intensity made out with certainty.

A farther investigation reveals the existence of other small discrepancies. These are exhibited to the eye in figs. 21 to 24,

Curves of Mean Diurnal Variations of Vertical Force and Difference of Temperature.

Fig. 21. Jan., Feb. and March, 1842.

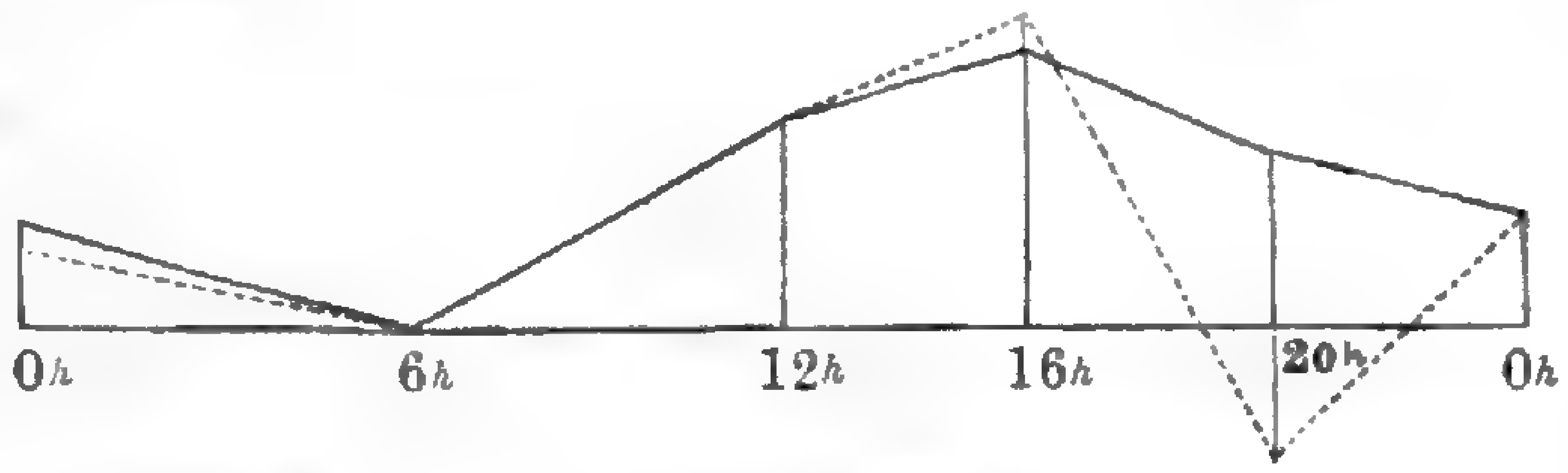


Fig. 22. April, May and June, 1841.

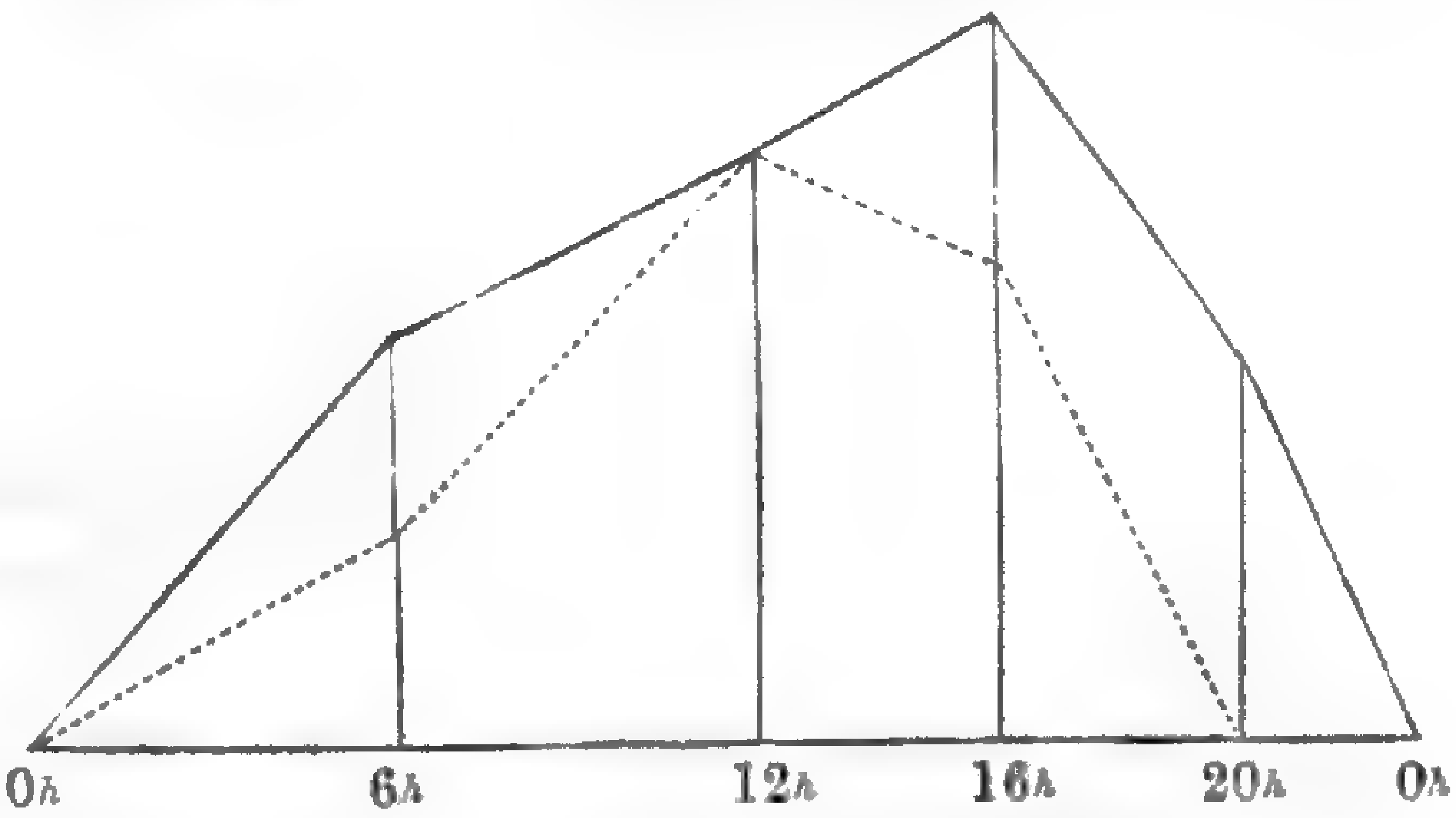


Fig. 23. July, Aug. and Sept., 1841.

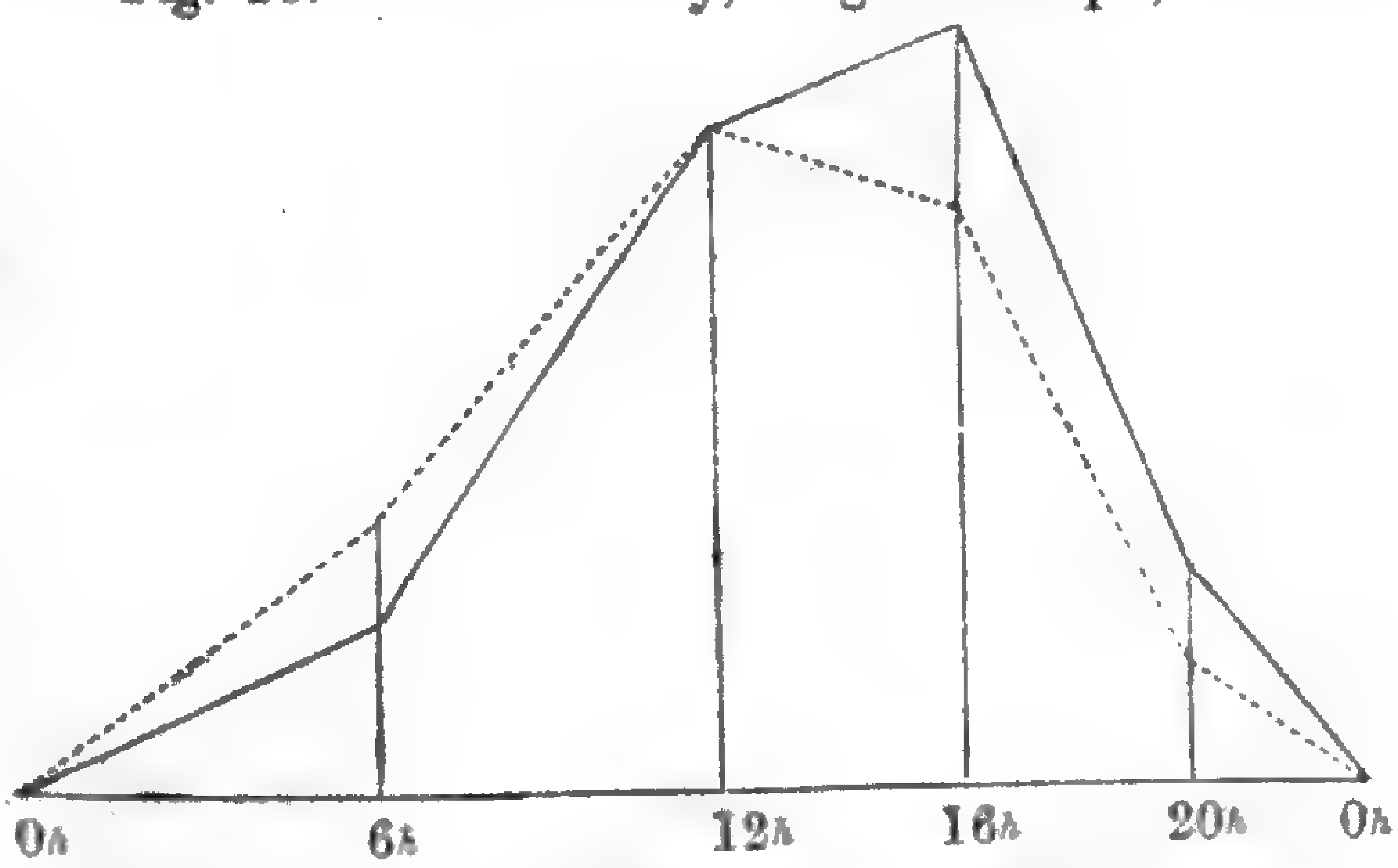
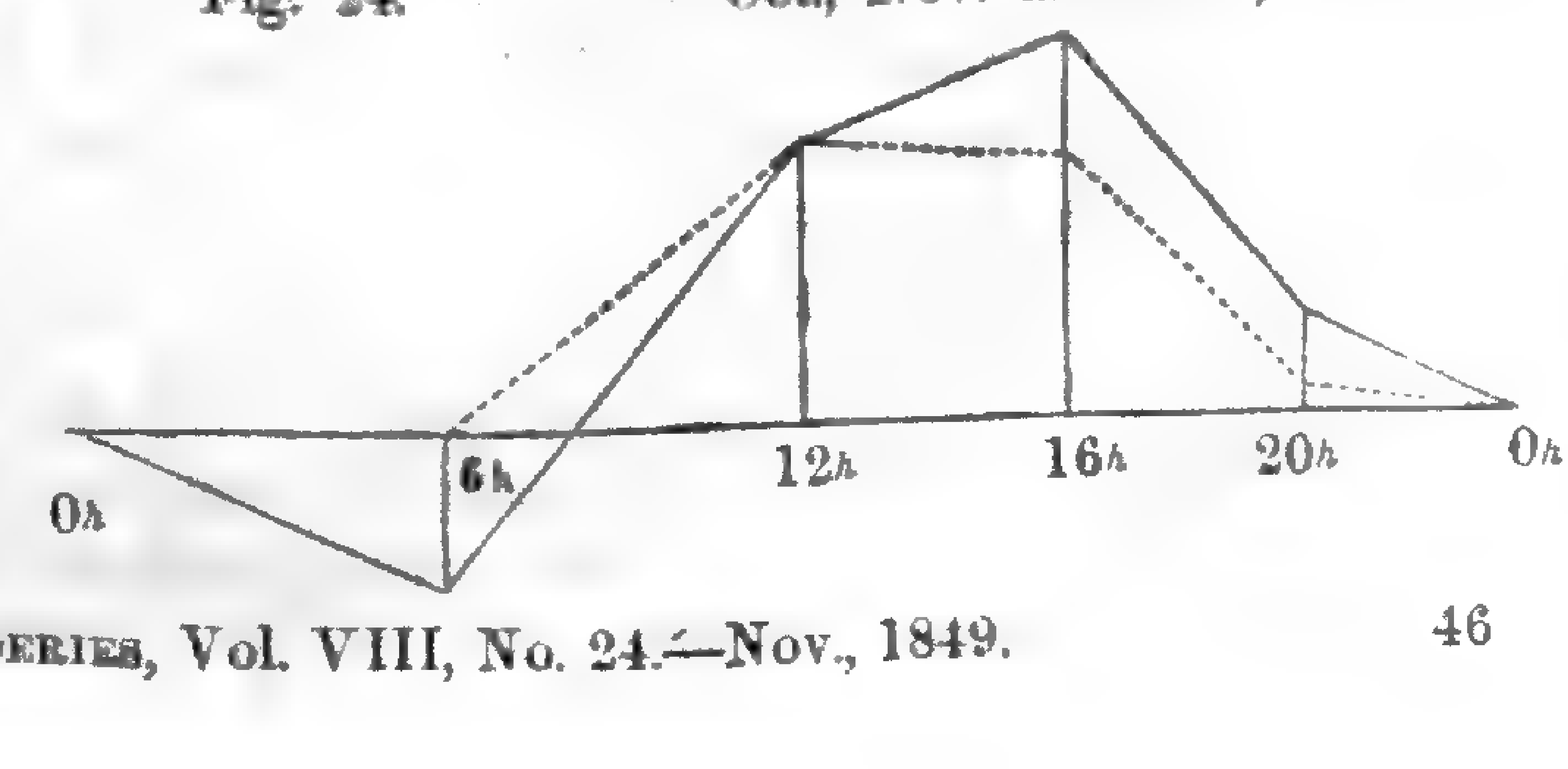


Fig. 24. Oct., Nov. and Dec., 1841.



in which the dotted lines represent the actual variations of the vertical force, and the full lines the variations as deduced from the theory that they are proportional to the variations of the difference of temperature. On examining these figures it will be seen that there is some cause in operation, making the vertical force to decrease more rapidly in the afternoon until 8 P. M., than the difference of temperature, and to decrease less rapidly or to increase from 8 P. M. to midnight. It will be seen also that in the Spring the vertical force increases less rapidly than the difference of temperature during the latter part of the night, and more rapidly during the forenoon; and that during the latter half of the year the reverse is true. It is observable also that these discrepancies are greatest in amount during the first half of the year; that they lie continually in the same direction during the first half of the year, and also continually in the same direction during the other half of the year. As to their origin, they may be purely accidental, for the locality, or for the time; or they may arise from the fact that the variations of the difference of temperature between Washington and Philadelphia do not represent with exactness the variations of the vertical force, since these depend upon the variations of the differences of temperature of all points of the earth's surface, situated within a certain distance of the station of the needle. It would, at all events, be premature to enquire after some secondary physical cause tending to produce these effects, after so partial an examination of the facts.

The curves shown by the full lines in figs. 21 to 24, were constructed upon different scales, obtained by assuming that, for each quarter of the year, the variation of the differences of temperature from 0^h to 12^h be represented by the line which represents in figs. 13 to 16, the variation of the vertical force during the same interval. The coincidence of the full and dotted lines at 0^h and 12^h is a necessary consequence of this assumption.

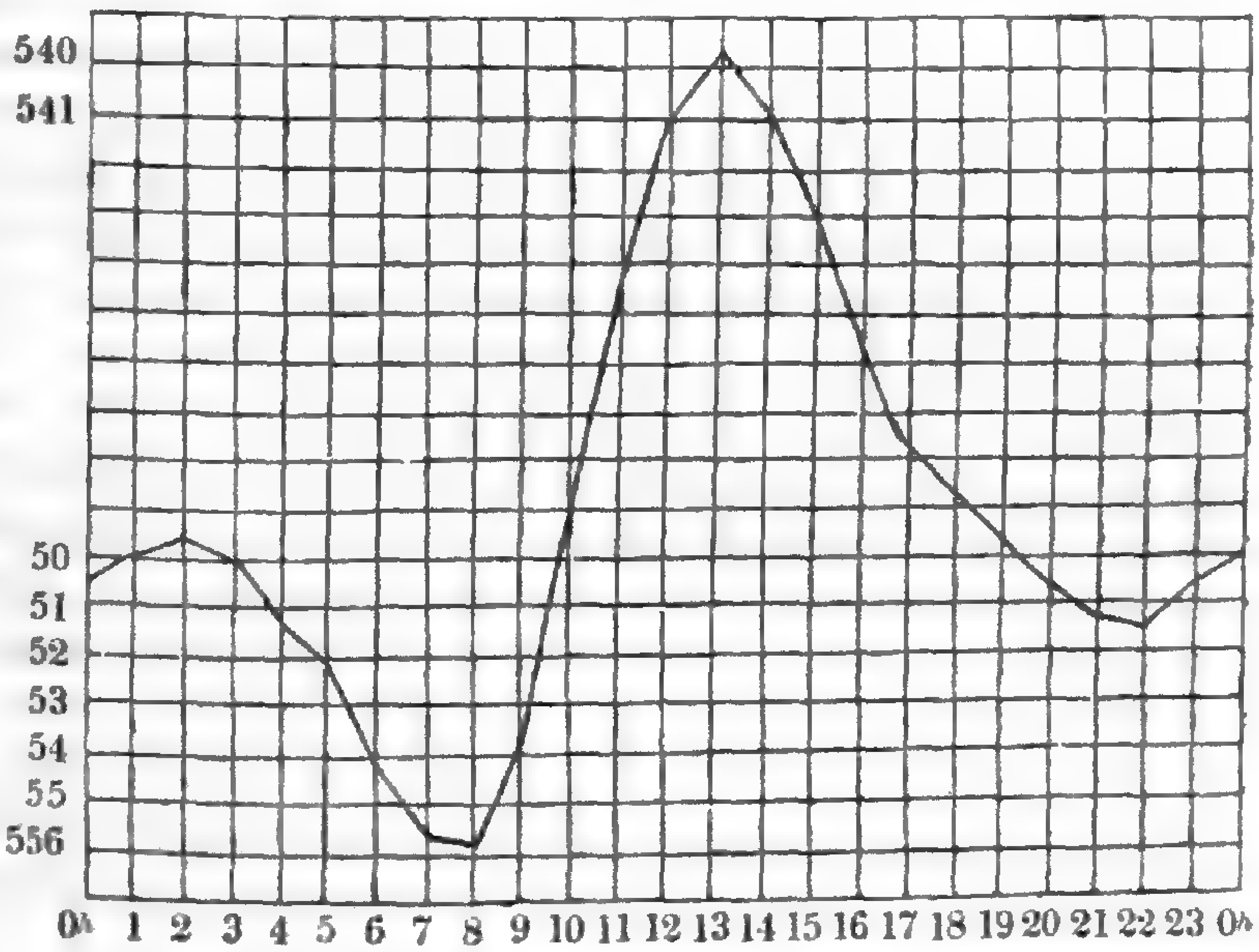
Diurnal Variations of the Declination.

The general theory is, that the needle is nearly perpendicular to the isogeothermal line—that is, that the mean position of the needle is at right angles to the ideal line passing through those places which have the same mean annual temperature. But, in general, the true and mean temperature are different to a certain depth in the ground. There is a stratum of about 60 feet in depth which slowly varies in temperature from one season to another, and a portion of this stratum, of the depth of some three feet, which varies in temperature during the day. If we consider the action of this latter stratum by itself, agreeably to our general theory, its tendency at any moment will be to place the needle at right angles to the line connecting the points where the average temperature of this stratum is the same. But we have seen in the course of the present investigation, that the magnetic action of the stratum subject to daily variation of temperature, is not proportional to the temperature simply,—that it is dependent upon the evaporation of moisture and the deposition of dew. Whatever may be our explanation of the effect of dew and evaporation, the diurnal variations of the magnetic force of a particle at any place may be regarded with but little probable error, as proportional to the diurnal variations of the horizontal magnetic force there; and the tendency of these variations will be to give the needle an oscillatory movement corresponding to the continually shifting line traced through the points where that portion of the horizontal force which is due to the action of the daily stratum is the same. For the tendency of the magnetic action of this stratum, at any moment, will be to set the needle at right angles to this line; which may be regarded as identical with the line of equal molecular magnetic force.

Having presented these theoretical considerations, let us glance at some of the results of observation. Fig. 25 shows the mean

Curve showing the Mean Diurnal Variations of the Declination, for the year 1844.*

Fig. 25.



Increase of numbers corresponds to decrease of declination.

diurnal variations of the declination, for the year 1844. The curves for the different quarters of the year are of the same form, and agree also with the curve for the year, or very nearly so, in

* The observations of declination, (and the same is true of the observations of horizontal force and vertical force,) were made about 20m. after the Observatory hours, but as our inquiries mainly relate to the laws of the variations, this fact may be disregarded without material error.

the positions of the maxima and minima. If fig. 25 be compared with the curve of the mean daily variation of the horizontal force, (see fig. 3, p. 40, in the July number of this Journal,) it will be observed that the maxima and minima of the former fall nearly midway between the maxima and minima of the latter. Thus, the morning maximum of the horizontal force is at 5 A. M., and the minimum at 10 A. M.—and the morning minimum of declination is from 7 to 8 A. M.: again, the evening maximum of horizontal force is at about 3 P. M., and the principal maximum of declination is at 1 P. M., nearly midway between this and the morning minimum of horizontal force (at 10 A. M). The morning maximum of declination (at 2 A. M.) is also nearly midway between the evening minimum of horizontal force (about midnight), and the morning maximum of the same (at 5 A. M). There is a small deviation from this general law in the case of the evening minimum of declination, which occurs some two hours later than the middle point of time between the evening maximum and minimum of horizontal force. Besides these relations between the maxima and minima of the two curves, it may be seen that there are points of inflexion in the curves of the horizontal force near the epochs of the maxima and minima of the declination; and accordingly that when the curve of the horizontal force is concave upwards the declination (westerly) is increasing, and when it is convex upwards the declination is decreasing. These facts render it highly probable that the diurnal variations of the horizontal force and declination are linked together by some physical connection, as theory has already led us to suppose.

Let us see whether this theory, besides suggesting the fact of such a connection, can also explain the precise connection which we have now found to subsist. If we recur to the principles already laid down (p. 359), we shall see that the inquiry before us leads us, in the first place, to seek for the daily changes of position in the line of equal molecular magnetic force. If we were to neglect the effect of dew and evaporation, the line in question would be very nearly the true isothermal line passing through the station of the needle. To simplify the matter we will for the present, consider the two as the same. Now take some point (B), to the east of the station (A) of the needle, situated on the isothermal line traced through A at 5 A. M., about the time of minimum temperature: an hour later these two points would not be on the same isothermal line, for the increase of temperature at B would be greater than at A. (See curve of daily variation of temperature.) The isothermal line through A would therefore be directed to the north of B. It is obvious that this motion of the isothermal line toward the north, to the east of the station A, will continue until the increment of temperature at B, in any short interval of time, becomes the same as at A. This will happen at the hour of the most rapid rise of temperature, or about 9 A. M. After this the hourly increment of temperature will be less for B than for A, and the same portion of the isothermal line will move southward. This southerly movement will continue beyond the time of maximum temperature (3 P. M. at Philadelphia), and until the fall of temperature at B becomes less rapid than at A. This will happen about 7 P. M. It is manifest, from the concave form of the curve of daily variation of temperature, during the night, that after this the decrease of temperature at B will be continually less than at A, and therefore that the isothermal line will move northward, to the east of station A, and southward to the west of it. This motion will continue until 5 A. M.; and beyond this, as we have already seen, until towards 9 A. M. In obtaining these results, we have taken it for granted that the law and rate of the mean daily variation of temperature is the same at B as at A. This doubtless is not strictly true, and therefore the epochs of maximum and minimum of declination should be somewhat different from the times above specified. If we neglect this difference, it appears, that on the supposition which has been made, the needle would move toward the east from 9 A. M. to 7 P. M., and toward the west from 7 P. M. to 9 A. M. The actual state of things differs from this in two or three points; during the last half of this period of westerly movement, or nearly so, there is actually an easterly movement, and during the first half of this period of easterly movement there is actually a westerly movement; and the evening minimum occurs generally some two or three hours later, (about 10 P. M.) These discrepancies, (with the exception of the last, which is comparatively trifling,) disappear if we compare the curve of declination (fig. 25) with that of horizontal force (fig. 3), instead of that of temperature, as we should do. If this be done, it is found, as we have already seen, that the points of maximum variation of the horizontal force, or of inflexion in the curve, fall at the epochs of the maximum and minimum of declination.

To understand the movements, in detail, of the line of equal surface magnetic action, upon which the daily horizontal movements of the needle depend, we have only to compare the change of the horizontal force during the hour following the time considered, with the change that occurs an hour later during the same interval of one hour; for the latter is the change that occurs at a place an hour to the east of the station of the needle, cotemporaneously with the change at the station itself. When these two changes are equal the line in question is stationary. When they are both decrements, if the first is greater than the second, as from 8 A. M. to 10 A. M., the line rises, to the east of the station, and the needle moves westwardly; but if it is less, as from 6 A. M.

to 8 A. M., the line moves towards the south and the needle eastwardly. When the changes are both increments, if the first is less than the second, as from 10 A. M. to 1 P. M., the line rises and the needle moves toward the west; but if it is greater than the second, as from 1 P. M. to 4 P. M., the line falls back, or toward the south, and the needle moves towards the east. When the first change is a decrement and the second an increment, as at about 10 A. M. and toward midnight, the line rises and the motion of the needle is toward the west; and when the first is an increment and the second a decrement, as near 3 P. M. and 5 A. M., it falls and the needle moves eastward. It appears therefore that the needle should move toward the west when the curve of the horizontal force is concave upward, and toward the east when the same curve is convex upward. The westerly movement should then be from 8 A. M. to 1 P. M., and from 7 or 8 P. M. to 2 or 3 A. M.; and the easterly movement from 1 P. M. to 7 or 8 P. M., and from 2 or 3 A. M. to 8 A. M. These results accord with observation, with the single exception, that the time of minimum declination is generally about two hours later than 8 P. M.

If we compare the curves of horizontal force for the different quarters of the year, we find that, while the points of maxima and minima, as well as the points of inflexion, are pretty nearly the same for all, the curvatures are in general greater for the two middle than for the first and last quarters of the year, and therefore the daily changes of declination should be greater toward the middle than toward the beginning or end of the year—a result which accords with fact. There appears, however, to be generally a more rapid variation of the horizontal force toward midnight, during the cold than during the warm months; which must be attended with corresponding differences in the small nocturnal increase of declination. This result seems also to be in accordance with fact; but it would be premature to attempt the detailed explanation of such minute differences among the variations, from a limited series of observations made only at the station of the needle. A similar remark may be made with respect to certain small discrepancies which may be observed, between theory and fact, in relation to the relative amounts of the variations at the same hour in the different quarters of any one individual year. A theory which furnishes a sufficient explanation of all the laws deducible from the observations, cannot reasonably be rejected on the score of small discrepancies in quantity, when the observations are much less extended than the theory calls for. The precise movements of the line of equal magnetic action of the surface stratum upon which the motion of the needle depends, can only be ascertained with certainty by instituting special observations at a variety of places in every direction and at various distances from the station of the needle. The foregoing results have been obtained by taking it for granted that the changes of the molecular magnetic intensity are the same at the same hour of local time all around the station of the needle as at the station itself; which is doubtless not strictly true.

It remains for us now to enquire into the amount of the actual daily angular movement of the line of equal magnetic action, and into the intensity of the disturbing force necessary to the production of the amount of movement of the needle which actually occurs. Let us, in the first place, regard this line as identical with the true isothermal line, and suppose B to be a place situated on this line at 5 A. M.* (or thereabouts), and one hour, say, to the east of the station A. By 9 A. M. the rise of temperature at B will be as much as 2°, on the average, greater than at A, and therefore the isothermal line through A will now pass through a point (C), to the north of B, where the temperature is 2° less than at B. In the present discussion the station A is Philadelphia, and it appears from an examination of the differences of temperature at various hours during the day, between Washington and Philadelphia, used in the discussion of the vertical force, that the difference of latitude of B and C is about equal to the difference of latitude of Washington and Philadelphia, or about 1°. Taking this result and conceiving the isothermal line to be an arc of a great circle, we find, by an easy calculation, the displacement of this line from 5 A. M. to 9 A. M. to be about 3¾°. The actual isothermal line, at 9 A. M., will really lie a little to the north (as far as C) of the great circle taken for it, since the variation of temperature about 9 A. M. is nearly uniform. This angle (3¾°) is, however, only a part of the daily angular movement of the isothermal line toward the north, to the east of A, since, as we have already seen (p. 361), this movement begins about 7 P. M. and continues until 8 or 9 A. M. The whole movement cannot be less than 5°. This calculation proceeds upon the supposition that the daily variation of temperature at B is the same as at A, but as a matter of fact the change is somewhat greater for A than for B; since, as we have seen, the difference of temperature of Washington and Philadelphia increases during the forenoon, and A is south and west of B. This will have the effect to diminish the rise of the line of equal magnetic force, from 5 A. M. to 9 A. M., (possibly to 2°); but, as the fall of temperature will be more rapid after 4 P. M., at A than at B, the westerly movement will begin earlier in the evening and attain to a greater amount by 5 A. M. than upon the supposition made above. We may lay it down then as highly probable that the displacement of the line in question cannot be less than 3°.

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* The time considered in this connection is the local time at the station A of the needle.

If now we take the line of equal magnetic action, as it has been accurately defined, by its relations to the horizontal force instead of the temperature, we have to consider the amount of the variation of the horizontal force from the minimum at 10 A. M. to the time of greatest hourly variation, at 1 P. M., and enquire how far to the north of B we must go to obtain a horizontal force as much less than that at B as that at B is greater than that at A. But we here meet with a difficulty, inasmuch as the horizontal forces, so called, at B and C (to the north of B), to be compared, are really only the portions of the entire horizontal force, which are due to the action of the variable stratum. The difference between these forces is very much less than that which subsists between the actual horizontal directive forces acting upon the needle, but how much less we have no means as yet of ascertaining with any certainty. For this purpose we must know the proportion which the force of the variable stratum bears to that of the whole magnetic stratum.

Conjectures might be made as to the probable value of the proportion between these forces, but without attempting to enter upon such uncertain ground, I will content myself with remarking that no proportion which, in the light of the investigations of this and the previous paper, seems probable, gives movements of the line of equal surface magnetic force materially less than those of the isothermal line, above determined.

As to the question of the intensity of the disturbing force which produces the diurnal variations of declination, it is, in the first place to be observed, that that portion of the horizontal force, which is due to the action of the variable stratum, is entirely effective in displacing the needle in a direction toward the perpendicular to the line of equal magnetic action of this stratum. Now it appears, upon calculation, that this force must be as much as thirty times its daily variation, in the summer, to produce upon the supposition of a displacement of this line to the amount of 6°, a change of declination amounting to 12′.

ART. XXVI.—*Chemical Examination of the Water of the Tuscarora Sour Spring, and of some other Mineral Waters of Western Canada;* by T. S. HUNT, Chemist and Mineralogist to the Geological Commission of Canada.

IN the autumn of 1847, I visited in the discharge of my duties, a portion of the province which lies to the west of Lake Ontario, and while there, collected several mineral waters, some of which have proved of unusual interest. The results of my examinations appear in our report presented to his excellency the Earl of Elgin, Governor-general of the Province, on the 1st of

May, 1849; from this report the subjoined analyses are taken. Among the waters is the Tuscarora Sour Spring, to which I have already alluded, in a paper read before the Meeting of the American Association for the Promotion of Science, at its session in Philadelphia, in Sept., 1848, and since published in this Journal. It is situated in the Indian Reserve, in the County of Wentworth, about nine miles south of Brantford, and three miles south of the bank of the Grand River. The limestone rock of the region belongs to that formation which is designated by the geologists of New York, as the Onondaga Salt Group. The country for some distance around is thickly wooded; but in the immediate vicinity of the spring is a small clearing, upon a rising ground, on one side of which is the spring, in an enclosure some eight or ten rods square. In the centre of this, is a hillock six or eight feet high, made up of the gnarled roots of a pine now partially decayed. The whole enclosure is covered with crumbling rotten wood, and resembles a tan-heap; upon digging down eighteen inches, the same material was found, apparently derived from the crumbling away of the trunk of the once huge pine, whose roots now occupy the centre of the enclosure. The whole soil, if it may be thus designated, is saturated with acid water, and the mold at the top of the hillock, as well as without the enclosure, is strongly acid. Near the confines of this region, but in soil still quite sour to the taste, several plants were observed growing. They were the sheep's sorrel (***Rumex acetosella***), the wild strawberry (***Fragaria virginiana***), two species of ***Rubus***, the red raspberry (***R. strigosus***) and ***R.*** *canadensis*, besides several mosses, and a fern. The more acid parts were devoid of all vegetation.

The principal spring is at the east side of the stump, and has a round basin about eight feet in diameter and four to five feet deep; the bottom is soft mud. At the time of my visit (Oct. 18th) it was filled to within a foot of the brim; and as the guide assured me, unusually full, much fuller indeed than it had been five days previous, although no rain had fallen in the interval. There is no visible outlet to the basin; at the centre a constant ebullition is going on from the evolution of small bubbles of gas, which is found on examination to be carburetted hydrogen. The water is slightly turbid and brownish-colored, apparently from the surrounding decayed wood, which indeed forms the sides of the basin. It is strongly acid and styptic to the taste, and at the same time decidedly sulphurous; a bright silver coin is readily blackened by the water, and the odor of sulphuretted hydrogen is perceived for some distance round the place.

Within a few feet of this, was another smaller basin, two feet in diameter, and having about one foot of water in it; this was evolving gas more copiously than the other, and was somewhat more sulphurous to the taste, although not more acid. In other parts of the enclosure were three or four smaller cavities partly filled with a water more or less acid, and evolving a small quantity of gas. The temperature of the larger spring was 56° F., that of the smaller one 56° near the surface, but on burying the thermometer in the soft mud at the bottom it rose to 60·5°.

A large glass jar was filled with water, and to three bottles into which a solution of arsenic had been previously introduced, were added thirty cubic inches of water; these were then carefully sealed and transported to the laboratory at Montreal.

Examination of the Water.—The specific gravity was found to be 1·005583. A solution of nitrate of silver did not sensibly affect it, shewing the absence of chlorine, but salts of baryta produced at once a copious precipitate insoluble in any acid, indicating that the acid present in the water was the sulphuric; the usual tests applied to the recent water shewed the iron to be in a state of proto-salt, a condition indeed necessarily connected with the presence of sulphuretted hydrogen. When concentrated by evaporation with the addition of a little nitric acid, ammonia gave a copious red-brown precipitate, a portion of organic matter in the liquid interfered with the perfect precipitation of the iron, and hydro-sulphuret of ammonia was consequently added at the same time. The precipitate thus obtained after being thoroughly washed, was dissolved in hydrochloric acid, then boiled with nitric acid, filtered and precipitated by ammonia, with the previous addition of sal-ammoniac, and again filtered. The transparency of the filtrate thus obtained, was not disturbed by hydro-sulphuret of ammonia, indicating the absence of manganese and other metals of this class, including zinc, nickel and cobalt. The precipitate was in part soluble in a solution of potash; the soluble portion was alumina, and the residue peroxyd of iron with a little magnesia. The alumina obtained from the alkaline solution was found to contain traces of phosphoric acid; by dissolving it in hydrochloric acid, adding tartaric acid, ammonia in excess and sulphate of magnesia, a slight granular precipitate of ammonio-magnesian phosphate was obtained.

The filtrate from the original precipitate by hydrosulphuret of ammonia, gave an abundant precipitate of lime, by oxalate of ammonia, and the filtrate from this precipitate yielded, when concentrated and mixed with ammonia and a solution of phosphate of soda, a granular precipitate of phosphate of magnesia and ammonia.

Another portion of this filtrate was evaporated to dryness, and ignited to expel the ammoniacal salts; the soluble salts in the residue were dissolved in water and mixed with a solution of chlorid of barium and excess of caustic baryta, and the mixture heated; to the filtrate from the precipitate thus obtained, were added carbonate of ammonia and excess of caustic ammonia, and the whole boiled and filtered; the solution was then evaporated to dryness and ignited, when a residue of alkaline chlorids was obtained. The presence of soda was shewn by the peculiar color imparted to the flame of alcohol when it was burned over the salt, and with chlorid of platinum, a bright yellow precipitate of platino-chlorid of potassium was obtained.

In a water so novel in character, we might be led to expect some metal not usually present in mineral springs, and I have accordingly given the details of the qualitative analysis, to shew the measures taken to detect their presence. Arsenic, antimony, tin, lead and copper have all been recently detected in different ferruginous waters of Europe, but the presence of free sulphuretted hydrogen, which is found in the recent water of the present spring, is incompatible with their existence in solution, at least after the small quantity of this gas which it contains, had been decomposed by exposure to the air.

1000 parts of the water yielded—

Sulphuric acid, (SO_3)	4·6350
Potash, ...	·0329
Soda, ...	·0219
Lime, ...	·3192
Magnesia, ...	·0524
Alumina, ...	·1400
Peroxyd of iron, ...	·1915
Phosphoric acid, ...	traces.

Representing the bases as combined with their equivalent of sulphuric acid, we have for the composition of 1000 parts of the water—

Sulphate of potash, ...	·06080
" of soda, ...	·05020
" of lime, ...	·77520
" of magnesia, ...	·15395
" of iron, (proto.) . . .	·36385
" of alumina, ...	·46811
Phosphoric acid, ...	traces.
Sulphuric acid, (SHO_4)	4·28952
Water, ...	993·83837
	1000·00000

The quantity of sulphuretted hydrogen present is small, being about one-half of a cubic inch in 200 cubic inches of the water.

The question of the origin of this spring presents such difficulties, that I will not attempt to speculate upon it; the fact that the spring issues directly at the roots of a pine not yet wholly decayed, is evidence that it has not existed for a very long period, at least with its present character; for as it has been remarked, no vegetable life exists for some distance around the place. Under the ordinary atmospheric influences, I should suppose thirty or forty years would be required to produce the state of decay which the pine exhibits, although both sulphuric acid and the sulphates of iron and alumina are powerful antiseptics, and would considerably retard the progress of decay. Apart from any consideration of this kind, there is not wanting evidence that the waters of the spring have materially changed their character within two or three years. In April, 1846, Professor Croft, of King's College, Toronto, published in the British North American Journal an account of the spring he had obtained from some one who had visited it, with a partial analysis of the water, such as he had been able to execute upon the specimen in his possession. He found in one pint (7680 grains)—

Sulphuric acid, (average of three determinations,)	22·425 grs.
Peroxyd of iron, ...	3·950 "
Magnesia, ...	1·584 "
Lime, ...	3·685 "

No experiments were made to detect the presence of alkalies, nor was alumina sought for; it is probable that the alumina is included in the weight of the peroxyd of iron. The specific gravity was found by Professor Croft to be 1·0038.

For comparison I have reduced Professor Croft's results to the same standard as my own, and give them for 1000 parts; he found the iron as a per-salt, probably from the effect of exposure to the air. I have calculated that obtained by myself, as peroxyd, and added to it the alumina—

	Croft.	Hunt.
Sulphuric acid, ...	2·9069	4·6350
Potash, ...	——	·0329
Soda, ...	——	·0219
Lime, ...	·4798	·3192
Magnesia, ...	·2036	·0524
Peroxyd of iron and alumina,	·5148	·3315

The water examined by Professor Croft contained much less foreign matter than that collected by myself, being in fact more dilute. The sum of the ingredients determined in the former is 4·1051 parts, and in the latter 5·3281 parts in 1000. In the former, the sum of the bases is to the amount of acid, as 412 : 1000, and in the latter as 152 : 1000. The difference in the comparative quantity of sulphuric acid in the two, may be attributed to the dilution by surface water, but the great change in the proportion of the bases to the acid, indicates some change in the internal economy of the spring. The nature and causes of this change with their probable connection with the gypsum deposits, and some of the geological phenomena of the region, have already been discussed in the paper above referred to.

Since the publication of my report, I have received a specimen of a singular water from a spring near Chippewa on the Niagara River, a few miles above the Falls. It is quite as acid to the taste as that of Tuscarora, and contains like it, salts of iron, alumina, lime and magnesia in large quantity; the amount of sulphuretted hydrogen in solution, appears to be very considerable. The soil for some distance around the spring is described as being destitute of vegetation and of a reddish-brown color, which seems probably to be due, like that of the Tuscarora, to decaying vegetable matter which undergoes under these circumstances a somewhat peculiar change.

Charlotteville Sulphur Spring.

This interesting mineral spring is situated a few miles from Port Dover on Lake Erie; it is near the township of Simcoe, and on the third lot of the twelfth range of Charlotteville. It rises near the bank of a small stream which turns a mill. About twelve feet above the level of the creek, is a depression five or six feet deep, forming a natural basin about one rod in width and four rods in length, from N.E. to S.W.; it is oval in form, broader at the S.W. end, near which the spring rises. At the other end, the basin discharges itself by a little rivulet into the adjoining creek. The depth of the water at the time when I visited it, was from one to two feet, and the discharge, as it formed a little cascade before entering the creek, was roughly determined to be about 16 gallons per minute. Its temperature, as observed on the morning of the 19th October, when the air was 26° F., was found to be 45°, while that of the creek was 49°.

The water rises gently through several apertures in the soft mud of the bottom, occasionally accompanied by bubbles of gas. In a still day the surface, with the exception of a small area about the source, is coated with a film of sulphur, which also covers the bottom of the basin. Leaves and sticks near the outlet, are found thickly incrusted with the same substance, or rather with a mixture of sulphur and carbonate of lime. The proprietor of the spring informed me that he was in the habit of gathering the substance thus deposited, and burning it under his bee-hives for the purpose of stupefying the insects while extracting the honey, perhaps the only economical application which can be made of the sulphur itself.

The specific gravity of the water is 1·002712; it is limpid and sparkling, its odor strongly sulphurous, and its taste pungent, with something like sweetness, leaving an impression of warmth in the mouth for some time. When mixed with a solution of chlorid of arsenic, it becomes quite opaque from the precipitation of yellow sulphuret of arsenic. A qualitative examination shewed besides, the presence of chlorids and sulphates, the latter in large quantities; the bases were potash, soda, lime, magnesia, with traces of alumina and iron; a large portion of the lime and magnesia were not precipitated by boiling. The carbonic acid was determined by the aid of chlorid of calcium and ammonia. For the sulphuretted hydrogen, three bottles were prepared by adding a solution of chlorid of arsenic; to each of these was added 30 cubic inches of the water; the whole was then agitated and allowed to stand a few minutes to permit the escape of carbonic acid, after which the bottles were carefully corked and sealed. This was done at the spring, and the bottles were then transported to the laboratory. When they were opened, the precipitate was collected on carefully weighed filters, dried at 212° F., and weighed. Its purity was determined by its complete solution in ammonia. From the average of these three, the weights closely agreeing, the amount of the sulphuretted hydrogen was calculated to be ·17763 parts to 1000 by weight, or 11·6 cubic inches to 100 cubic inches of the water.

To determine the state in which the sulphur existed, a portion of the water was digested for some time with pure magnesia and then boiled, carefully excluding the air; sulphuretted hydrogen was abundantly evolved, and after a few minutes not a trace of sulphuret could be detected in the liquid. This shews the sulphur to exist as sulphuretted hydrogen, and not as a fixed sulphuret.

The amount of carbonic acid in the water was found to equal ·273 parts in 1000 of the water by weight.

1000 parts of the water gave—

Sulphuric acid,	1·22939
Chlorine,	·06478
Potash,	·02760
Soda,	·20586
Lime,	·64484
Magnesia,	·19436
Carbonic acid,	·27300
Sulphuretted hydrogen,	·17763

These may be combined to give the following composition for 1000 parts:—

Sulphate of potash,	·05103
" of soda,	·47182
" of lime,	1·12670
" of magnesia,	·43510
Chlorid of magnesium,	·08783
Carbonate of lime,	·30500
" of magnesia,	·01798
" of iron,	traces.
Sulphuretted hydrogen,	·17763
Carbonic acid,	·15350
Water,	997·17341
	1000·00000

Amount of solid matter by calculation, 2·49446 parts.

The peculiarity of this water is the unexampled quantity of sulphuretted hydrogen it contains. The strongest of the celebrated Harrowgate Springs yields but 14 cubic inches of sulphuretted hydrogen gas to the gallon, while the Charlotteville contains in the same measure 26·8 cubic inches.

Ancaster Saline Spring.

This spring, which is known to the inhabitants as a Salt Well, is about two miles west of the village of Ancaster, on the land of Mr. Robert Heslop. A well was sunk some years since, to the depth of thirty feet; and during the war of 1813–15, it is said a considerable quantity of salt was manufactured from it in a rude way. The water rises nearly to the surface, and at times a stream is said to flow from it; no outlet is visible, yet the spring, as I was told by the proprietor, fills up rapidly when the water is dipped out. The temperature was found to be the same as that of a neighboring fresh spring, 48° F.; no evolution of gas is perceptible. The water is intensely bitter and saline to the taste; by boiling, a minute quantity of carbonate of lime is deposited, and the liquid contains chlorine, bromine, sulphuric acid, with potassium, sodium, calcium and magnesium. The specific gravity is 1·0291.

1000 parts of water yielded—

Chlorine,	20·2181
Bromine,	·0891
Sulphuric acid, (SO_3)	·4570
Soda,	9·4520
Potash,	·0580
Lime,	5·5916
Magnesia,	2·0990

These may be combined to give the following composition for 1000 parts of the water:—

Chlorid of sodium,	17·82800
" of potassium,	·09200
" of magnesium,	5·07370
" of calcium,	12·80270
Bromid of magnesium,	·10309
Sulphate of lime,	·77690
Water,	963·32361
	1000·00000

Amount of saline matters, 36·67639 parts in 1000.

This water is extraordinary on account of the immense proportion of chlorid of magnesium and calcium which it contains; the sum of these exceeding the amount of common salt. With almost the same amount of solid matter, it contains less than two-thirds of the quantity of this salt, that is found in sea-water; in this respect it is quite unlike any water hitherto described. For the sake of comparison, I transcribe here Dr. Schweitzer's analysis* of the water of the British Channel. The specific gravity was 1·0274.

In 1000 parts were found—

Chlorid of sodium,	27·059
" of potassium,	·766
" of magnesium,	3·666
Bromid of do.	·029
Sulphate of do.	2·296
" of lime,	1·406
Carbonate of lime,	·033
Traces of iodine and ammoniacal salts,	
Water,	964·745
	1000·000

Amount of solid matters, 35·295 parts in 1000.

In a subsequent paper I propose to describe some interesting saline waters from the eastern part of the province, several of which are strongly alkaline, while others, in addition to the ingredients generally found in this class of springs, contain salts of barium and strontium.

Montreal, May 15th, 1849.

Art. XXVII.—*On the Decomposition of Aniline by Nitrous Acid;* by T. S. Hunt, of the Geological Commission of Canada.

Although modern researches have shown that several azotized bodies besides those formed by the direct action of ammonia, may under certain circumstances be separated into that substance and a non-azotized body, yet these have either been neutral substances or acids,† and if we except urea, melamine, and some of those amids of the cyanic series, none of the alkaloids have ever yet been found susceptible of such a decomposition. They combine directly with the strongest acids, and resist the action of hydrate of potash, which often evolves new bases from them and even from neutral substances. Piria in his fine memoir on aspar-

* Philos. Mag., July, 1839.

† For some considerations upon the constitution of the azotized bodies, see my remarks on gelatine in this Journal, for January, 1848, p. 74, and September, 1848, p. 259; also an examination into the formula of proteine in the Journal, for January, 1849, p. 109—in which I have attempted to show that these substances are different ammonids of cellulose or dextrine. The analyses of protid and erythroprotid, present also a very close approximation to the formula which I have proposed for proteine.

agine,* has however, pointed out the action of nitric acid containing nitrous acid, as a means of effecting this decomposition in bodies which like that substance had hitherto resisted all agents; and he has shown moreover, that benzamid and butryamid are easily decomposed with the liberation of their respective acids, when a current of nitric oxyd gas is passed through their solutions in nitric acid.

Led by these considerations, I was desirous of submitting to the action of nitrous acid, some of the organic alkaloids, and I selected aniline as the one most convenient for the purpose; Hoffman has shown that the compound of ammonia and phenol is slowly converted into this alkaloid with the elimination of water, when exposed in sealed tubes to a high temperature, and it was to be expected, if this plan of research proved successful, that phenol might be regenerated. Accordingly, some pure aniline obtained by the distillation of indigo with hydrate of potassa and carefully rectified, was dissolved in nitric acid; the saturated solution of the nitrate thus obtained, was mixed with half its volume of nitric acid, sp. gr. 1·25, and three or four volumes of water. The gas evolved by the action of heated nitric acid upon mercury, was then passed through the cold liquid; but no action was perceived, and the orange-red fumes of nitrous acid passed off into the air. The solution was then heated to about 170° F., and again submitted to the action of the nitric oxyd; immediate absorption and a violent action ensued; the whole liquid effervesced from the escape of a colorless, inodorous gas, which had the characters of nitrogen. The liquid, which before was transparent, grew brownish and turbid, and soon an oily film appeared on its surface. When the effervescence had ceased, and the odor of nitrous acid announced that the reaction was complete, the liquid was cooled and agitated with ether; the etherial solution decanted, filtered and evaporated at a gentle heat, left an oily liquid which was nearly equal in volume to the aniline employed.

It was brownish colored, and possessed in the highest degree the peculiar odor of castoreum, with an acrid, caustic taste. It was more dense than water, and soluble to a small extent in that liquid, to which it imparted its own smoky flavor; a splinter of pine wood, moistened with this solution and then dipped in nitric acid, assumed on drying a characteristic blue color, changing to a dark brown. The oil was readily soluble in a solution of caustic potash, and was precipitated unchanged from this solution, by hydrochloric acid. Boiled with a solution of nitrate of silver, the salt was reduced and metallic silver precipitated. The action of strong nitric acid was violent; on boiling the mixture as long as red fumes appeared, an acid was obtained which gave with

* Ann. de Chim. et de Physique, Feb., 1848, and this Journal, Nov., 1848, p. 421.

potash a salt crystallizing in bright yellow needles, very sparingly soluble in water, of an intensely bitter taste and detonating when heated, which was evidently nitrophenisate of potash. These characteristic reactions show beyond a doubt, that the product of this decomposition of aniline is nothing else than phenol or carbolic acid.

The reaction may be represented by the following equation:

1 eq. of aniline and 1 eq. of nitrous acid yield 1 eq. phenol, 2 of nitrogen, and 1 of water.

$$C_6H_7N + NHO_2 = C_6H_6O + N_2 + H_2O.$$

The same process applied to conine $C_8H_{15}N$ should yield a body having the composition of suberone $C_8H_{14}O$, and cotamine $C_{12}H_{13}NO_3$, would probably in like manner give phloretine $C_{12}H_{12}O_4$, or something isomeric with it. The extension of this process to the alkaloids, opens a wide field for investigation, and while it promises many new compounds, may enable us to fix with greater certainty than before, the composition of some of those bodies, and thus disclose relations which will guide us in obtaining artificially many of those important substances.*

As the intervention of nitric acid is objectionable from the difficulty of getting rid of it afterwards, and from its tendency to change many organic substances, I thought, reasoning from the ready decomposition of nitrite of ammonia, that the formation of hyponitrites of the other alkaloids might obviate these objections and yield satisfactory results. In pursuance of this idea, having made a solution of nitrite of silver in boiling water, I added to the still hot liquid, crystallized hydrochlorate of aniline in small successive portions; a precipitation of chlorid of silver immediately appeared, followed after each addition by a violent effervescence, which was due to the evolution of a colorless neutral gas, without doubt nitrogen. Heat was then applied to the solution until the effervescence ceased, and the liquid which had assumed a dark brown color and was covered with an oily film, was treated with ether as in the previous experiment. The etherial solution left upon evaporation, a brownish, adhesive, semifluid substance, which had a strong odor of castoreum, gave with an acid the peculiar blue tint to pine wood, and in all its reactions was identified with the product obtained by the action of nitric oxyd upon the nitrate of aniline.

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* An examination of the action of reducing agents upon the ether of nitrid organic acids, promises to yield some interesting bodies of this class. I mixed an alcoholic solution of nitrobenzoic ether with sulphuric acid, and digested this with zinc until water no longer precipitated any ether from the solution; the alcohol being removed by evaporation at a gentle heat, caustic lime was added and the liquid agitated with ether. The etherial solution left upon evaporation, a heavy oil of a very pungent taste, which was insoluble in water, but dissolved instantly in dilute sulphuric acid; the solution gave by evaporation a white crystalline salt. The quantity of ether operated upon was very small, and I have not since been able to examine farther the product, which appears to be a new alkaloid.

The clear watery solution which had separated from the ether, contained an excess of the nitrite of silver, and gave with a hypochlorite, no evidence of the presence of aniline. The brown color and altered character of the phenol in this experiment, were probably due to the action of the silver salt at a high temperature, which, like the nitrate in similar circumstances, seems to be partially reduced.

The reaction between an alkalamid and a nitrite, is one which results in the production of a new saline genus in place of the nitrite, and the formation of a new amid or an anhydrid amid and water, for I have shown both from the decomposition of the nitrite of ammonia, and from its atomic volume, that gaseous nitrogen may be regarded as an anhydrid amid, represented by NN.* The proper amid of nitrous acid, $(NHO_2, NH_3) - H_2O = N_2 H_2 O$ is, like carbonic acid, decomposed at the moment of its liberation into an anhydrid and water.

As my official duties call me immediately to the field, I am unable to follow out farther these researches upon the alkaloids, but give my results, hoping that some other person may find time and inclination to pursue the investigation.

Montreal, May 29th, 1849.

Art. XXVIII.—*Description of a Coal Plant supposed to be new;* by Charles Whittlesey, Esq., of Cleaveland, Ohio.

I send herewith the sketch of a coal fossil made by Mr. Jehu Brainard, an artist of this city, which is so singular and elegant as to merit attention, and so far as my limited knowledge of palæontology extends, is not found in the books.

It was first observed by my brother, the Rev. S. H. Whittlesey, about four years ago in the falling roof of the "Chesnut Ridge" coal mine, discovered and opened by us in 1845, and which is situated one mile and a quarter northwest by north from the centre of Tallmadge, Summit County, Ohio.

It is there called "the flower," and has a striking general resemblance to one, but has no botanical resemblance to flowers or other parts of fructification.

If this was originally an *open pod,* whether a flower or not, there should have been seen among several hundred specimens that I have examined, evidences of a circular or oval opening at the edge or apex of the figure. These edges could not always have been pressed together symmetrically so as exactly to cover each other, and if there were two surfaces with interior organs

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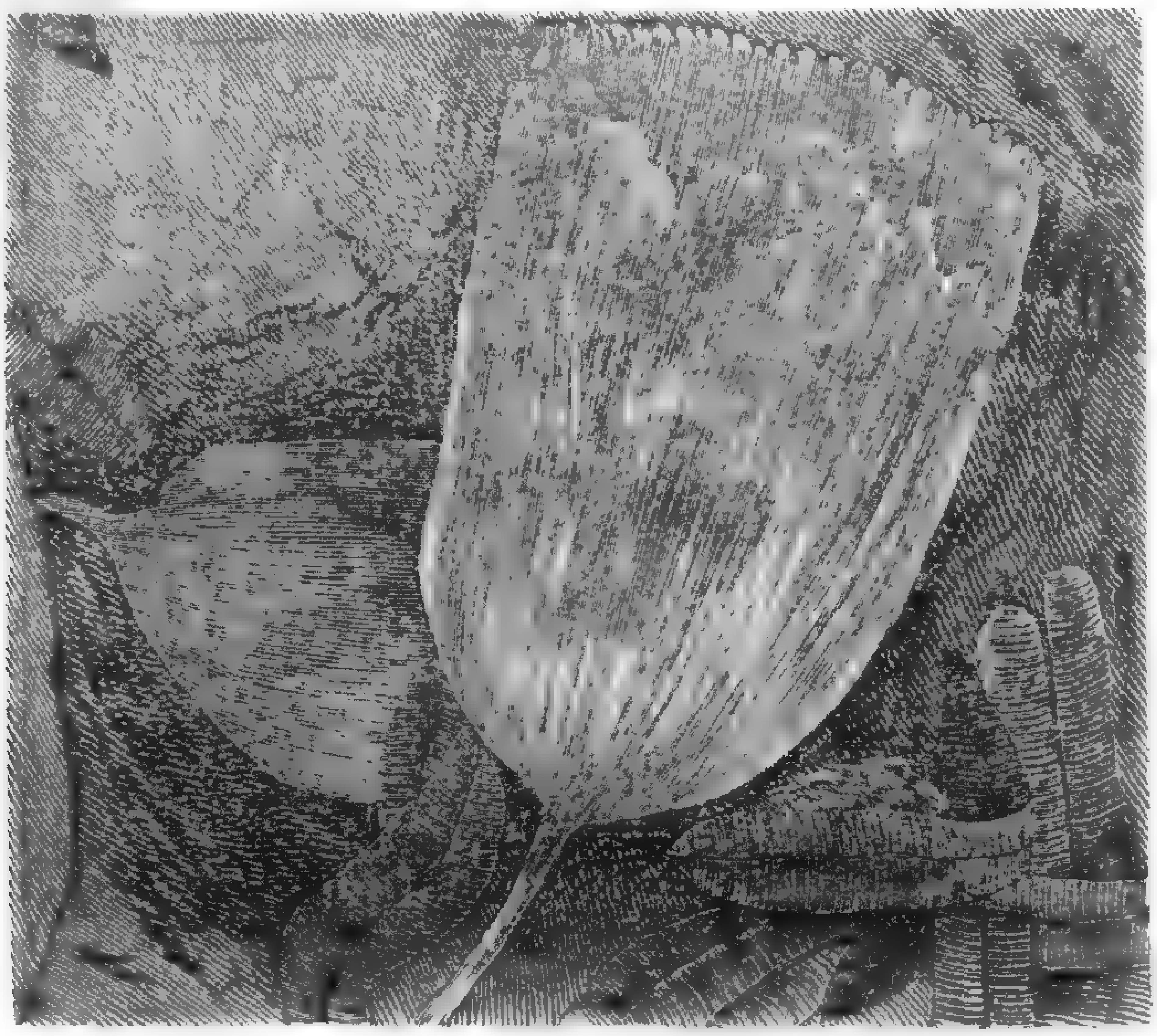
* See this Journal for May, 1848, p. 408, and for September, 1848, p. 172.

between them, it must have occasionally appeared in that light. But in no instance is there such a separation of the serrated edges, there being but one line across the apex, which is generally straight or slightly curved outward, as in the drawing.



The impression varies in size from a width of five-eighths of an inch by a length of one and a half inches, to a breadth of one and a half, and a length equal to the breadth. The sketch is made from nature and represents the average size and appearance. The very fine but distinct curved lines or striæ, extend without breaks from the tips of the teeth with great regularity, converging to a point at the base, where the stem unites. Its space in the rock is represented by a *very thin* scale of coal, the raised lines on one face of the specimen corresponding to depressed lines on the counterpart, showing it to be a single thickness and not double.

On some of them may be seen fine cross markings like nerves of reticulation, but in the finest specimens these are wanting, and are probably due to wrinkles of compression. The teeth at the edge are not uniform in number. I have counted from eighteen to twenty-six. After much research, no connexion has been observed with any branch or other vegetable, or with each other. The light, slender, but well defined stem is generally wanting. It is never seen longer than represented in the sketch, and seldom more than half an inch in length, where it terminates abruptly, as though it were broken off. There are minute straight lines like fibres in this stem.

I have never seen the fossil elsewhere; but Mr. John Newberry of Cuyahoga Falls, has a specimen from his father's mine, three-fourths of a mile west of "Chestnut Ridge." They exist in the ordinary bluish gray, soft argillo-silicious shale of the coal series, and in spots are seen in immense numbers, from one to one and a half feet above the coal. The shale is charged with myriads of coal plants, but the only hint I have met with showing any relation between this and other plants, is the fact, that where the *Pecopteris lonchitica* is most abundant, this is seen in the greatest numbers. The Tallmadge mines are in a bed, geologically, at the base of the coal series, and from seventy-five to ninety feet above the conglomerate. One of the sections of the leaf of the *Nœggerathia flabellata* (Hutton and Lindley, plate 29), has an edge marked somewhat like the specimen before us, but it is not straight, the nerves are not as regular and distinct, and its base is tapering and not an oval curve. Although there are thousands of these impressions lying over and across each other, no connexion exists between them as in the Nœggerathia.

The Corpolithus is abundant in the roof of the same mine. I believe the drawing taken with these remarks, will give a full idea of this beautiful medal of ancient vegetation. In searching for a description of it, or some analogue, I have had access to only a part of the numbers of Brongniart.

Cleaveland, Ohio, May 24, 1849.

Art. XXIX.—*Descriptions and Analyses of several American Minerals;* by B. Silliman, Jr., M.D., Professor of Chemistry applied to the Arts in Yale College, and of Medical Chemistry and Toxicology in Louisville University, Ky.

The results embodied in this article have been lately obtained in the Analytical Laboratory of Yale College by myself, or by my pupils under my immediate supervision and direction.

The research upon the new and interesting species which belong to the family of micas is not complete: but as many months must pass before I can again take up this investigation, it is deemed best to present the results already obtained, that the attention of mineralogists may be directed to them. I will present in a second memoir, such further results as may be determined by the analyses which will be carried forward this winter on the same species. Enough has been done, it is believed, to give definiteness and importance to the subject.

The subjects treated of in this article are as follows:—

I. Description and analyses of several mineral species belonging to the family Mica.

II. Description and analysis of Unionite, a new mineral species.

III. Description and analysis of a species resembling Worthite.

IV. Identity of Sillimanite, Bucholzite and Fibrolite with Kyanite.

V. Analysis of a granular Albite, associated with the corundum of Pennsylvania, and a new analysis of the Indianite of Bournon.

VI. On Boltonite, and Thomson's Bisilicate of Magnesia.

VII. On Nuttallite of Brooke.

I. Species of the Family Mica.

This series of minerals, forming a new and very interesting addition to the mica family, is found associated with the corundum of Pennsylvania, and one or more of the species are probably associated with corundum in every locality where the latter is found. My attention was first called to these minerals by receiving from Dr. J. L. Smith, now in Constantinople, a small portion of a similar mineral which he has called *Emerylite.** The quantity of this mineral received (only 0·2 gramme), was quite too small to enable me to obtain more than its general characters. As this mica was the means of calling my attention to the others, I will repeat the results of Dr. Smith, with such additional characters as were obtained here.

Emerylite.

This mineral is found associated with the emery from the localities of Asia Minor. It is in brilliant micaceous scales, brittle and inelastic. Color—gray with a tinge of lilac; laminæ easily separable. Hardness 3–3·25. Gravity not satisfactorily determined on so small a quantity. B. B. alone in forceps exfoliates, whitens and emits a very brilliant light, but does not fuse. In close tube yields water which gave a feeble reaction for fluorine. Dissolves in borax to a clear glass, and leaves a siliceous skeleton in salt of phosphorus. The reactions for $\dddot{Si}$ $\dddot{\mathbf{Al}}$ $\dot{Ca}$ Fe and K, are satisfactory. It is not acted on by strong acids; even by long continued boiling with Nordhausen sulphuric acid very imperfect decomposition was effected.

Fused with carbonate of baryta, a qualitative analysis gave reactions for silica, alumina, peroxyd of iron, lime and potash, with a trace of soda.

I was unable however, with the most exact care, to confirm Dr. Smith's observation of the existence of zirconia—probably a larger portion of the mineral might give a different result.

Dr. Smith gives the following as an approximate result of the constitution of the "*Emerylite*" from several analyses made by himself.

Silica, ...	30·
Alumina, ...	50·
Zirconia, ...	4·
Lime, ...	13·
Oxyd of iron, mang., and potash, .	3·
	100·

* See this Jour., vol. vii, 285.

This analysis gives the ratio $\dddot{Si}^4 \dddot{\mathbf{Al}}^6 \dot{R}^3 = \dot{R}^3 \dddot{Si} + 3(\dddot{\mathbf{Al}}, \dddot{\mathbf{Zr}})^2 \dddot{Si}$, which gives the following result:—

4 atoms silica	. .	2309·24 =	pr. ct. 31·93
6 " alumina	. .	3854·00 =	" 53·30
3 " lime	. .	1068·06 =	" 14·77
		7231·30	100·00

As however the mineral is hydrous and the analysis confessedly only approximate, this formula cannot be regarded as entirely correct, but it will be found useful in connexion with the results which follow.

The mineral which most closely approaches Smith's Emerylite as far as our observations authorize us to form an opinion, is the next in order and marked in our analyses "A."

A. This mineral is from Village Green, in the town of Aston, Chester Co., Pa., and was sent to me by Mr. L. White Williams, of Westchester, to whom mineralogists are much indebted for bringing to light many interesting things. It is associated with corundum, and occurs in considerable masses, and so much resembling common mica as to have escaped notice until Dr. Smith's observations on "Emerylite" called my attention to the minerals associated with the American corundums. Form like mica, apparently hexagonal, foliæ easily separable but inelastic and brittle. Color white, transparent in thin foliæ. *Lustre*, silvery, vitreous and pearly. Hardness 3·5. Gravity 2·995. B. B. in forceps exfoliates and emits a strong light, fuses on the edges of thin laminæ. In the close tube it is hydrous and gives very feeble traces of fluorine. It behaved with the fluxes like the Turkish mineral. A qualitative analysis showed the presence of silica, alumina, lime, magnesia, soda, a trace of potash and iron, water, and fluorine, the last in very feeble quantity.

The quantitative analysis of this species is still incomplete in its alkaline constituents, which are given by the difference, and the amount of water is probably placed too high.* The analysis was conducted under my direction, by my pupil, Mr. Wm. J. Crawe. Three analyses gave him as follows:—

	I.	II.	III.	Oxygen.	
$\dddot{Si}$	32·311	31·060	31·261	16·24 =	4
$\dddot{\mathbf{Al}}$	49·243	51·199	51·603	23·74	6
$\dot{Ca}$	10·663	9·239	10·146		
$\dot{Mg}$	·298	·283	·499	3·42	1
Na and K†	2·215	2·969	1·221		
$\dot{H}$	5·270	5·270	5·270	4·72	1
	100·000	100·000	100·000		

* The mean of two determinations. † By the difference.

It is obvious that this is very nearly the true constitution of the mineral ; the following formula corresponds very closely with the analytical results, viz. :

$$\dot{R}^3\,\dddot{Si}^4\,\dddot{\mathbf{Al}}^6+\dot{\mathbf{H}}^3=(\dot{Ca}\,\dot{Na}\,\dot{Mg})^3\,\dddot{Si}+3\dddot{\mathbf{Al}}^2\,\dddot{Si}+3\dot{\mathbf{H}}.$$

4 atoms silica	=	2309·24	= pr. ct.	30·51
6 " alumina		3854·00		50·92
3 " lime		1068·06		14·11
3 " water		337·44		4·46
		7568·74		100·00

This result leaves but little doubt that the mineral here examined is the same as the Turkish Emerylite. That the American species will be found constant in containing water I have no doubt.

Great care was bestowed on the trials to detect zirconia, but none was found.

Corundellite.

The next mineral belonging to this series I have called *Corundellite.* This species in external characters much resembles the last, but its composition is different in important particulars. It is also found associated with the corundum and emery of Unionville, Chester Co., Pa. The specimen here analyzed is marked "D," and was taken by me in May last, from the mineral collection of the Chester Co. Cabinet, formed by Mr. Williams. It is in broad foliated masses of a yellowish white color, easily cleavable and apparently hexagonal in form, penetrated by hexagonal crystals of corundum. Inelastic, brittle, resembles common mica but not so strikingly as A. Hardness 3·5. Gravity 3. B. B. gives the same characters as the last species. No reaction could be obtained for lithia or boracic acid in any of the minerals of this series. The reaction for fluorine in this one was feeble. It is unaffected by strong acids even on long boiling, except partially by very strong sulphuric acid. Its qualitative analysis gave silica, alumina, lime, potash, soda and water, with a trace of iron and fluorine.

The following analysis was made by Mr. J. J. Crooke, on 1·389 gramme of the substance fused with carbonate of baryta. It yielded

			Oxygen.		
$\dddot{Si}$	·496 = per cent.	35·708 =	18·553 =	18·55 =	9
$\dddot{\mathbf{Al}}$	·738	53·131	24·872	24·87	12
Ca	·101	7·271	2·042		
K	·017	1·224	0·207	2·36	1
$\dot{Na}$	·006	0·413	0·110		
$\dot{\mathbf{H}}$ and Fl	·032	2·303	2·050	2·05	1
	1·390	100·068			

This gives the ratios

$$\dddot{Si}^3\,\dddot{\mathbf{Al}}^4\,\dot{R}+\dot{\mathbf{H}}=\dot{R}\,\dddot{Si}+2\dddot{\mathbf{Al}}^2\,\dddot{Si}+\dot{\mathbf{H}}.$$

		Atoms.		Required.	Found.
3 atoms silica	=	1731·94	= per ct.	36·31	35·708
4 " alumina	=	2569·32		53·87	53·131
1 atom lime	=	356·02		7·46	8·926
1 " water	=	112·48		2·36	2·303
		4769·76		100·00	100·068

This species somewhat resembles margarite, and it may be shown on further examination that margarite is a hydrous mineral. At present it is reported as anhydrous, and its proportions of silica and alumina are different from the present species. Its analysis given by Hausmann on the authority of the Göttingen Laboratory is

Silica,	33·50 =	8 atoms.	Silica,	= 4618·48	per ct.	34·47
Alumina,	58·	12 "	Alumina,	7708·00	"	57·55
Lime,	7·50	3 "	Lime,	1068·06	"	7·98
Protox. iron,	·42					
Manganese,	0·03			13394·54		100·00
Magnesia,	0·05					
	99·50					

$$\dot{R}^3\,\dddot{\mathbf{Al}}^{12}\,\dddot{Si}^3=\dot{R}^3\,\dddot{Si}^2+6\dddot{\mathbf{Al}}^2\,\dddot{Si}.$$

Possibly a new analysis may bring these species together.

The species Corundellite occurs not only in the broad foliated masses above alluded to, but also in small scales disseminated throughout the mass of granular corundum, at Unionville, Pa., and in this form is quite abundant. Not unfrequently these scales have a delicate shade of violet, especially when wet. The rock is difficult to break and the corundellite appears to adhere very strongly to the associated minerals, and the laminæ are not so easily separable as in the foliated masses.*

Euphyllite.

This beautiful pearly white mineral is found associated with black tourmaline and corundum, at Unionville, Pa. Form apparently hexagonal, cleavage eminent on basal plane, the laminæ

* The species *Barsowite* (G. Rose), appears in the Urals to hold the same geognostic relations to corundum as do the minerals of the present memoir, in this country. Its composition, however, is quite distinct, (silica 49·01, alumina 33·85, lime 5·46, magnesia 1·55=99·87, Varrentrapp,) while its hardness 6, and absence of micaceous structure render it entirely distinct. It approaches scapolite in composition, but with a smaller quantity of protoxyd. I am led to allude to this species from the fact, that an intelligent foreign mineralogist to whom I showed some of the corundellite, remarked that there appeared to be a similarity between the species. There is however a most marked difference in that corundellite is a mica.

not so easily separable as in mica. Hardness 3. G. 2·963. Lustre of sides faint pearly, of basal plane very brilliant pearly, resembling Heulandite, but perhaps more brilliant even than in that species. *Color* of cleavage face pure white, of sides grayish, sea green or whitish. Laminæ rather brittle, inelastic, and quite transparent.

B. B. Exfoliates, fuses on edges of thin laminæ and emits a stronger light than either of the corresponding species. In the matrass, it evolves water and gives a reaction for fluorine. No reaction for lithia or boracic acid was obtained, but it gives a soda yellow to the flame.

The qualitative analysis of this mineral gave silica, alumina, lime, magnesia, soda, water, and fluorine.

The quantitative analysis was conducted by Mr. J. J. Crooke, and gave on fusion with carbonate of baryta the following results, viz., quantity taken, 1·378 gramme, found—

					Oxygen.	
$\dddot{Si}$	·538	=per ct.	39·042 =		20·28 =	15
$\dddot{\mathbf{Al}}$	·708	"	51·378		23·99	18
$\dot{Ca}$	·044	"	3·193	0·897		
$\dot{Mg}$	·015	"	1·088	·421	1·54	1
$\dot{Na}$	·012	"	0·871	·223		
$\dot{\mathbf{H}}$	·063	"	4·593		4·08	3
	1·380		100·165			

This gives the following as the theoretical composition of the mineral.

5 atoms	silica	=	2886·55	=per ct.	39·02
6 "	alumina	=	3854·00	"	52·10
1	Ca Mg	=	319·38	"	4·32
3 "	water	=	337·44	"	4·56
			7397·37		100·00

The following formulas therefore express its constitution.

$$\dddot{Si}^5\,\dddot{\mathbf{Al}}^6\,\dot{R}+\dot{\mathbf{H}}^3=\dot{R}\,\dddot{Si}+2\dddot{\mathbf{Al}}^3\,\dddot{Si}^2+3\dot{\mathbf{H}}.$$

The alumina obtained in this analysis (as well as in all the others also) was very critically examined for zirconia, but without success.

The black tourmaline which is associated with euphyllite has left the impression of its crystals on the lateral face of the mineral with such a smooth hard looking surface that it shows no trace of a micaceous structure. The tourmaline has an uncommon form, the faces R of the primary form being rudimentary from the extension of the tangential plane, truncating the summit.

The beautiful foliæ of this pearly white mineral have suggested the name *Euphyllite*, as an appropriate designation for the species, while the name *Corundellite* has the same obvious derivation as *Emerylite*, the mineral described by Dr. Smith.

There is a similar mineral associated with the blue corundum of North Carolina, which was made known to mineralogists by Hon. T. L. Clingman, M. C., from North Carolina. It occurs investing the corundum. Color faint olive brown. Lustre vitreous to pearly, like mica. In cleavable plates apparently hexagonal. Cleavage perfect, laminæ separable. H. 3. G. 2·94 to 3·008. Brittle, transparent, not acted on by strong acids. B. B. whitens, gives a brilliant light, but does not fuse, unless with great difficulty on the edges. It contains a trace of fluorine, and a qualitative analysis detected in it silica, alumina, lime, soda and water. An insufficient quantity of the mineral prevented a perfect analysis being made. So far as its constituents have been obtained, it contains silica 36·369, alumina 42·373, lime 10·141, magnesia 4·462, water 1·448, the difference soda and loss. Soda about 4 per cent.

Should it appear on repeating the analysis of this mineral, that it is new as the present would appear to indicate, I would propose to adopt the name *Clingmanite*, suggested by Prof. Shepard, in honor of the distinguished gentleman before named, who has shown great interest in advancing the study of mineralogy.*

The following tabular arrangement will make the constitution of these species of easy comparison.

	$\dddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dot{\text{Ca}}$	$\dot{\text{Mg}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$ & Fl.	$\dddot{\text{Zr}}$	Total.
1. Emerylite of Smith, ..	30·	50·	13·	....	....	3·	....	4	100·00
2. " Pennsylvania,	33·50	58·	7·50	0·005[a]	....	....	....	..	99·50
3. Margarite, ...	31·260	51·199	9·239	0·283	2·969	....	5·276	..	100·
4. Corundellite, ...	35·708	53·131	7·271	....	0·413	1·224	2·303	..	100·068
5. Euphyllite, ...	39·042	51·378	3·193	1·088	0·871	....	4·593	..	100·165
6. Clingmanite ?	36·369	42·373	10·141	4·462	....	....	1·448	..	94·783
			$\dot{\text{R}}$						
The formulas given yielded on calculation, 1....	31·91	53·30	14·79	....	....	....	....	..	100
2....	30·51	50·92	14·11	....	....	....	4·46	..	100
3....	36·31	53·87	7·46	....	....	....	2·36	..	100
4....	39·02	52·10	4·32	....	....	....	4·56	..	100
5....	34·47	57·55	7·98	....	....	....	....	..	100

[a] + $\dot{\text{Fe}}$ 0·42 and $\dot{\text{Mn}}$ 0·03

* Prof. C. U. Shepard had noticed this mineral, and supposing it to be new, he had determined to give it the above name. When he found, however, that I was engaged on this series of minerals, he promptly abandoned the investigation. At that time we both thought that the Emerylite of Dr. Smith would probably include all the American species herein described, which now appears not to be the fact. On going to England in June, Prof. S. left me a memorandum containing his notes on the North Carolina mineral, and I have embodied them in the above description with my own.

I have had no means of comparing the optical properties of these several minerals. The angle between their axes of polarization should be measured to ascertain if the differences shown in their composition are found also in their molecular structure. When we review the characters of the minerals here described, we are struck with the almost identity of all their ordinary physical characters, and yet there are differences which are apparent especially in their composition. It therefore becomes an interesting question to decide if the optical characters will sustain the chemical results. The occurrence of a class of salts with such a very small amount of protoxyd bases, and so large a content of alumina as these possess, is a novelty in the chemical history of minerals, and may have some important theoretical connections. Our knowledge of the whole mica family is quite imperfect at present. The true function of the fluorine found in so many of them yet remains to be explained, and especially is it of the greatest importance that a careful series of optical measurements should be made on authentic specimens from numerous localities, and at the same time an exact series of chemical analyses conducted on specimens from the same localities.

Mineralogy hardly offers a more inviting investigation than this, and should it not fall into better hands, it will at a future day be attempted in this Laboratory.

II. On Unionite.

The next mineral to be noticed is from the same specimen which furnished me the *Euphyllite.* In general appearance it somewhat resembles scapolite or spodumene. It is implanted in black tourmaline, and is intimately associated with the euphyllite. Its form is discernible only by its cleavages which are distinct in one direction, the planes dividing the mineral into parallel laminæ, in two other directions less distinct, but yielding a form probably triclinate.* Lustre vitreous. Color yellowish white to white. Hardness 6–6·5. Gravity 3·2984. Brittle, and easily reduced to powder. In acids does not gelatinize.

B. B. In forceps it whitens, swells up and fuses to a white enamel, giving out at the same time an extremely brilliant light. In the matrass it gives out water which is acid, and the glass is etched with fluo-hydric acid. Qualitative analysis detected silica, alumina, magnesia and soda. The amount of water was determined by the loss on heating, and the fluorine was not separately estimated. In the quantitative analysis the mineral was attacked by carbonate of baryta.

The following are the results of analysis.

* The angles do not admit of measurement.

Taken ·7335 grammes. Yielded—

					Oxygen.	
$\dddot{Si}$	·32385 = per ct.		44·151 =		22·940 =	7
$\dddot{Al}$	·31000	"	42·263		19·763	6
$\dot{Mg}$	·05400	"	7·361	2·85 }	3·290	1
$\dot{Na}$	·01270	"	1·731	0·46 }		
$\dot{H}$ and Fl	·02590	"	3·532		3·146	1
Loss	·00705	"	0·962			
	·73350		100·000			

7 atoms silica	=	4041·17	= per ct.	44·86
6 " alumina	=	3854·00	"	42·78
3 " magnesia	=	775·06	"	8·62
3 " water	=	337·44	"	3·74
		9007·67		100·00

$$\dot{R}^3\,\dddot{Al}^6\,\dddot{Si}^7\,\dot{H}^3 = \dot{R}^3\,\dddot{Si} + 6\dddot{Al}\,\dddot{Si} + 3\dot{H}.$$

This formula and constitution are believed to be unknown in any previously noticed species among minerals, and I therefore propose it as new and suggest for it the name *Unionite*, derived from Unionville, its locality. At present it is a rare substance, but I understand that the place where it was found is to be worked soon for emery, and probably both it and the Euphyllite will be obtained there in abundance. This species was also supplied to me by Mr. Williams of West Chester.

III. On Monrolite.

A mineral resembling Wörthite.—My attention was called to this mineral by Mr. Wm. S. Vaux, of Philadelphia, who had received it from the locality marked "topaz." It somewhat resembles pycnite in general aspect, but as will be seen is a very different thing.

It occurs at Monroe, Orange Co., New York, where it is found in a quartzose rock with magnetic iron, pink feldspar, black mica, pinite and common garnet. Color green to greenish gray. Structure radiating in sheafs from a centre in groups from an inch to two inches in diameter. Also in single implanted individuals. Cleavage and form of single crystals resembles sillimanite. Hardness 7·25 on an angle; on cleavage face about 6. Gravity 3·045, 3·096, 3·07. Columnar, fibrous. The oblique prisms were not measured, being too irregular.

B. B. Alone in tube gives off neutral water. Infusible, whitens; dissolves slowly in carb. soda, readily in borax and in salt of phosphorus, leaves a siliceous skeleton which reacts slightly for iron.

Its qualitative assay indicated the presence of silica and alumina, with a trace of iron and magnesia.

It was fused with carb. potash and caustic potash, and its analysis yielded

	I.	II.	III.
Silica,	40·92	40·389	40·389
Alumina,	56·61	55·729	56·618
Magnesia,	·28	·280	·280
Water,	3·09	1·840	2·794
	100·90	98·238	100·079

These analyses correspond closely with $8\dddot{Si}\ 10\dddot{\mathbf{Al}}\ 3\dot{\mathbf{H}}$.

8 atoms silica	= 4618·48	= per ct.	40·59
10 " alumina	= 6423·30	"	56·44
3 " water	= 337·44	"	2·97
	11379·22		100·00

We have then the formula

$$8\dddot{\mathbf{Al}}\dddot{Si}+\dddot{\mathbf{Al}}^2\dot{\mathbf{H}}^3.$$

The Wörthite of Hess gave the formula

$5\dddot{\mathbf{Al}}\dddot{Si}+\dddot{\mathbf{Al}}\dot{\mathbf{H}}^3$ corresponding to his analysis, viz.:

Silica,	40·79
$\dddot{\mathbf{Al}}$	53·06
$\dot{\mathbf{H}}$	4·63
$\dot{Mg}$	0·88
	99·36

I have never seen the Wörthite and have therefore no means of judging of the similarity of these two minerals in other respects. The probability of being able to refer the present mineral to kyanite seemed to me at first quite strong, but I was unable by any care to procure an amount of silica less than that given in these analyses. Should this mineral on further examination and comparison prove to be distinct, I propose for it the name Monrolite, derived from the locality where it was found.

IV. On the identity of Sillimanite, Fibrolite and Bucholzite with Kyanite.

Sillimanite was originally described by Bowen,* from an analysis made in Yale College Laboratory in 1825; which showed it to be a silicate of alumina with a proportion of silica too high to allow it to come within the formula of kyanite. It was subse-

* Jour. Acad. Nat. Sci., Phil., iii, p. 375.

quently analyzed by Dr. Thomas Muir, in the Laboratory of Dr. Thomson, who found in it a large quantity of zirconia, an observation which all subsequent researches have failed to confirm. Since that time it has been analyzed by various chemists, viz.: by Connel, Norton, Staff, Hayes and Thomson. The most recent of these analyses which has been published is that by Thomson, who reports it to contain 45·65 per cent. of silica. We have then the following discordant results in the amount of silica found in Sillimanite by different chemists in the order of their publication:

	1. Bowen.	2. Muir.	3. Connel.	4. Norton.	5. Staff.	6. Hayes.	7. Thomson.
Per cent.	42·67	38·67	36·75	37·40	37·36	42·60	46 65

The cause of this disagreement will undoubtedly be found in the difficulty of effecting a complete decomposition of anhydrous silicates of alumina, which contain a high per centage of alumina. This decomposition can be completely effected only by the aid of caustic potash applied to the mixture of carbonates and the mineral during the fusion, as first recommended by Berzelius, or by fluo-hydric acid.

Select crystals of this mineral were taken from the original locality at Chester, Conn., and their analysis afforded the following results: Quantity taken, 775·5 grammes, found,

Silica, ...	·292	= per ct.	37·653
Alumina, ...	·484	"	62·411
	·776		100·064

			Required.
2 atoms silica	1154·62	$=\dddot{Si}$	37·47
3 " alumina	1927·00	$\dddot{\mathbf{Al}}$	62·53
	3081·62		100·00

This result gives then exactly the formula of kyanite, viz.: $\dddot{\mathbf{Al}}^2\,\dddot{Si}^3$. The analyses of Staff and Norton give also the same result.*

We can therefore have no longer any hesitation in referring sillimanite to kyanite, as originally suggested by Haidinger.†

Bucholzite is a name given by Brandes to a silicate of alumina from Tyrol, which occurs in compact masses of a finely fibrous

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* In Prof. Norton's analysis, which was made in Yale College Laboratory, the excess of 2·73 was owing undoubtedly to aluminate of potash which remained with the alumina after separating the peroxyd of iron by caustic potash. Subtracting this sum from the sum of alumina and peroxyd of iron, we have 62·30 per cent. alumina and peroxyd iron, which is almost exactly the quantity required by theory, and I have corrected the analysis accordingly with the consent of Prof. Norton. That analysis was made on the sillimanite from Fairfield, New York.

† In his translation of Mohs, vol. iii, 154.

structure and hardness equal to kyanite. Thomson also has analyzed a mineral from Chester Co., in Pennsylvania, well known to collectors, and has referred it to Bucholzite.* Being in possession of authentic specimens of the Chester mineral, I have analyzed it with the following result. Quantity taken 0·561 gramme. Found,

				Another sample.
$\dddot{\mathrm{Si}}$ . .	·1925	=per ct.	34·31	35·96
$\ddot{\bar{\mathrm{Al}}}$ . .	·3615	"	64·43	
$\dot{\mathrm{Mg}}$ . .	·0028	"	·52	
$\dot{\mathrm{Mn}}$ . .	trace	"	trace	
	·5568		99·26	

This also will give us the same formula with kyanite. The mineral being less pure than sillimanite, cannot be expected to furnish results as accurate as the former analysis. Prof. Shepard in his "System" expresses the opinion that bucholzite and sillimanite were the same species.

There is also found at Brandywine Springs, Delaware, a mineral which has been extensively circulated under the name of both bucholzite and fibrolite. A specimen from this locality furnished me the following results, viz.: Quantity taken 1·0675 gramme. Found—

Silica, ...	·386	=per ct.	36·159
Alumina, . . .	·679	"	63·525
	1·065		99·684

This is evidently identical with kyanite. Minute traces of iron and manganese, which are found in both the above, are regarded as of no importance in the result, being mere impurities.†

Fibrolite of Bournon. This mineral was first distinguished by Count Bournon, who detected it among the associated minerals of corundum from India and from China. The name has reference to its fibrous character. It was analyzed by Chevenix, who found

* Erdmann appears also to have made his analysis on the mineral from the same locality.

† It may be objected to the conclusion that bucholzite is identical with kyanite that I have not analyzed a specimen of the original mineral. This I should have done could I have procured one in season for my present purpose. The Chester mineral here analyzed was received by Baron Lederer from Dr. Nuttall, and so far as I can learn, no one questions that the mineral from that locality corresponds entirely with the bucholzite of Brandes. I am convinced that those chemists who have obtained so high a percentage of silica in their analyses of *disthene* minerals, have not taken the precaution to employ the aid of caustic potassa, *added to the assay during fusion*, as recommended by Berzelius; and that if they had re-analyzed their silica they would invariably in cases where the amount exceeded 38 per cent., have found in it a portion of alumina.

Silica, ...	38·
Alumina, ...	58·25
	96·25

Even upon so imperfect an analysis, there has been no hesitation with most writers in referring it to kyanite. Having a specimen of this mineral from Count Bournon at my disposal, I have analyzed it.* It yielded on 0·427 gramme taken:—

Silica, . . .	·1551	= per ct.	36·309
Alumina, . .	·2665	"	62·415
Magnesia . .	·0030	"	·702
	·4246		99·426

The results just given leave it no longer possible for us to separate sillimanite, bucholzite and fibrolite from kyanite. The hardness of sillimanite proves also to possess the same inequality on different faces which is found in kyanite. The cleavage face is much softer than the angle or side of the prism, so as to be easily scratched with a sharp point of hard steel. The crystalline forms of sillimanite and kyanite are also identical, the one being derived by the simplest modification from the other. The cleavage in both is in the orthodiagonal.

It may be worthy of remark that "Andalusite" has the same chemical constitution as kyanite, but belongs to the right rhombic form, while kyanite is oblique. Doubtless a case of dimorphism, and perhaps the same may be said with truth of staurotide.

My pupil, Mr. George J. Brush, afforded me essential aid in the foregoing investigation.

V. On a Granular Albite associated with Corundum, and on the Indianite of Bournon.

A specimen of a granular mineral was sent me by Mr. G. of Andover, last year, with the remark that it was found in beds in Lancaster Co., Penn., and was so hard as to resist all attempts to penetrate it by hardened steel—greatly impeding the operations of the miners in the chrome iron districts.

I also received other specimens of the same from Mr. Williams of Westchester, associated with corundum which was found imbeded in it, and from this circumstance it has been mistaken by some mineralogists for *Indianite*, which species it resembles in hardness, gravity and in granular structure, but not at all in composition.

* The specimen referred to was taken from the collection of Col. Gibbs, (now in Yale College,) and was received by him from Count Bournon in a large collection of gems which this gentleman furnished to Col. G.

In its granular structure it so resembles dolomite that no difference can be detected between them by the eye, while its hardness, and great difficulty of fracture completely blind the enquirer as to its real character. Its characters are as follows:—

Massive, compact, granular, resembling white dolomite; tough; fracture even but very difficult. Color white with shades of gray. Streak white. Hardness 7–7·25 (scratching quartz with facility). Gravity 2·619.

Insoluble in acids. B. B. infusible and does not *color the flame yellow;* with the fluxes yields evidence of $\dddot{Si}$, $\dddot{\mathbf{Al}}$ and $\dot{Ca}$. By a quantitative fusion with carbonate of baryta soda was detected.

The first specimen analyzed was from Lancaster Co., Penn., and showed no trace of corundum disseminated in it.

This analysis was made by Mr. G. J. Brush and yielded on the quantity taken 1·234 gramme as follows:—

					Oxygen.	
Silica,	·8225 =	per ct.	66·653	=	34·85 =	12
Alumina,	·2565 =	"	20·786		10·70	3
Lime,	·0253 =	"	2·050 }			
Magnesia,	·0071 =	"	0·519 }		3·08	1
Soda,	·1155 =	"	9·360 }			
	1·2269		99·420			

It gives the constitution $\dddot{Si}^4 \, \dddot{\mathbf{Al}} \, \dot{Na} = \dddot{\mathbf{Al}} \, \dddot{Si}^3 + \dot{Na} \, \dddot{Si}$.

4 atoms silica	=	2309·24 =	per ct.	69·09
1 " alumina	=	642·33	"	19·22
1 " soda	=	390·90	"	11·69
		3242·47		100·00

This is precisely the formula and constitution of an albite.

The second analysis was on a specimen from Unionville, Chester Co , Pa., having identical characters, but associated with corundum which occurs implanted in it. This analysis was made by Mr. M. C. Weld. Quantity taken 2·180 gramme. Found—

				Oxygen.
Silica,	1·4575 =	per ct.	66·857 =	12
Alumina,	·4772	"	21·889	3
Lime,	·0389	"	1·785 }	
Magnesia,	·0105	"	·481 }	1
Soda,	·1914	"	8·779 }	
Water,	·0105	"	·481	
	2·1860		100·272	

This obviously yields the same formula as the last analysis.

The extreme hardness of this mineral is its most remarkable quality and is not easily accounted for. It is probably connected with its association with corundum, for we find the quality equally developed in the Indianite, (or anorthite,) the Asiatic associate of the same species.*

Analysis of Indianite.—I thought it of interest in connection with the foregoing analyses to make a new analysis of Bournon's *Indianite*, which, as already remarked, is found to be the matrix of the corundum in India. Being possessed of an authentic specimen, I requested Mr. Brush to conduct the analysis, the results of which are now given. This mineral is granular and of a pink color, sometimes gray or blackish, very tough and hard. Hardness 7–7·25. Gravity 2·668. It gelatinized completely in cold chlorohydric acid. Before the blowpipe alone infusible. The analysis gave on 1·594 gramme,

					Oxygen.	
Silica,	·6710	=per ct.	42·09	=	21·869	=4
Alumina and a trace of iron,	·6200	"	38·89		17·160	3
Lime,	·2516	"	15·78	4·449	5·592	1
Soda,	·0651	"	4·08	1·043		
	1·6077		100·84			

$$\dddot{Si}^4 \mathbf{\dddot{R}}^3 \dot{R}^3 = \dot{R}^3 \dddot{Si} + 3\mathbf{\dddot{R}} \dddot{Si}$$

which is the formula for anorthite.

VI. On the Boltonite of Shepard, and Thomson's Bisilicate of Magnesia.

The Mineral named Boltonite by Prof. Shepard† is found at Bolton in Mass., in a lime quarry, disseminated in irregular masses, seldom showing any traces of crystalline form. The description of Prof. S. is quoted below.‡

The changes of color are peculiar, and often the same mass which is dark greenish gray on one end, will have turned light yellow on the other.§ Hardness 5·50; specific gravity 3·008—the same on two specimens, one dark and one light.

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* Dr. Martin H. Boyé of Philadelphia, has lately informed me in conversation, that he also made an analysis of this granular albite some time since, and with results closely accordant to those here given. See Proceed. Am. Phil. Soc.

† Shepard's Treatise on Mineralogy, New Haven, 1835, vol. i, p. 78.

‡ Prof. Shepard's description is as follows—"Massive, composition granular: individuals large, cleavage in one direction pretty distinct, in two others oblique to the first, indistinct, but affording indications of a doubly oblique prism, fracture uneven or small conchoidal. Lustre vitreous. Color blueish gray, yellowish gray, wax yellow to yellowish white. The darker colors change to yellow on exposure to the weather. Hardness 5·0–6·0. Gravity 2·8–2·9."

§ Mr. Saemann of Berlin, Prussia, in a paper read before the Am. Assoc. for the Promotion of Science at Cambridge, attributes the change of color in Boltonite to minute grains of magnetic iron found disseminated in the substance of the crystals, which, undergoing change by exposure, leave the mineral of a lighter color than it was when fresh.

This mineral when first found, was called *Pyrallolite*, and is now so labelled in some old collections. Baron Lederer's Cabinet of American Minerals, now in the Yale College collections, contains eight or ten specimens of this mineral from Bolton, under the name Pyrallolite, which were received, as the catalogue indicates, from Robinson, Shepard, Nuttall, Boyd, and other of the early cultivators of American mineralogy.

In his remarks on this mineral, Prof. Shepard says, it is believed to be identical with the substance described by Dr. Thomson* under the name of "bisilicate of magnesia;" and accordingly the analysis of Dr. Thomson is quoted under "Boltonite," as giving the supposed chemical constitution of this substance.

It will presently be shown that there is every probability that Dr. Thomson applied the name bisilicate of magnesia to another substance, and that the Boltonite of Prof. Shepard is not the substance which he analyzed.

Having received specimens of Boltonite from Mr. Saemann, a very intelligent and discriminating mineralogist from Berlin, I was induced to undertake an analysis of it which gave me the following results. The specimen analyzed was the yellow variety. ·5753 gramme of substance gave:

				Oxygen.	
Silica,	46·062 =			23·93 =	8
Alumina,	5·667			2·64	1
Magnesia,	38·149	14·76	}		
Protox. Iron,	8·632	1·95	} =	17·14	6
Lime,	1·516	·43	}		
	100·026				

Formula $8\overset{...}{Si}\ 1\overset{...}{\mathbf{Al}}\ 18\dot{M}g = \dot{R}^2(\overset{...}{Si}, \overset{...}{\mathbf{Al}})$ or $(\dot{M}g, \dot{C}a, \dot{F}e)^2(\overset{...}{Si}, \overset{...}{\mathbf{Al}})$

8 atoms silica	= 370·08	= pr. ct.	46·556
1 atom alumina	= 51·47	"	6·372
18 atoms magnesia	= 372·66	"	47·072
	794·91		100·000

If we consider the alumina as not an essential constituent of the mineral instead of replacing a part of the silica, (a view, which I am not disposed to take,) then we shall have a silicate of magnesia and the other bases, whose formula will be

$$R^9\,\overset{...}{Si}{}^4.$$

Referring to Thomson's analysis and description of his bisilicate of magnesia, we read (loc. cit. p. 50) that the mineral received by him from Mr. Nuttall, (from Bolton, Mass.,) bears so much

* Am. Lyc. Nat. Hist., New York, vol. iii, p. 50.

resemblance to the picrosmine of Haidinger, both in character and composition, "that he strongly suspects the two things to be mere varieties. The mineral is white, with a shade of green, powder white. *It consists of a congeries of prismatic crystals, very irregularly disposed, and involved in each other. Lustre glassy;* transparent on the edges." The analysis gave:

Silica, ...	56·64
Magnesia, ...	36·52
Alumina, ...	6·07
Perox. iron, ...	2·46
	101·69

This analysis must certainly refer to another mineral than Boltonite. The description certainly does not compare at all with that of Boltonite, which cannot be said to "consist of a series of prismatic crystals," with a glassy lustre and faint green color. Nor is it white. In searching among the minerals from Bolton, in the cabinet of Baron Lederer, for something corresponding with Thomson's description, I found one from that locality marked "Picrosmine?" "Actynolite?" This mineral answers the description of Thomson, quoted above, as nearly as anything could, and is undoubtedly the same thing which he received from Mr. Nuttall, and examined with the above results. Nothing else occurs at the locality at all resembling the mineral which is described by Dr. Thomson. A qualitative analysis of this specimen gave silica, magnesia, alumina, peroxyd of iron, manganese, but no lime or water. These are the constituents of a hornblende, and this specimen is undoubtedly such—variety actinolite.*

If the foregoing conclusions are correct, it would appear that Boltonite and "bisilicate of magnesia" are not the same mineral as described by Prof. Shepard.

The formula for Boltonite is that of a salt not before described, while that deducible from Thomson's analysis, corresponds as accurately as we could expect with common hornblende.

I am happy therefore to be able to reëstablish Boltonite as a species on good grounds.

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* I am altogether at a loss to understand what Dr. Thomson intends, when he says in his memoir before quoted, that the analysis here given corresponds to the constitution of a "Bisilicate of magnesia." For

2 atoms $\dddot{Si}$	=	92·52 =	per ct.	81·72
1 atom $\dot{Mg}$	=	20·70		18·28
		113·22		100·00

This result is entirely different from his analysis.

VII. On Nuttallite.

Nuttallite was established as a species by Mr. Brooke,* on general physical grounds, principally of hardness and color, and a slight departure from the usual angles of scapolite. It was analyzed by Thomson,† who found for it a constitution so different from scapolite, that it has been regarded as a distinct species by many mineralogists, and is so placed by Nicol in his Manual just published. I was induced to make a new analysis to decide the doubt regarding its true constitution. The mineral is partially decomposed by strong chlorohydric acid with heat, but it is not thus possible to obtain a complete analysis. The mineral is found at Bolton, Mass., in a white cleavable limestone with black augite. Having a good specimen, I requested Mr. Ludwig Stadtmuller, one of our pupils, to undertake the analysis. The following are the results confirmed by several trials. The alkaline constituents being determined by fusion with carbonate of baryta.

Silica,	45·791
Alumina,	30·107
Perox. iron,	1·861
Lime,	17·406
Potash,	3·486
Soda, Manganese,	traces.
Water,	1·630
	100·281

It is obvious from simple inspection, that this analysis corresponds exactly with scapolite, and we have no hesitation in referring nuttallite to scapolite.

Analytical Laboratory, Yale College, September 15, 1849.

Art. XXX.—*On the Prime Meridian;* by Lieut. Davis, U.S.N.

[Read before the American Association for the Promotion of Science, Aug. 15, 1849.]

The question is, whether, having a National Observatory, and being about to publish an American Nautical Almanac, we shall still continue to count our longitude from the meridian of Greenwich, or whether it is preferable for convenience, for accuracy, or for other reasons, to establish a new Prime Meridian on this continent.

I will endeavor to treat this question fully, and to present all the practical and scientific views in relation to it of which I am possessed.

* Ann. of Philos., xli, p. 366.

† N. York Lyceum Nat. Hist., vol. iii, p. 82.

It would undoubtedly be for the advantage and convenience of all civilized nations if a general meridian were adopted by common consent; if all longitudes were counted in the same manner and from a single origin. The man of business, the general student, and, above all, the navigator, would profit by this rule; and the man of science would also find it beneficial in removing the necessity for those allowances and calculations occasioned by the variety of meridians, and with them, a constant source of error.

The Congress of the United States, in a report of one of their committees upon a proposition to make the capitol the first meridian, evinced at an early period an enlightened apprehension of the benefits that would result from the establishment of a general meridian.*

But it also was fully aware how little probable such an event was then, and there are obstacles in the way of its occurrence now, which render it distant and doubtful. It is not to be denied that our own situation is, in some respects, unfavorable for originating successfully such a project. If, nevertheless, you should agree with me, in thinking that the opinions which have been entertained for a long time by scientific and practical men here and elsewhere, should be again consulted, I shall be most happy, under your instructions, to communicate on this subject with European astronomers.

In the mean time we are called to decide upon a meridian for present use. This decision is the basis in my work. Hitherto we have used the English meridian of Greenwich; all our geographical positions and territorial limits are fixed according to it, our astronomical calculations are based upon it, our nautical charts and books of navigation are adapted to it, and our chronometers are set to its time. It has been so much our general practice to count from this meridian that it constitutes a part of our familiar thought and knowledge.

On this account, and especially with reference to the convenience of our wide spread and growing commerce, a change of the old meridian, if necessary, should be reconciled, as far as practicable, to the wants and habits of the country.

The scientific importance of assuming, at present, an American meridian is undoubted. So long as we depend upon that from which we are separated by an ocean, our absolute longitudes remain indeterminate. Such are the difficulties attending the astronomical determination of this element, that the greatest accuracy attainable is only an approximation to the truth; varying, as observations or computations are multiplied, or as new and better methods and values are introduced. There is no place on our coast, the longitude of which from Greenwich is so well ascertained as Boston. The observations and computations made for

* Report of the committee on Lambert's memorial, Jan 25, 1810.

this purpose by the late Dr. Bowditch, and communicated to the American Academy, bear the marks of his genius and labor. The means of determination have since been greatly multiplied —solar eclipses, occultations, and moon culminations, have been collected in great numbers. The transportation of numerous chronometers between England and Boston has afforded the materials of further improvement. Commodore (now Admiral) Owen, whilst engaged in the survey of the Bay of Fundy, carried his chronometers to Boston, adopting that as his American first meridian, because it was the best determined. Mr. Bond, the Director of the Observatory at Cambridge, has been for several years, employed in the service of the government, in accumulating all the means of perfecting the longitude of Boston. Yet I am informed, that there still exists an uncertainty in this longitude, notwithstanding all the labor and care bestowed upon it, to the amount of, perhaps, two seconds of time. It is, also, a pregnant fact, worth mentioning, that the relative longitudes, even of the Greenwich and Paris observatories, have been recently changed.

But the uncertainties arising from the intrinsic difficulty of making absolute determinations of longitude increase as the place is more remote, and therefore less known or cared for. The assumption of a new origin of longitude situated in this country, will, to a considerable extent, remove these uncertainties, and save us from those fluctuations in our geographical positions to which we are now subject. In the magnetic telegraph we have a means of determining differences of meridians, which belongs to the highest order of accuracy. It can be applied at once wherever the wires now run. An American prime meridian being adopted, this should be done as soon as possible. As the use of the telegraph is extended, the interior, throughout its whole space, would be connected in this manner with the stations of the coast survey and the national observatory, and would have the geographical positions of its chief cities and county towns permanently and unalterably fixed, and thus the foundation would be laid of a correct geographical map of the whole country.

In making a change, however, that is so radical with regard to some of our citizens and their pursuits, great consideration is to be had, I think, for their practical wants and conveniences. These last should be no farther sacrificed than the first demand of an independent accuracy strictly requires. Our navigators and seafaring people generally, are chiefly concerned in the result of this change. Speaking a common language with the greatest commercial nation of the world, our own vessels are constantly meeting those of Great Britain on the highway of nations, and are in the habit of comparing with them their longitudes. From this facility and frequency of intercourse they receive and confer great benefit, upon which sometimes the safety of a vessel at sea may depend. They are also accustomed to employ British charts and chronometers; and it is very desirable to secure the greatest possible facility for their use, and comparison for the future, and in every quarter of the world; throughout all parts of which our communication with British ships, ports, and means of navigation is intimate and habitual.

For these and similar reasons, it will be better if our own meridian is so situated as to admit of an easy interchange with that of Great Britain, particularly at sea, where intercourse is always necessarily brief, and frequently, owing to circumstances of weather, distance, or haste, very difficult.

If the meridian of Washington, which, as the capital of the country, it will first occur to us to select, be adopted, it will prove unsuited to these emergencies. The longitude of Washington is in time about 5h. 8m. and 16s., or in space 77° 04′ from Greenwich. These are inconvenient sums to add or subtract; their application is not ready and easy. This meridian will also cause that kind of difference in the division of our charts, the face of our chronometers, the reading of our text-books of navigation, &c., which would seriously interfere with the habits of our present, and the wants of our future nautical men. These as I have said, are considerations worthy of great regard.

The life of commerce subsists by the mutual interchange of relations, not material only, but also personal and intellectual. These relations are, in our case, much more numerous and complex with Great Britain than with any other nation, on account of her large fleets, her distant colonies, and our community of speech. We may omit to provide for the wants and habits growing out of them, but we cannot alter, indeed as a great commercial people we do not desire to alter, the fact of their existence.

To avoid in some measure the difficulties and inconveniences already stated, and to satisfy as far as possible, the demands of daily practice, I propose to establish an arbitrary meridian at the city of New Orleans, which will be exactly six hours in time and ninety degrees in space from the meridian of Greenwich. These round numbers are easy in their use and application. They are taken from or added to the headings of charts, the readings of chronometers, or the values in the astronomical ephemeris, without delay, and with little danger of mistake.

They are also convenient for the interchange of longitudes at sea. This meridian cuts the great valley of the west, and approaches to the central line of our territory on this side of the Rocky Mountains. It passes nearly through the centre of the great eastern slope of the continent, and enters the city of New Orleans, the mart and outlet of its products and trade. I propose to call it the meridian of New Orleans, in which city a spot is to be found having this suitable difference of meridian of six hours, or one quarter of the circumference, from our present standard meridian of Greenwich.

This choice has other recommendations, which give it the preference over Washington. The meridian of the latter cuts the coast between Cape Fear and Cape Lookout. Our coasting vessels, and domestic packets, therefore, in going and returning between our northern and southern ports would be subject, if it were taken, to the inconvenience of a change of name in the longitude, which, as is well known to navigators, always involves a liability to error.

The meridian of New Orleans on the other hand, is so far west, that all the longitudes on the Atlantic coast remain on the same side. It is only on the coast of Louisiana, west of New Orleans and of Texas, that they change. This change takes place where the river Mississippi empties its turbid waters into the Gulf, where nature has marked the line by an altered condition of the water, such as may be observed by the careful seaman at some distance from the land.

Another practical recommendation of this choice is this: If New Orleans be adopted, then between the American and English meridians, the degrees and minutes on the chart will be the complements of each other. To the westward of the American meridian, up to 180°, the minutes will be the same, the degrees being less by 90°. To the eastward of the English meridian there is the same advantage; the number of degrees on our part being greater by ninety, up to 180° of the English longitude. Between the inferior meridians of the two nations for the space of 90°, the sum of the American and English longitudes will be equal to 270°, but they will be of different names.

These normal differences are easily remembered, and compare favorably with the confusion that will follow, if the modes of reckoning longitudes by the two nations differed by so unmanageable a quantity as 77° 04′. The time is not distant when we shall have published, under the authority of the government, perfect charts of our harbors and external sea-coast. I trust also that the day is not far distant when foreign charts (improved by surveys made by our own officers) will be issued from the bureau of Hydrography of the Navy Department, for the benefit of the commercial marine of our own and other nations. These charts should be rendered as serviceable and available as possible to the whole maritime world; and this end will be attained in the manner pointed out above. What is for our own advantage will prove beneficial to others.

It may be proper to observe here, that although I speak only of the meridian of New Orleans as arbitrary, yet all prime meridians are essentially arbitrary. They have been selected always with a sole reference to the national convenience. Some nations, as the French, Portuguese, and Dutch, have placed their prime meridians out of their own country; but I need not consume space by entering into historical details that are easily obtained.* The early conduct of the French, however, in this matter, deserves to be mentioned because it contains some instructions for ourselves. By a royal ordinance of Louis XIII, the island of Ferro was established as the French first meridian, and Paris was assumed to be twenty degrees to the eastward of it. It appears from the memoirs of the Royal Academy of Sciences of 1742 and 1746, that attempts were subsequently made to fix with accuracy the exact distance of Paris from the island, notwithstanding that no precise spot on it had been designated as the origin of longitudes, and that there was a prevailing ignorance as to the topography and shape of the island. The determinations by different persons of course varied, and this caused those uncertainties and fluctuations in the French longitudes which led to the final abandonment of the assumed meridian. We may profit by this example.

Having decided to take for our prime meridian that great circle of the earth which is ninety degrees or six hours from Greenwich, we are to keep it wherever it may fall. By means of the magnetic telegraph, the distance of this circle from the meridian of the National Observatory can be determined with sufficient accuracy, and, being once determined, it is to be regarded as fixed and permanent. If it should be found necessary to make any change hereafter, that change will be applied to the imaginary meridian, and not to the meridional differences of other places from Washington, which are to remain always the same.

The Washington Observatory is thus made the virtual standard according to which all values are assigned, and to which all meridional differences are referred; and from which, also, all *absolute* longitudes are computed.

Its own distance from the six hour circle being once ascertained by magnetic communication, it will be, in effect, for this country, the true origin of longitude.

It will not be practically indispensable to distinguish by any visible, real mark, the meridian of New Orleans, so far as the National Observatory is concerned; for the latter, its distance in time from the arbitrary meridian being once assumed, becomes the effectual, established zero; but this mark will be useful for reference in the adjacent country, saving labor and time in fixing longitudes in its vicinity, and its foundation appears to be peculiarly proper as a national monument. The cost of such a mark will be but trifling.

Thus the new meridian will be, what its name implies, strictly arbitrary. It may be thought that there are reasons of a scien-

* See Encyc. Perthensis, and Britannica, art. Geog.—Good's Pantologia, and London Encyc., art. Meridian—Delambre's Hist. of Astronomy, Mackay on Long., &c.

tific character why the National Observatory at Washington should be selected as the nominal origin of longitude, on this continent. Such is not the case. Our National Observatory at Washington must have existed half a century before it will be able to furnish independent observations sufficient for the determination of a correct theory of the moon or primary planets. But these theories are already calculated from the observations (begun long since and uninterruptedly continued) at the old established observatories of Europe. In preparing new tables, I shall avail myself of the Washington observations to the utmost extent of their utility.

I propose, also, to give, in the Astronomical Ephemeris, the times of transit, and the corresponding places of the planets, and principal fixed stars, over the meridian of Washington.

Hitherto I have treated this question without an express reference to merely national views and feelings. So far as the subject is merely scientific, they do not enter; so far as it is practical, they are of paramount importance.

But I am very far from being seduced into a forgetfulness of national sentiments, by the silly pretense that there are or can be duties to science or to humanity, which are at variance with those to country; a notion, wherever it is held, that implies not only a want of patriotism, but of true humanity also. "Science knows no distinctions of country"—in its claims to support and in its exemption from hostilities—in its spirit and in its communions—in its highest aim, which is to study the laws of nature, and endeavor to make the knowledge of those laws useful to mankind.

But science, like all objects of human interest and pursuit, is compelled to recognize the distinctions of country in the duties it imposes, in the means of its progress, and in some measure in its associations and the limits of its operations. It prospers and is fostered by those affections which divide us into distinct families and nations, at the same time that they preserve our relation to the whole race.

Being designed to act within a limited sphere of usefulness, we are happily supplied with a motive to every duty in a corresponding affection, which, if rightly elevated and directed, renders the performance of that duty easy and agreeable.

Feeling assured that it is by laboring in the sphere assigned us that we are most likely to accomplish something that may be beneficial to mankind, and that by making ourselves good citizens of that state to which our efforts are unavoidably confined, we may best hope to prove ourselves useful citizens of the great republic of letters and science constituted by the union of all cultivated people, I indulge a sentiment of American pride and gratification, that another step has been taken by the government towards the promotion of science, by the foundation of an American Nautical Almanac.

NOTE.—The preceding paper is the substance of a letter addressed to the Hon. Wm. Ballard Preston, Secretary of the Navy, by Lieut. Davis, upon the latter being called to take charge of the preparation of the Nautical Almanac provided for by the act of Congress, approved March 3, 1849.

Lieut. Davis stated that he had been officially directed by Mr. Preston to lay this paper before the Association with the request that it should be submitted, for a report thereon, to a committee of members of the association, consisting of mathematicians and astronomers from various parts of the country. On motion of Prof. A. D. Bache, the paper was thus referred, and the following gentlemen were nominated by the President and confirmed by the Association as the committee.

Prof. A. D. BACHE, Supt. U. S. Coast Survey.
Lieut. M. F. MAURY, Supt. Nat. Observatory.
Prof. BARNARD, of Alabama.
Prof. LEWIS GIBBES, of S. Carolina.
Prof. COURTNAY, of University of Virginia.
Prof. S. ALEXANDER, of Princeton.
Prof. FRAZER, of University of Pa.
Prof. ANDERSON, of New York.
O. M. MITCHEL, of Cincinnati.
Prof. STANLEY, of Yale College.
WM. MITCHELL, of Nantucket.
Prof. LOVERING, of University at Cambridge.
Prof. SMYTH, Bowdoin College.
Prof. TRINLOCKE, of Kentucky.
Prof. COCKLEY, St. James, Md.
Prof. CURLEY, of Georgetown Coll.
Prof. FOWLER, of Tennessee.
Prof. PHILLIPS, of N. Carolina.
Prof. BARTLETT, of West Point.
Prof. SNELL, of Amherst.
Prof. CASWELL, of Providence.
Lieut. C. H. DAVIS, Supt. Naut. Alm.

ART. XXXI.—*Contributions to the Mycology of North America;* by the Rev. M. J. BERKELEY, of England, and the Rev. M. A. CURTIS, of South Carolina.

Mr. BERKELEY having generously proposed that the new species of Fungi which I communicate to him shall be published under our joint names, though the greater part of them would justly have fallen to his own share, they will henceforth be published accordingly. They will be first described in the London Journal of Botany by Mr. Berkeley, and transferred from thence to this Journal, with such alterations, additions or omissions, as later observation may demand, and as may best subserve the purpose of these contributions.—M. A. C.

31. AGARICUS (Amanita) AGGLUTINATUS, Berk. and Curt.—pileo ex hemispherico plano viscido e volva areolato, margine sulcato; stipite curto solido; lamellis latis liberis rotundatis. Ad terram in sylvis arenosis. Aug. Society Hill, S. C.

White, pileus 1–2 in. broad, scaly from the remains of the volva, margin thin. Stem ½–1½ in. high, 2 lines thick, enlarged at the apex, bulbous at base, furnished with a volva whose margin is free. Ring wanting. Gills broad, ventricose, rounded and free behind. Spores white, elliptic.—Resembling small forms of A. vaginatus, but distinguished by its solid stipe, more distant and thicker gills, and decidedly viscid areolato-squamose pileus.

32. A. ASPERATUS, Berk.!—In sylvis paludosis, Society Hill. This beautiful species was previously known only as an inhabitant of Ceylon.

33. A. FULIGINOSUS, Fries.—In umbrosis. June. Society Hill.

34. A. VELLEREUS, Fr.—In sylvis aridis. June, July. Society Hill. Item, Santee Canal. Mr. Ravenel.

35. A. ANGUSTISSIMUS, Lasch.—Ad terram. Aug. Santee Canal. Ravenel.

36. A. SCALPTURATUS, Fr.—Ad truncos pineos. Aug. Society Hill. Item, Santee Canal. Ravenel.

37. A. CONIGENUS, Pers.—Ad conos pineos dejectos in humidis. Wilmington, N. Car.

38. A. CLAVUS, Bull.—Inter muscos ad terram argillaceam. Sept. Hillsborough, N. C.

39. A. CIRRHATUS, Pers.—Ad terram subter asses. Aug. Society Hill.

40. A. CAMPANULATUS, Linn.—May. Society Hill. Item, Santee Canal, ad fimum vaccinum. June. Ravenel.

41. A. MURALIS, Sow.—In sylvis humidis. May. Society Hill.

42. A. SCYPHOIDES, Fr.—Ad terram in hortis. June, July. Society Hill.

43. A. PYXIDATUS, Bull.—Ad terram in graminosis. June. Santee Canal. Ravenel. Item, Hillsborough, N. C.?

44. A. BRUMALIS, Fr.—Ad truncos putridos. Sept. Santee Canal. Ravenel.

45. A. UMBELLIFERUS, Linn.—In sylvis humidis; Rhode Island. Mr. Olney.

46. A. ATROCŒRULEUS, Fr.—Ad Caryam dejectam. June, July. Society Hill.

47. A. POMETI, Fr.—Ad truncos dejectos. July. Hillsborough. N. Car. Has a pleasant anisate odor when fresh.

48. A. SEPTICUS, Fr.—Ad Polyporum corruptum. July. Hillsborough.

49. A. (PLUTEUS) CURTISII, Berk.!—pileo erugi viscido hepatico; stipite æquali solido glabro albo; lamellis liberis ex albo cinnamomeo-roseis. Ad lignum corruptum in paludosis. March–Oct. Society Hill.

Cap 2–3 in. broad, shining, from pale becoming livid or liver colored, smooth, margin thin. Flesh white, 2–3 lines thick in the centre. Lamellæ white (becoming discolored by the pale cinnamon colored spores), unequal, numerous but not crowded, ventricose, 3 lines wide, free and rounded at base, leaving a deep impression around the stipe. Stipe rather brittle, 2–3 in. long, about 3 lines thick, smooth and shining, somewhat thickened at base. Spores oval. Taste and smell disagreeable, but weak.

50. A. SINUATUS, Fr.—Rhode Island. Olney.

51. A. CAMPHORATUS, Fr.—Ad terram in umbrosis. June, July. Society Hill. Item, Santee Canal. Mr. Ravenel.

52. A. SANGUINEUS, Wulf.—In sylvis humidis inter folia. July–Sept. Society Hill.

53. A. PENETRANS, Fr.—Ad truncos dejectos corrumpentes. June. Society Hill. Item, Santee Canal. Ravenel.

54. A. LANUGINOSUS, Bull.—Ad humum lignosam in sylvis humidis. May. Society Hill.

55. A. SEMIORBICULARIS, Bull.—Ad terram fimosam. Aestate. Society Hill and Hillsborough.

56. A. VERVACTI, Fr.—Rhode Island. Mr. Olney.

57. A. FABACEUS, Berk. !—Ad terram pinguem. July–Nov. Santee Canal; Mr. Ravenel; and Society Hill. First discovered in Ohio by Mr. Lea. This is among the most delicious species for the table. The fresh specimen has a distinct taste and odor of peach kernels or bitter almonds, which are nearly lost in being cooked.

58. A. (Psalliota) ACHIMENES, Berk. and Curt.;—pileo plano glabro nitido verrucis exasperato; stipite floccoso-farcto; lamellis liberis ex albido cinereis.—Ad terram. June. Santee Canal. Mr. Ravenel. Item, Society Hill.

Solitary. Cap 4–6 in. broad, pallid or ochroleucous, smooth like kid leather, but studded with warty excrescences especially towards the centre. Stipe 4–6 in. high, 3–4 lines thick, white, stuffed with floccose fibres, furnished towards the apex with a large deflexed ring. Gills broad, crowded at first, whitish, then cinereous and fuscous, free. Spores brownish, oval or ovate.—A splendid species allied to the preceding, but differing in its paler spores, warty cap, ample ring, &c.

59. A. LACRYMABUNDUS, Bull.—Ad latera fossarum. Sept. Santee Canal. Mr. Ravenel.

60. A. VELUTINUS, Pers.—Ad terram humidam, &c. Apr., Sept. Santee Canal. Mr. Ravenel.

SCIENTIFIC INTELLIGENCE.

I. Chemistry and Physics.

1. *Deflection of the Magnetic Needle by the act of Volition,* (taken from Phil. Mag, xxxiv, 543.)—This curious and interesting experiment is due to the investigations of M. Du Bois Reymond of Berlin, and his method of performing it is as follows:—He takes a very sensitive galvanometer, and attaches to the terminal wires thereof two perfectly homogeneous strips of platina. These strips are dipped down into two vessels filled with salt and water, into which fluid, as contained in each vessel, two corresponding fingers of the two hands are to be plunged. On the first immersion of the fingers there is almost always observable a more or less decided deflection of the needle, this deflection not being amenable to any known law, and being in the opinion of the experimenter due to the difference existing to some extent and in some way or another between the cutaneous covering of the two fingers. Whenever there is a wound on one of the fingers the deflection is greater than usual; and its direction is uniformly such that the injured finger behaves like the zinc-side of an arc of zinc and copper, which we may conceive to be inserted between the two vessels instead of the human body. It need hardly be remarked, that it is not this sort of action to which in the experiment in question it is purposed to direct the attention. On the contrary, in order to observe the effects alluded to, it is requisite to wait either till the needle has gone back to the zero point of its scale, or at least until it has assumed a constant deflection attributable to the residue of a current which it is beyond us to eliminate. As soon as this state is attained, the whole of the muscles of one of the arms must be so braced that an equilibrium may be established between the flexors and the extensors of all the articulations of the limb, pretty much as in a gymnastic school is usually done when it is desired to exhibit the development of one's muscles.

As soon as this is done the needle is thrown into movement, its deflection being uniformly in such a sense as to indicate in the braced arm "an inverse current," according to Nobili's nomenclature; that is to say, a current passing from the hand to the shoulder. The braced arm then acts the part of the copper in the compound arc of zinc and copper mentioned above.

With his own galvanometer, and when M. Dubois Reymond himself performs the experiment, the deflection amounts to 30°. He obtains however movements in the needle of far greater extent by contracting alternately the muscles, first of one arm and then of the other, in time with the oscillations of the needle. On bracing simultaneously the muscles of both arms, inconsiderable deviations are observable, sometimes in one direction, sometimes in another; and these minute deflections are evidently attributable to the difference between the contractile force of the two limbs. Hence it arises that when the experiment is repeated many times in succession, the results diminish gradually in amount, not only in consequence of the energy of the contractions becoming less and less, but also because it becomes more and more difficult to restrain the act of slackening or letting down the muscles to only one of the two arms.

The amount of deviation, *cæteris paribus*, depends upon the amount of the development and the exercise of the muscles. The author is said to have an arm of considerable power, and among the number of savans that have tried the experiment at his residence, there has not as yet been found one who excelled or even came up to him in this respect. There are indeed individuals who do not possess the power of producing a sensible deflection in the needle of his galvanometer, but it is readily ascertained that in these instances there is a want of sufficient muscular tension.

There is one remark, to conclude, which the author has been frequently led to make, namely, that the habitual superiority of the right hand over the left in this experiment is to be interpreted by the preponderance of the amount of deflection produced by the tension of the right arm. This peculiarity was likewise observed when the experiment was performed by M. von Humboldt. The impulsion impressed on the needle by the contraction of the muscles of his right arm was appreciably more considerable than that produced by his left arm.

For his own part, M. von Humboldt has addressed to M. Arago a letter of the following tenor:—He says, the fact of the experiment of affecting a magnetic needle by the alternate tension of the muscles of the two arms, an effect due to volition, is established beyond all question or doubt. Notwithstanding my advanced years and the little strength that I have in my arms, the deflections of the needle were very considerable; but they were naturally more so when the experiment was performed by M. J. Müller or by M. Helmkoltz, who are younger men. To facilitate the experiment it is advisable to plunge the fore-fingers into the water, and to support the palms of the hands, to enable one to brace up well the muscles of the arm which it is purposed to bring into play.

2. *On the Development of Electricity in the Act of Muscular Contraction;* by M. Becquerel, (Compt. Rend., May, 1849; Phil. Mag., xxxv, 53.)—I have repeated unsuccessfully the experiment of M. Du Bois Reymond, relative to the production of an electric current in the act of muscular contraction, making use of the arrangements which he indicated in a letter addressed to M. Arago by M. de Humboldt, dated the 17th of May, excluding however, all those secondary causes which could give rise to electric currents, excepting that one, the action of which is described.

I shall commence by recalling to mind the observations which I made in studying the electric effects obtained with a condenser, the plates of which were made of platinum or copper gilt (*Traité de l'Electricité et du Magnétisme*, t. v. 2e partie, page 10):—

"The electro-chemical effects produced on the contact of acid solutions with the liquids which moisten the fingers, must be taken into account. In these various reactions the acids acquire positive electricity, which is transmitted to the plate, and the liquids which moisten the fingers negative electricity. With the alkalies the effects are inverse."

It follows from this, that if one of the plates is covered externally by a very thin layer of hygrometric water, and if it is touched with a finger moistened with perspiration, electric effects, resulting from the reaction of the perspiration upon the water, ensue. It is also produced when a finger in a great state of transpiration is applied upon one of the plates, after having been previously moistened with water; in this case the water acquires positive electricity, and the contrary electricity flows into the body of the experimenter. If we add to these effects those which take place when foreign bodies are adherent to the skin, we must conceive that a large number of complex electric effects would be produced in plunging two fingers, as is done by M. Du Bois Reymond, into two capsules filled with water in which are contained two plates of platinum in communication with a multiplier. This is not all: when, in virtue of these various causes, a current has circulated in the liquid and in the wire, the two plates of platinum are polarized in opposite directions, as may be shown by withdrawing the fingers and establishing the communication between the two capsules by means of a siphon filled with the same liquid as that which they contain. This current, during the first few moments, having the same intensity as the primitive current, annuls it; but if, in the act of contraction, the finger of the contracted hand become more or less immersed in water, the inverse current may be less or superior to the direct current. I guarded not only against the effects of the inverse current, but also against the effects resulting from the greater or less immersion of the fingers, by smearing with fat those parts of the fingers which might temporarily come into contact with the liquid. By proceeding in this manner, I found it impossible to observe the effects described by M. Du Bois Reymond.

3. *Note relative to the Electricity developed by Muscular Contraction;* by M. C. Despretz, (Ibid.)—The note which I have the honor of communicating, is a simple enumeration of the experiments which I made with the view of reproducing the phenomena announced by M. Du Bois Reymond of Berlin.* I shall not discuss these phenomena, my only object being to reproduce them. * * * *

The galvanometer which I used was made by M. Ruhmkorff, whose skill is well known. The diameter of the wire was $\frac{1}{10}$th of a millimetre, and its length 300 metres. The wire made about 1800 convolutions round the frame of the apparatus. The delicacy of the instrument is shown by the following numbers.

A copper wire $\frac{3}{4}$ths of a millimetre in diameter, when immersed to a depth of two centimetres, afforded a deflection of 3° in distilled water, 25° in the water of the river Seine, and 68° in a solution of chlorid of sodium, containing from four to five per cent. of the salt.

Plates of gold, the surfaces of which were nearly one square centimetre, afforded under the same circumstances deflections of 11°, 24° and 85°. The gold, which was perfectly pure, had been recently pre-

* Comptes Rendus, May 21; and Phil. Mag., vol. xxiv, p. 453.

pared at the Mint of Paris, in the laboratory of M. Pelouze and M. Peligot. The needle, when set free, took about half a minute in moving from 50° to zero.

I was not at first acquainted with M. Reymond's method of proceeding. In my earliest experiments, two cylindrical conductors were held in the hands, and when the needle had returned to zero, or had acquired a perfectly stationary position, one of the arms was powerfully contracted; the deflection was then observed, and when the needle had again become stationary after the cessation of the contraction, the other arm was strongly contracted, also observing the deflection.

These first experiments were made with common copper conductors. But for the sake of avoiding the objection which might arise from the ready oxydation of this metal, I had them covered with gold-leaf. Other conductors were coated with silver, platinum and gold.

The experiments were made by three persons. Were there no occasion for using galvanometers, we should be inclined to believe that silver, and especially gold and platinum, which preserve their polish and lustre in contact with moist air, would be appropriate for these experiments, on account of their unalterability. This is however not the case; silver, gold and platinum afford currents which are almost as strong as copper. When the platinum conductor is held in the hand, and the needle has become stationary, merely touching it with one finger more, or less, is sufficient to change the position of the needle several degrees.

In these experiments the needle was deflected 50°, 75° and even 90°. When one of the conductors was squeezed powerfully, the needle moved in one direction, and when the other conductor was squeezed, the needle moved in the same or in an opposite direction.

It is indispensable to repeat these experiments several times, without which we should be liable to errors. Thus it happens that the deflections of the needle occur alternately in one and the other direction; but on multiplying the experiments, we find that the deflections frequently take place in the same direction, although the compression is produced first by one and then by the other arm. If the chemical action was regular like that of a watch-spring, we ought to obtain currents in the opposite direction. We only experimented in this way, because, on the one hand, we were unacquainted with M. Reymond's method of proceeding; and on the other, we thought that silver, and especially gold and platinum, when simply held in the hand without any compression, would only afford a very weak current. But experience unfortunately proves that gold and platinum are under these circumstances as *impressionable* as brass, if I may be allowed to use such an expression. I have repeated M. Reymond's experiment several times, both following rigidly and varying his method of proceeding.

I first wished to ascertain whether the instrument, which I had not yet used, was sensible or not to changes of temperature. For this purpose, I heated one of the places at which it was soldered to the melting-point of wax, the communication being established by the hands between the two plates; I also augmented the temperature of one of the two solutions of common salt, by immersing in it glass tubes filled with boiling water, the communication being always kept up by the hands;

in neither case did I observe the slightest deflection, which might be anticipated from the known properties of thermo-electric phenomena; nevertheless it appeared to me of use to verify this in the present instance. To avoid the effect of a more or less deep immersion of the metallic plates, in consequence of the introduction of the fingers, I partly covered these plates with black wax, so that the uncovered surface was always in contact with the solution.

As regards the fingers, I attempted to immerse them to the same extent in all the experiments, having found that in plunging successively one, two or three, or more fingers, or a single finger to a greater or less depth, the intensity of the deflections varied. This result indeed had been anticipated. I had even had some long kinds of copper thimbles gilt, so as to regulate the immersion better. But I abandoned this method of proceeding, because it differed too much from that adopted by M. Du Bois Reymond.

In experiments made according to M. Du Bois Reymond's process, the alternate contraction of each arm has sometimes afforded deflections in the same, sometimes in the opposite direction.

In other experiments, each arm was successively contracted out of the water, and on each contraction the vessels were connected by means of the fingers. In others, large capsules were used, so as to allow more freedom of motion of the hands, and so as to permit the immersion of the closed hands, either contracted or not contracted. The results of these two series of experiments are sometimes favorable, sometimes contrary to the assertion of M. Reymond. The necessity of multiplying the experiments is very distinctly shown in this case. The results of two or three experiments agree with the results announced by M. Reymond; and then, if they are continued, opposite results are obtained. A singular fact is also remarked in these experiments, viz., that the fingers are influenced much in the same way as metallic conductors; they lose part of their efficacy by repeated immersions.

I was desirous of reducing the experiment to a greater amount of simplicity. I replaced the galvanometer by a frog which was properly prepared. Several persons, separately or in connection, having strongly contracted one of their arms, in vain endeavored to produce convulsive movements, by connecting the two arms by means of the most sensible parts of the animal. Nevertheless with a very fine copper wire and a plate of zinc, without the use of any liquid, very marked contractions were produced both before and after the experiment.

I also endeavored in vain to deflect a very delicate astatic magnetic needle, by the union of the two hands, whilst one hand was strongly contracted. Finally, I attached a cylindrical gilt conductor to the back of each hand by silk cord: the contraction of one or the other arm did not perceptibly change the deflection of the needle, which amounted to 10° from the simple contact. The effects of the contact were increased in a marked degree by moistening the back of the hand with a few drops of salt water; but the contraction of one or the other arm did not produce deflections alternately in one or the other directions.

These three experiments appear to me to be under more favorable conditions than those of M. Reymond. The results of them are removed from the intervention of the immersion of metallic laminæ in saline solutions, which is always somewhat obscure. Unfortunately they only furnished negative results.

In conclusion, if we are only to admit as true that which is clearly demonstrated, we think that the experiments detailed in this note show, that if the contraction of one arm gives rise to an electric current, this current is not appreciable to our present means, at least to those which we have employed.

We are, however, far from believing that the tetanic contraction of a limb does not give rise to the decomposition of a certain quantity of electricity. The friction of the parts upon each other, and the unequally heated state of heterogeneous parts would give rise to electric decompositions; but recompositions ensue immediately. This is probably the case in all the chemical actions which occur in the economy.

Until chemistry has discovered a metal or an alloy which does not afford any current by the contact of liquid conductors, we shall always be exposed to numerous errors in researches upon the currents of animals and vegetables.

The galvanometer is a very valuable instrument, but it requires a very large amount of skill and prudence on the part of the experimenter. If it is made but slightly sensible, it only indicates powerful phenomena; if it is made very delicate, it obeys the slightest perturbating causes. It is not impossible that a large number of experiments upon the currents in animals and vegetables may merely arise from illusions, and that what is attributed to animal and vegetable currents, may be nothing more than the action of liquids upon the plates of gold or platinum of galvanoscopes, or upon other different liquids. If the two plates of gold of a galvanoscope are inserted in any direction in a potato which has either budded or not, in an apple, or a cabbage-stalk, or the flesh of beef; if any two parts of the skin, slightly moist, are touched with these same plates, we have currents; if first one and then the other plate be withdrawn in succession, and after having washed and wiped it, it be replaced, the current is reversed; if the plates are more or less deeply immersed, reversions may also occur.

It is possible that the convulsions experienced by the frog from the contact of the crural nerves with the muscles of the legs, may depend only upon the heterogeneity of the liquids which moisten these parts. It is possible that the permanence of the direction of what is called the current of the frog may be owing to a different alterability of the extremities of the animal by the various solutions employed in these experiments. In the experiment as arranged for determining the true or false current in the frog, we merely require to substitute for the animal a cord of thread impregnated with common salt, and one of the ends of which has been touched with the stopper of a bottle of sulphuric acid, and the other with the stopper of a bottle of nitric acid, to reverse the current a great many times, as is done in the case of the current of the frog.

There is one experiment upon this subject which would have a certain value without being decisive, it is that of the action of a circuit of frogs upon a magnetic needle.

I arranged a chain of frogs in the same manner as the pairs of a voltaic pile are arranged; this chain traversed a bell-glass, beneath which a very delicate astatic needle was suspended. I did not observe any distinctly appreciable effect at the moment at which I united or separated the extremities of the chain. Had an effect been obtained, the objection from the action of the heterogeneous moist parts would still remain.

It does not appear to me that the existence of electric currents in frogs and plants is a perfectly proved fact. I speak openly, submitting my doubts to those philosophers who have made most interesting, and in some cases very ingenious experiments upon this subject.

4. *On the Polarization of Heat.*—The polarization of heat first announced by Bérard, has been established by various experiments by Forbes and Melloni. Provostaye and Desains have lately announced to the Academy of Sciences at Paris, (Session of July 30,) new investigations showing—

(1.) That heat traversing Iceland spar is divided into two pencils, completely polarized in the plane of the principal section or a perpendicular plane.

(2.) That the law ascertained by Malus, according to which, the intensity of a ray completely polarized is divided between the ordinary and extraordinary images to which it gives origin in traversing the spar, is applicable to heat as well as light.

(3.) That the variations of intensity which polarized heat experiences in its reflexion from glass at different incidences, are exactly represented by Fresnel's formulas determined for light, only allowing that the solar heat traversing the prism has a little different index—1·5.

(4.) That there is a most perfect correspondence between the phenomena presented in the reflection from polished metals of polarized heat and polarized light.

5. *Composition of Bones*, (Acad. Sci. Berlin, Feb., 1849.)—M. W. Heintz, finds for the phosphate of lime in bones, the composition $\dot{R}^3\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathbf{P}}$, instead of the hypothetical formula $\dot{Ca}^8\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathbf{P}}{}^3$ of Berzelius. He obtained in his analyses—

	Bones of the ox.	Sheep.	Human bones.	
Lime,	37·46	40·00	37·89	37·51
Magnesia,	30·97	0·74	0·57	0·56
Phosphoric acid,	27·89	29·64	28·27	28·00
Carbonic acid,	3·10	3·08	2·80	2·81
Water, fluorine and organic matter,	30·58	26·54	30·47	31·12
	100·00	100·00	100·00	100·00

Supposing the acids and bases united, adopting the formula given—

Carbonate of lime,	7·07	7·00	6·36	6·39
Phosphate of magnesia,	2·09	1·59	1·23	1·21
" lime,	58·30	62·70	60·13	59·67
Lime,	1·96	2·17	1·81	1·62
Water, fluorine, organic substances,	30·58	26·54	30·47	31·11
	100·00	100·00	100·00	100·00

He thus finds some lime (1·62 to 2·17 per cent.) not combined with the acids detected. This is accounted for by the existence of fluorine in bones, with which this lime is probably united. According to the analyses of Berzelius, the bone of a human thigh contained 3 per cent. of fluorid of calcium, and a bone of an ox 4·25 per cent. out of those portions which resisted the action of heat. Marchand has found in human bones one per cent. of this fluorid, or 1·6 per cent. in the bones when calcined. Heintz, in his experiments, found 2·05 per cent., corresponding to 2·97 per cent. in the bones after calcination. The amount of fluorid of calcium corresponding to the lime found in Heintz's analyses, equals 3·57 and 3·24 per cent. of the calcined material.

Heintz has also found that bones after boiling in water contain no trace of iron. He attributes that found by some chemists to the blood which is not easily removed entirely by cold water.

6. *On the Specific heat of Potassium, with remarks on the equivalents of Silica and the Alkalies;* by V. Regnault, (Ann. Chem. Phys. [3], xxvi, 261.)—The author considers the bearing of the law brought out by Dulong and Petit—that the specific heats are in an inverse ratio to the atomic weights—on the equivalents of silver and other elements. He observes that the law holds true for a large part of the elements. Uranium, silver and carbon are three of the exceptions. Uranium has not yet been sufficiently investigated. As to silver, the law alluded to gives an equivalent half of that usually adopted, and would make the oxyd $Ag^2 O$, instead of $Ag O$, and the sulphuret $Ag^2 S$, instead of $Ag S$. The isomorphism of $Cu^2 S$ with the sulphuret of silver, the analogy of chlorid of copper and chlorid of silver, besides other reasons, are urged as favoring a change in the equivalent.

Carbon exists in three conditions, each with distinct specific heats; and it is important to ascertain which of these is its condition in its combinations. It is natural to assume that to be the modification in which carbon is most disaggregated. But the capacity for heat of carbon, as found by Regnault, from the decomposition of organic substances, corresponds to the equivalent 150, instead of 75 the number usually adopted. As an important proof on this point, the author mentions that among a great number of organic compounds whose composition is well determined, the number of the equivalents of carbon *is an even* number. There are two exceptions to this, viz., in the oxyd of carbon (CO), and carbonic acid (CO^2). But there is no special reason for writing CO rather than $C^2 O^2$; and chemists write the formula of carbonic acid CO^2, because they regard as neutral salts, those of most common occurrence,—the carbonates of lime, of baryta, &c., and as bicarbonates, the alkaline carbonates which contain double the quantity of carbonic acid. The anomaly disappears if we adopt the above view and regard the latter as neutral carbonates (as some chemists have actually done), in which case the others are basic carbonates.

The same law as regards the inverse relation of specific heat and atomic weight holds also for compounds. Regnault suggests farther that the alkaline oxyds should have the form $R^2 O$, and the equivalent be halved. Soda and oxyd of silver, or sulphate of soda and sulphate of oxyd of silver, have been known to be isomorphous; and this change would render the composition analogous. With reference to this point, the author experimented on the specific heat of potassium, and he found it to be 5·40 in his best trial, a result which sustains his conclusion. He hence infers that the equivalent of potassium should be halved, and that the formula of the alkaline oxyds is $R^2 O$.

7. *On Chloroniceic Acid;* by M. E. Saint Evre, (Ann. de Chim. et de Phys., April, 1849.)—This acid is obtained by the action of chlorine upon benzoic acid in the presence of an excess of alkali.

Two hundred parts hydrate potash and 60 benzoic acid are dissolved in 300 water—chlorine is passed until the liquid changes yellow and finally green, with a pulpy deposit. By saturating the excess of potash and boiling, this deposit is dissolved and an oily liquid appears, which floats or sinks, according to the density of the solution, and on cooling, concretes and becomes hard and brittle. Repeated crystallizations first from water and finally from alcohol afford the pure acid.

Chloroniceic acid forms microscopic crystals, which are four-sided prisms; it is volatile without decomposition, the odor is penetrating and resembles that of most chlorinated compounds, being quite different from that of benzoic acid. Distillation with lime or baryta produces a liquid and a solid hydro-carbon; other powerful reagents seem to have no effect.

The formula of the author is $C_{12} H_5 Cl O_4$. Salts of baryta, silver, &c., were formed.

[The formula above given is that of a chlorinated species of *white hydro-quinone*, (Pyroquinol, Ger.) $C_{12} H_6 O_4$, one equiv. of hydrogen being replaced by one of chlorine. That this is the true relation of the so-called chloro-niceic acid, is not surprising, when we remember that Wöhler found benzoic acid and bodies allied to it among the products of the destructive distillation of quinic acid. Benzoic acid moreover differs from hydro-quinone, only by two equiv. of carbon. In the process detailed above, there is oxydation and substitution of chlorine simultaneously carried on. It is true that Hoffman failed to obtain chloranile from benzoic acid by chromate of potash and muriatic acid; but from the reaction above mentioned, it would appear that the product should have been a quadri-chloro-hydro-quinone, which is in reality colorless and might well have been overlooked.

But we have more conclusive evidence of the correctness of our opinion in the researches of Dr. Staedeler, (more particularly noticed below,) in which he has proved the existence of several chlorinized species of hydro-quinone—in fact of all but this very one which he does not seem to have formed; his process, however, was a totally different one. As it is, the description of the others will answer almost word for word for this, which should be called *mono-chloro-hydro-quinone*, a name somewhat longer than that given by the discoverer, but which has the advantage of expressing at once the relation to twelve different allied bodies. G. C. Schaeffer.

8. *On the Chlorinated Products of the Decomposition of Quinic Acid;* by Dr. G. Staedeler, (Liebig's Ann., March, 1849.)—It is well known to chemists that by distilling quinic acid with sulphuric acid and peroxyd of manganese, a substance called quinone, $C_{12} H_4 O_4$, is formed, which is very singular in its properties and reactions. Under the influence of an excess of reducing agents, e. g., sulphurous acid—two equiv.

of hydrogen are taken up, forming hydro-quinone $C_{12}H_6O_8$. By the union of the two substances, the first yellow, the second colorless, an intermediate body, green hydro-quinone ($C_{12}H_5O_4$) is found; this substance has been represented as the most beautiful known to chemists, excelling murexide in its rich metallic golden green crystals; they are formed of great size even in a small quantity of solution.

Dr. Staedeler has formed chlorinized species both of quinone and of hydro-quinone, in all cases the former being yellow and the latter colorless. In one instance the union of the two formed a substance intermediate in composition and of equal beauty with green hydro-quinone. Of the quinones, we have according to our author, 1, 2 and 3 equiv. of H replaced by Cl; four equiv. replaced in the well known chloranile.

Of the hydro-quinones, one equiv. is replaced in the chloro-niceic acid [see above], the others were formed by the action of sulphurous acid on the corresponding quinone; the most remarkable is that formed from chloranile, as by means of it the true relation of that substance to quinone is demonstrated.

Some other compounds are described by the author, although of no particular interest. Wöhler has also recently reviewed his investigation of the sulphur compounds of the series. He finds that in some instances there is direct union with S H. G. C. S.

9. *Volatilization of Carbon;* by C. Despretz, (Compt. Rend., 1849, 48.)—M. Despretz has commenced a series of experiments on the fusion and volatilization of various refractory substances. As one of his first results, he announces the fusion and volatilization of carbon. He used a battery of 496 elements in four parallel series. Carbon from sugar in an "œuf electrique" was subjected to its action; a high degree of incandescence was produced, and the globe was covered with a black powder, dry and crystalline. After many precautions to test the reality of the result, and various changes in the mode of experiment, Despretz satisfied himself that the effect was owing to a volatilization of the carbon. In one case, when the carbon reached a white heat, some white traces were deposited on the sides of the vase; then suddenly it was reduced to a state of vapor, with nearly the appearance which iodine presents when a fragment is cast on a heated body. The glass was lustrous with the crystalline sublimate. This result failed with less than 496 elements.

Experiment has farther shown that carbon is best fused into globules in nitrogen under a pressure above the ordinary atmospheric pressure. Glass vessels break too easily, and therefore it is necessary to use metallic.

Alumina, rutile, anatase, nigrine, oxyd of iron, kyanite and other species were fused immediately into globules and then gave off vapors. Despretz has this subject still under investigation.

[Note.—The fusion and volatilization of carbon by Prof. Silliman, was long since announced in this Journal, (see vols. v, 108, 361, vi, 341, 378, x, 109, 119, 1822–1826.) The condensation of carbon upon the inner surface of a globe has been a frequent class experiment with Prof. S., and it has been customarily mentioned in his lectures as a case of vaporization. The battery used in the Yale College Laboratory consists of 900 pairs, and is one of the largest ever constructed. The same result may be obtained by a Bunsen's battery of 60 pairs, as Prof. Silliman, Jr., has often observed. The experiments of Professors Silliman and Hare extended to the melting of various refractory substances, which had never before been fused.]

10. *On the Atomic Weight of Silica;* by H. Kopp, (Liebig's Annalen, lxvii, p. 356, in Chem. Gazette, July, 1849.)—The doubts entertained respecting the atomic weight of silicon and the composition of silica according to one of the three formulæ SiO, SiO^2 or SiO^3, have not been solved by the views which have hitherto prevailed on this subject, where in general the decision has been made to depend on the circumstance, that a particular series of compounds might be most simply represented, sometimes according to one, sometimes according to the other formula. A peculiar mode of conceiving this subject shows that, admitting the correctness of the analytical results of Pelouze, the atomic weight of silicon with H=1 is 21·3, and the formula of silicic acid SiO^3.

Kopp has deduced this result from the difference between the boiling-points of the chlorid and bromid of silicon. The possibility of deciding the question by this means is sufficiently evident from a number of determinations of the differences between the boiling-points of several chlorids and bromids, in which the chlorine, on the one hand, may be regarded as a substitute for the bromine in the otherwise corresponding bromid, thereby establishing how many degrees the boiling-point rises or falls when in any compound chlorine is replaced by bromine, or *vice versâ* bromine by chlorine. After establishing the number of degrees which express this difference for the substitution of each atom of chlorine or bromine, it is possible, on the other hand, to conclude, from the difference between the boiling-points of a chlorid and the corresponding bromid, as to the number of atoms replaced. Now it results, from the comparison of the boiling-points of several bromids and chlorids, that the substitution of 1 Cl by 1 Br raises the boiling point 32° Cent. of 2 Cl by 2 Br $2 \times 32 = 64°$ of 3 Cl by 3 Br $3 \times 32 = 96°$, while the boiling-point falls in the same proportion when, on the contrary, bromine is replaced by chlorine. Compare, for example, the boiling point of the following substances:—

		Boiling-point.
$C^4 H^5 Cl$	Chlorethyle	+11°, Pierre.
$C^4 H^3 Cl$	Chloracetyle	−18° to −15°, Regnault.
PCl^3	Chlorid of phosphorus .	78°, Dumas, Pierre.

		Boiling-point found.	Calculated.
$C^4 H^5 Br$	Bromethyle	41° Pierre.	43°.
$C^4 H^3 Br$	Bromacetyle	Ord. temp.	14° to 17°.
PBr^3	Bromid of phosphorus .	175°, Pierre.	174°.

Several other comparisons enumerated by Kopp lead to the law above announced respecting the change in the boiling-point in substitutions of bromine and chlorine. It consequently follows, as above stated, that according as the boiling-point of a bromid, on comparison with that of its corresponding chlorid, is situated at 32, 64 or 96 degrees higher than in the chlorine compound, this latter must be regarded as containing 1, 2, 3 atoms of chlorine replaced by bromine. The boiling-points of the chlorid of silicon and of the bromid of silicon have been determined by Pierre, a most accurate observer, the first to be 59°, the latter to be 153°; the difference is 94°; whence it follows that in the bromid of silicon 3 atoms of bromine are substituted for 3 atoms of chlorine in the chlorid of silicon; that the first is $SiBr^3$, the latter $SiCl^3$, and that silica is therefore SiO^3; and consequently we must admit the atomic weight of silicon to be 21·3, H being assumed =1.

II. Mineralogy and Geology.

1. *Notes on the California Gold Region;* by Rev. C. S. Lyman, (in a letter to one of the editors, dated Puebla de San Josè, March 27, 1849.)—From the western base to the summit of the range of the Sierra Nevada, is a distance generally of a hundred miles, or more. The western slope is broken and precipitous, and through the deep ravines that abound, flow the numerous mountain streams that form the tributaries of the Sacramento and San Joaquin rivers. The gold region is a longitudinal strip or tract from ten to forty miles in width lying about midway, or a little lower, between the base and summit of the range, and extending in length a distance of many hundred miles—active operations being already carried on through an extent of four or five hundred miles at least. The gold mines near San Fernando in a spur of the same range and which have been known and worked to some extent for many years, are doubtless a part of the same great deposit.

On approaching the gold region from the valley of the Sacramento or San Joaquin, soon after leaving the plain, the attention is arrested by immense quantities of quartz pebbles, slightly rounded, and of the size of walnuts, scattered over the gentle elevations which form the western base of the Snowy Mountains.* There is here but little soil—the earth is of a yellowish red color, and nearly destitute of vegetation. Nearer to the gold deposits the quartz pebbles become larger, and not unfrequently boulders are noticed of considerable size. The quartz is so uniformly associated with the gold, that even the most unscientific explorer would not think of looking for the metal where quartz did not abound. Passing up the mountains it is easy to tell when you leave the region of gold from the sudden disappearance of the quartz. In August of last year, in company with Mr. Douglass and others, I ascended from the "Dry Diggings" near the Rio de los Americanos, to within a few miles of the snow, enjoying in the highest degree the sublime scenery presented by lofty and precipitous mountains, separated from each other by dark, deep ravines, and wooded with primæval forests of towering firs and pines. The back bone of this mountain range is granite, the several varieties of which constituted almost the only rock visible in the last few miles of our journey. In descending we passed successively several forms of gneiss and other primitive and transition rocks, till we reached the slate formation which prevails in this part of the gold district. We penetrated on this occasion some forty or forty-five miles beyond the "dry diggings," and after leaving the quartz twelve or fifteen miles up, scarcely a particle of gold was discovered.

* See observations by J. D. Dana, [2], vii, 257, 261.

As I have mentioned, the prevailing rock of the gold region near the Rio de los Americanos is slate. There are many varieties of it—some shaly and friable, others hard and massive, somewhat resembling greenstone. The laminæ of the slate beds are nearly perpendicular, and their direction about N.N.W. and S.S.E., or nearly the same as the direction of the range. These slate beds often include dykes or beds of quartz rock several feet in thickness. At the dry diggings above named, I passed at right angles over the upturned edge of continuous strata of slate a distance of four or five miles; and in the same direction, slate beds occur several miles farther on, but I had not the means of knowing that they were a part of the same great deposit.

In some of the richest explorations yet made, this slate formation immediately underlies the stratum of drift or diluvium which contains the gold, and much of the gold is found in the crevices of the slate, the rough edges of the upturned strata forming innumerable receptacles or "*pockets*," as they are called, into which the metal has originally found its way, from its own gravity assisted by aqueous agency. It is this accidental association of the gold with the slate rocks which has caused the statement to be frequently made, even by persons of much general intelligence, that the gold exists in the body of the rock itself, and forms a component part of it, in the same sense that iron pyrites forms a part of the rocks in which it occurs. But I have nowhere seen gold among the slate, except in circumstances where its presence could be accounted for by its introduction from without, a close scrutiny readily discovering some cleft or opening through which it might have entered. The richest of these "pockets" are in the bottoms of sharp ravines which seem to have been notched into the body of the slate, and generally in situations where the bottom of the ravine, after descending at a considerable inclination for some distance, becomes more nearly horizontal. Just below a sudden descent or precipice, in the bottom of a dry ravine, gold is often found in the cavities in great abundance. From such a spot Mr. Douglass extracted a pound of gold in a few hours, even after the place had been previously "dug out," as was supposed, and abandoned.

I have noticed in published accounts, many erroneous statements respecting the geological position of the gold. Some have said there is no particular formation in which the gold occurs—but that in different places it is found in different kinds of earth or rock. You will not need to be informed that this is without foundation. So far as I have been able to examine, or can learn from competent witnesses, there is but *one* geological formation with which the gold of the Sierra Nevada is associated and in which it uniformly occurs. This is the stratum of *drift* or *diluvium*, composed of a heterogeneous mixture of clay, sand, gravel, and pebbles, and varying in thickness from a few inches to several feet. Here, as elsewhere, this stratum is neither horizontal nor of uniform slope, but conformed to the varying inclination of the earth's surface, covering the declivities, and even the summits of the hills, as well as the bottoms of the ravines and valleys. Out of this stratum I have no where found gold, except where a stream has cut it away and made its contents a part of some alluvial formation of comparatively modern date. The sandbars of some of the mountain torrents, and the gravelly projections formed at the bendings of the streams, are often extremely rich in metal. A bar in the Rio de los Americanos, (at high water an *island*,) about twenty-three miles above New Helvetia (now called Sacramento) and on which some of the earliest explorations were made, is of this character. But where the diluvium has remained undisturbed since the period of its deposition, I am confident no "alluvial" or "stream" gold has been, or will be discovered, except in connection with it. It is evidently as much "part and parcel" of this formation as its associated quartz, greenstone, hornblende, and other pebbles, and whoever will explain the origin of the one, will at the same time elucidate the origin of the other—for one and the same agency unquestionably spread both of them over the surface of the district. What the latest theory of geologists is to account for the dispersion of drift, I am too isolated from the scientific world to know. Quartz is the only substance with which I have seen the gold intimately united, and these compound lumps seem to show clearly that the original *matrix* or *vein-stone* of the metal was a dyke or bed of quartz rock. And we have only to suppose, that when the quartz, with its accompanying rocky strata, was broken up by natural agencies at some former geological epoch, the interspersed or included veins of gold were at the same time reduced to fragments, and these rough and angular fragments subsequently broken and further comminuted and rounded by mutual attrition, to account for the present form and appearance of the gold, and for its constituting a portion of the materials of the drift. But whether these materials with their golden treasure, now occupy the precise geographical position of their parent rocks, or whether they have been transported by aqueous or glacial agencies or both, from some neighboring or perhaps far distant locality, is a question which future investigations into the geology and physical geography of the region will better elucidate than the imperfect data at present in my possession. I cannot avoid the fancy, however, in connection with the glacio-aqueous theory, that when the continent was wholly or partially submerged, the materials of the diluvium, including the gold, were transported by icebergs from their parent locality, and when at length set free, left to assume their present position on what was then the rocky and uneven bottom of the superincumbent ocean. And we have only to imagine these freighted icebergs stranded by oceanic currents against the partially emerged range of the Sierra Nevada, to account for the great longitudinal extension of the gold region along the western slope of the mountains, while laterally it appears to extend neither above nor below certain definite limits.

The gold of different localities varies very much in size. That from the banks and sandbars of the rivers, is generally in the form of small flattened scales, and commonly it is found to be finer the lower down you descend the stream. That taken from the bottoms of the dry ravines, which every where abound in these mountains, and furnish outlets for the torrents of the rainy season into the principal streams, is mostly of larger size, and occurs both in small particles and also in small lumps and irregular water-worn masses, from the size of wheat kernels to pieces of several ounces or even pounds in weight. The fine gold of these ravines is commonly less worn and flattened than that in the alluvion of the rivers. And the flattened scale-like form of the gold in these latter deposits would seem to be owing to the great malleability of the metal—the stones and pebbles among which the minuter particles and fragments of the original vein of native metal chanced to lie, and by which they were rudely hammered, having performed very effectually the gold beater's office, and gradually reduced the rough angular particles, on their granite anvils, to the flattened spangles which we now observe. Some of these flakes are often an inch or more in diameter and scarcely thicker than paper. Many specimens bear the distinct impression of the crystalline structure of granite and other rocks; and I have seen several pieces deeply stamped, as with a die, by crystals of quartz, the form of the crystal being as distinctly apparent as the device on a gold eagle fresh from the United States mint.

The black, ferruginous sand, which every where accompanies the gold, and which, from its great specific gravity, remains with it in the bowl or machine after the other earthy materials have been removed, varies in fineness with the size of the accompanying gold. That obtained in connection with the fine river gold being of the fineness of writing sand, while that associated with the coarse gold of the ravines is often as large as wheat kernels, or peas, and sometimes of the size of hazelnuts or walnuts. These coarser pieces are fragments of crystals very hard and heavy. I found no specimens with the faces complete, and have not the means of knowing to what species they belong, but suppose them to be magnetic iron. That the fine sand is composed of fragments of the same crystals greatly comminuted, I infer from the regular gradation of the one into the other.

I am not aware that the gold has yet been discovered *in place*, or imbedded in its native matrix. The slates, however, of the gold region, as I have before observed, are often traversed by dykes or beds of quartz rock, and I have examined these in many places for indications of the presence of the metal, but could detect no traces of it. Individuals have asserted that they have found veins of it in the rocks, but they have refused to divulge the place where, inasmuch as they intended to work the veins themselves as soon as the season would permit. Though these statements are of course not impossible nor indeed improbable, I do not consider the fact as established by testimony, since the witnesses are men in whom I place but little confidence.

The amount of gold taken from these mines it is impossible to estimate, but it has been immense, and the coming season it will doubtless be greater. New and rich deposits are developing every day. Accounts from various points in the mining district, represent the gold as very abundant, more so if possible than last year—individuals even that early in the season obtaining often from three to ten or even twenty ounces a day. The diggings on the several forks of the Rio de los Americanos, the Stanislaus, the Tuwalumnes, the Merced, the Mariposa, King's river (Lake Fork on Fremont's new map), and in many other places, are represented as peculiarly rich.

There was one specimen of gold mingled with quartz, found near Stanislaus last autumn, which I had resolved to procure if possible, for the cabinet of Yale. It was irregular in form, about four inches in diameter, and weighed $5\frac{1}{4}$ pounds avoirdupois. The metal was interspersed in irregular masses through the stone, and as near as I could judge without special investigation, was equivalent to about two pounds troy, perhaps a little more. Other specimens much larger, are said to have been found, and one of 20 pounds weight pure, near the Stanislaus; but these I have not seen.

2. *Geographical Survey of Tennessee.*—The geographical survey of Tennessee, under Dr. Troost, is still in progress, and is bringing to light many valuable additions to science, besides developing the various resources of the state. Prof. Troost is well known for his learning, his skill, and his enthusiasm in his investigations, and it is greatly to the honor of Tennessee, that such a savant is appreciated and his talents called into action. In a recent communication from Dr. Troost, he mentions that the number of the new genera and species of Crinoidea which occur in the state of Tennessee is really surprising. His Geological Report now before the legislature of the state of Tennessee, contains a monograph of Crinoidea of that state, in which 16 new genera and 88 new species are described, illustrated by 220 figures; this number not only surpasses that of those discovered in the other states of the Union, but perhaps is equal to those that have been found over the whole of Europe.

The list which he communicates is as follows:—

1. Cidaris Tennesseæ, T.
2. Asterias antiqua, T.
*3. Astrios Tennesseæ, T.
4. Melonites multipora, *Norwood* and *Owen.*
*5. Campanulites tesselatus, T.
*6. Catillocrinites Tennesseæ, T.
7. Cariocrinites meconideus, T.
8. —— hexagonus, T.
9. —— granulatus, T.
10. —— insculptus, T.
11. —— globosus, T.
12. Pentremites pyriformis, *Say.*
13. —— Tennesseæ, T.
14. —— florialis, *Say.*
15. —— —— elongatus, *varietas.*
16. —— Cherokeus, T.
17. —— Reinwardti, T.
*18. Olivanites Verneuli, T.
19. —— globosus, T.
*20. Cacabocrinites sculptus, T.
*21. Codonocrinites gracilis, T.
22. Echinocrinites fenestratus, T.
23. Actinocrinites moniliformis, Miller.
24. —— Humbolti, T.
25. —— gibbosus, T.
26. —— Agassizi, T.
27. —— Urna, T.
28. —— Nashvillæ, T.
29. —— cornutus, T.
30. —— fibula, T.
31. —— Verneuli, T.
*32. Balanocrinites sculptus, T.
33. Heterocrinites simplex, *Hall.*
*34. Agaricronites tuberosus, T.
*35. Conocrinites tuberculosus, T.
36. —— Leæ, T.
37. Eucalyptocrinites splendidus, T.
38. —— ovalis, T.
39. —— extensus, T.
40. —— lævis, T.
41. —— Phillipsii, T.
42. —— Goldfussi, T.
43. —— Nashvillæ, T.
44. —— conicus, T.
45. —— Tennesseæ, T.
46. —— gibbosus, T.
47. Gilbertsocrinites Americanus, T
48. Cyathocrinites inflatus, T.
49. —— stellatus, T.
50. —— gracilis, T.
51. —— corrugatus, T.
52. —— Tennesseæ, T.
53. —— planus? *Miller.*
54. —— robustus, T.
55. —— crateriformis, T.
56. —— globosus, T.
57. —— depressus, T.
58. —— tiariformis, T.
59. —— sculptus, T.
60. —— conglobatus, T.
*61. Zeæcrinites magnoliiformis, T.
62. Poteriocrinites municipalis, T.
63. Synbathocrinites Tennesseæ, T.
64. —— granulatus, T.
*65. Cupellæcrinites Verneuli, T.
66. —— lævis, T.
67. —— striatus, T.
68. Buchii, T.
69. —— magnificus, T.
70. —— corrugatus, T.
71. —— stellatus, T.
72. —— rosæformis, T.
73. Cupellæcrinites pentagonalis, T.

74. Cupellæcrinites inflatus, T.
75. Haplocrinites hemisphericus, T.
76. —— ovalis, T.
77. —— granulatus, T.
78. —— maximius, T.
79. Platycrinites Ann Dixoni, T.
80. —— Huntsvillæ, T.
81. —— polydactylus, T.
82. —— insculptus, T.

*83. Donacicrinites simplex, T.
*84. Dæmonocrinites cornutus, T.

Astylocrinites.

*85. Crumenæcrinites ovalis, T.
*86. Agassizocrinites dactyliformis, T.
87. —— gracilis, T.
*88. Granatocrinites cidariformis, T.

Those marked with * are new genera.

We may confidently believe that the state will bring out the results of the survey in the most liberal manner, with full illustrations.

3. *On the Altered Dolomites of the Island of Bute;* by JAMES BRYCE, (Phil Mag., 1849, [3], xxxv, 81.)—Mr. Bryce describes examples of magnesian limestone beds, intersected by dykes of greenstone. The limestone is rendered saccharine in texture, having a crumbling character adjoining the dyke, but hard a short distance off. By analysis, it was found that the unaltered rock contained 20 per cent. of carbonate of magnesia, while the part altered by the dyke contained only 1 to 3 per cent. The following are analyses made under the direction of Dr. Robert D. Thomson.

	$\dddot{Si}$ and $\dddot{\mathbf{Al}}$	Fe	$\dot{Ca}\ddot{C}$	$\dot{Mg}\ddot{C}$	
1. Altered,	.... 6·91	1·68	90·65	1·00	=100·24
2. "	.... 5·70	1·28	91·08	1·17	= 99·23
3. "	hard 1·94	0·52	96·48	1·23	=100·17
4. "	.... 0·28	0·56	96·58	2·24	= 99·66
5. unaltered,	... 9·70	1·12	67·42	17·31,	$\dot{\mathbf{H}}$, $\ddot{C}$, and coaly matter 4·45=100
6. "	.... 9·08	1·12	67·00	18·06	" " 4·74=100

The material for the first two analyses was that nearest the dyke and most altered. The author enquires, "To what cause are we to assign the changes that have taken place? Has the magnesia been sublimed by heat; or has it been withdrawn by the solvent power of free carbonic acid?" "The subject is one of great interest both to the geologist and chemist, as the facts are directly opposed to the received views, and as no instance of similar changes on dolomitic rocks has, so far as I am aware, been put on record."

Associated with the trap of the island of Bute, there are beds of lignite, in some cases three feet thick, and consisting of hard, stony coal. The lignite rests upon a tufa and is overlaid by an ochreous layer and then by trap or greenstone.

4. *Plumbic Ochre from Mexico.*—We have received from Prof. BAILEY of West Point, specimens of plumbic ochre, or native litharge, from New Mexico. He writes concerning it:—"It was given to me by Maj. Geo. Thomas, of U. S. Army, who got it in New Mexico, where he said it was called 'silver flux,' and used in working silver ores. Thinking it might be only an artificial 'litharge,' I wrote to Major Henry for particulars, and he says, 'I am certain that it is obtained in many places in the province of Chihuahua and Cohahuila. Whilst stationed at Saltillo I saw some forty or fifty sacks of it which had been taken from a mine near Mazapel, a mining town, some 100 miles south of Saltillo. I saw a few pieces which had been picked up by officers in the streams between Ceralvo and Monterey, and also in the Sabinas

river in the province of Cohahuila. This leads me to suppose this ore occurs in the range of mountains running nearly north and south through Cohahuila and terminating about twenty-five miles north of the city of Monterey.'"

We have examined the specimens sent us by Prof. Bailey, and find them to be the yellow oxyd of lead. The color is between orpiment and sulphur yellow, and it glistens like a granular mica of a nearly golden color. The natural surface is slightly crystalline and shining, and when broken it has a scaly texture.

5. *On the Formation of Minerals;* by M. H. de Senarmont, (Compt. Rend. Acad. Sci., Paris, June, 1849.)—Senarmont by keeping certain solutions under pressure at a temperature somewhat elevated, has been enabled to form several carbonates. The material is placed in a glass tube afterwards hermetically sealed, and a uniform heat is sustained by putting the tube in a small chamber or oven. For high temperatures the tubes were strengthened and the pressure equalized by placing them within a gun barrel, which was half filled with water and sealed up. In this way he formed—

Carbonate of Magnesia from sulphate of magnesia and carbonate of soda; temperature about 160° C. It was in the state of white crystalline grains, hardly attacked by the acids.

Carbonate of Iron from sulphate of protoxyd of iron and carbonate of soda; temperature 150° C. and above. Also, from protochlorid of iron and carbonate of lime; temperature between 130° and 200° for twelve, twenty-four, and thirty-six hours.

Carbonate of Manganese from chlorid of manganese and carbonate of soda; temperature about 160° C. Also, from chlorid of manganese and carbonate of lime; temperature between 140° and 170° C. for twelve to forty-eight hours.

Carbonate of Zinc from a process like that for carbonate of iron.

6. *On the Decomposition of Rocks;* by M. M. Ebelmen, (Ann. des Mines, [4], xii, 627.)—The following are M. Ebelmen's results with a trap from near St. Austle, (Cornwall.) This trap consists essentially of labradorite and pyroxene.

	Trap unchanged. A.	Altered Trap. B.	Trap more altered. C.
Alumina,	100	100	100
Silica,	325	212	201
Lime,	36	5	6
Magnesia,	17	14	12
Oxyd of iron,	106	107 }	79
Oxyd of manganese,	3	2 }	
Potassa, } Soda, }	33	14	13
Water,	11	43	38
	631	497	449

Hence the trap by decomposition has lost more than a third of its silica, $\frac{5}{6}$ of the lime, and half of the alkalies; this last shows that the feldspar was the last to change and had not been wholly decomposed.

A basalt from the Rhine consisting of labradorite about 54 p. c., pyroxene 24, chrysolite 10, with titanic iron 10, and water, 2 p. c., afforded him—

	Unchanged Basalt. A.	Basalt altered. B.
Alumina,	100	100
Silica,	283	228
Lime,	63	43
Magnesia,	39	29
Oxyd of iron and manganese,	80	78
Titanic acid,	6	6
Potassa,	7·4	2·6
Soda,	22·2	7·4
Water,	15·0	35·0
	615·6	529·0

Here two-thirds of the alkalies have disappeared, showing that the decomposition of the feldspar was far advanced. The result of the changes in both cases is to produce as the residue, a hydrated silicate of alumina or a clay. The removal of the silica is shown by M. Ebelmen to be independent of the alkalies present. The decomposition is attributed by him to carbonic acid and oxygen present in waters, to organic matters living or in course of decomposition, and the phenomena of nitrification.

7. *Phosphate of Lime in Greensand and Marl*, (from De la Beche's Address to Geol. Soc., London, Proc. Geol. Soc., May, 1849, p. lxxxii.)—The agricultural importance of phosphate of lime has of late years caused more search to be made for this substance than formerly, though its occurrence as a component part of certain organic remains and of some rocks has been long known. Mr. Paine, of Farnham, having pointed out that certain beds contained phosphate of lime in sufficient abundance to render them of much agricultural value, our colleague, Mr. Austen, was induced to investigate the mode of occurrence of the phosphate of lime in his own neighborhood, that of Guildford. He found that the phosphate of lime nodules are abundant in the upper greensand. They also occur in the gault, in two distinct beds, remarkably persistent in the district. In describing the position of these beds, Mr. Austen takes occasion to point out the inaccuracy of the published geological maps and sections of the district, calling attention to the beds of very different parts of the cretaceous series which are brought up along the escarpment of the North Down range. Having ascertained the facts connected with the layers of phosphate of lime nodules in the vicinity of Guildford, Mr. Austen examined the neighborhood of Farnham, and found the component parts of the cretaceous series the same as near Guildford, with the exception that sandstones, occasionally cherty, represent near Farnham the firestone on the eastward and the malm rock on the west, differing however from them in containing scarcely any carbonate of lime. This Mr. Austen infers to have happened from a stream of water, having a course somewhat north and south, drifting rather coarse materials with little calcareous matter in this locality.

Mr. Austen regards the phosphoric acid of the nodules as of animal origin. When the nodules are rubbed down they present a concentric arrangement of parts, resembling bodies formed, like agates, by infiltration into cavities; and our colleague points out that, where the casts of bivalve shells and ammonites are filled with matter containing phosphate of lime, these forms must have been first inclosed in the sand, that then the proper shelly matter was removed, and finally that the earthy phosphate occupied the place of the hollow. He supposes that the phosphoric acid may have formed part of the coprolitic matter of the time, this matter in part preserved with its original external form, while more frequently it was broken up and the component portions diffused amid the sand and ooze. He also draws attention to the conditions to which the beds containing these substances have been exposed since their formation, having been covered by thick deposits and having descended to depths beneath the level of the sea, where they were exposed to an elevated temperature corresponding with the depth and the amount of bad heat-conducting bodies above them, so that many chemical changes were effected, and among them a more general diffusion of phosphoric acid in the mass.

Mr. Nesbit has also communicated to us some remarks on the presence of phosphoric acid in the subordinate members of the cretaceous series. He states that he mentioned to Mr. Paine, in November, 1847, the existence of a large amount of phosphoric acid in a fertile Farnham marl, and that he subsequently obtained 28 per cent. of phosphoric acid from portions of this marl, the general mass containing about 2 per cent. Nodules from the Maidstone gault also gave him 28 per cent. of phosphoric acid. Other localities are noticed, and as much as 69 per cent. of phosphoric acid is mentioned as contained in a dark red sandstone rock occurring in masses in the upper portion of the lower greensand at Hind Hill.

Mr. Wiggins has sent us a notice of the fossil bones and coprolitic substances discovered in the crag of Suffolk, remarking on the value of the latter for agricultural purposes, 200 tons of them having been obtained from about a rood of ground,—an additional instance of the remains of animals and their fæces entombed in rocks of different geological ages becoming available for the growth of existing plants.

As regards phosphate of lime and its dissemination, which modern researches have shown is much greater, when sufficient quantities of rocks are examined, than appeared from the analyses of the small portions usually employed,—a matter of interest when we consider the phosphate of lime required for certain plants,—we should recollect that when free carbonic acid is present in water, the phosphate, like carbonate of lime, though not to the same amount, is very soluble. Hence, especially when, as noticed by Mr. Austin, phosphate of lime is disseminated in the state of fresh coprolites amid detrital matter, and water containing free carbonic acid is present and can have access to it, the phosphate of lime would be in a condition to be removed and disseminated. Mr. Austen has alluded to the mixture of such bodies with vegetable matter, to the decomposition of which, with animal matter also, we might look for some, at least, of the carbonic acid that would aid the solution of the phosphate of lime. As in the case of the carbonate of lime previously noticed, when the solution of this phosphate met with the silicates of potash or soda, whilst percolating amid the rocks, the silicates would be decomposed by the carbonic acid, and the phosphate of lime thrown down. We should expect,—in the same manner as carbonate of lime often replaces the original matter of a shell which has been decomposed and removed from the body of a rock, leaving those cavities commonly termed casts,—that phosphate of lime, in localities where from accidental circumstances it was somewhat abundantly filtering through rocks, would also enter these and other cavities, filling them under the needful conditions of deposit. In like manner as we find carbonate of lime separating itself from mud and silt in which it was disseminated, forming the nodules so common in calcareo-argillaceous deposits, should we also expect disseminated phosphate of lime to do the same under fitting conditions; so that it would not necessarily follow, however true in numerous cases, that nodules containing much phosphate of lime were coprolitic. We can readily imagine circumstances very favorable for the solution and spread of these phosphates amid layers of mud and silt. We find such phosphates surrounding some fossils, such as crustaceans from the London clay, leading us to infer a connexion between the animal matter and this substance.

8. *Arkose*, (Bib. Univ., March, 1848.)—The arkose of the Vosges, according to Delesse, is a metamorphic quartzite, consisting essentially of hyaline quartz and crystals of orthose (feldspar.)

III. Zoology.

1. *Conspectus Crustaceorum, &c.*, Conspectus of the Crustacea of the Exploring Expedition; by J. D. Dana,—continued.

CRUSTACEA ISOPODA.

Appendices abdominales, duobus posticis exceptis, plerumque branchiiformes, stylis caudalibus duobus aut nullis. Pedes thoracis 6 antici ad eandem seriem pertinent, 8 postici ad seriem alteram,* exceptionibus raris (in *Isopodis brachiatis.*)

I. ISOPODA BRACHIATA.

Pedes seriei posticæ sex.†—Species Amphipodis affines (præcipuè Dulichiis); habitum Caprelloideæ; sæpius algas, corallinas, etc. a pedibus sex posticis affixæ cum corpore arrecto.

Familia 1. Arcturidæ. (Idotæoideæ.)

Pedes sex postici inter sese unguiculati similes.—Abdomen pauci-articulatum, laminis operculiformibus infra opertum (sicut Idotæis), stylis caudalibus carens.

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* Amphipodis (etiam Isopodis rarissimis) series antica *octo* pedes, et *sex* postica; quoque, styli caudales *sex*, et alii appendices abdominales *natatorii*. Hæc discrimina optima et non negligenda.

† Hâc charactere species illæ aliis Isopodis remotæ et Amphipoda osculant.

Genus 1. LEACHIA,* *Johnston.*—Pedes 8 antici ciliati, non unguiculati. Antennæ superiores perbreves, 4 articulatæ; inferiores longæ, pediformes, ungue 1–3 articulato confectæ. Segmentum thoracis quartum prælongum.

LEACHIA NODOSA.—Corpus tuberculosum. Segmentum thoracis quartum valde elongatum anticè latius et utrinque cuspidatum. Abdomen 2-articulatum, segmento primo transverso, secundo oblongo, prope apicem latiore, posticè rotundato, prope basin utrinque emarginato. Antennæ superiores tenues, articulis duobus inferiorum primis parce longiores; inferiores pediformes, 6-articulatæ, fere corporis longitudine, articulo quinto breviore quam quartus, sexto (ultimo) brevi, unguiformi, fere recto, infra parce setuloso.—Long. 6‴.

Hab. prope insulas Mangsee in freto Balabac.

Familia 2. TANAIDÆ.

Pedes 2 antici, manu validâ instructi, reliqui unguiculati, mediocres, sex posticis inter sese similibus. Abdomen 5–6-articulatum, appendicibus decem subnatatoriis, stylis caudalibus articulatis.

Genus 1. TANAIS, *Edwards.*—Corpus lineare. Caput perbreve. Segmentum thoracis primum oblongum. Antennæ quatuor, breviusculæ, superiores flagello non confectæ. Abdomen 5–6-articulatum. Pedes antici breves, crassè cheliformes.

1. TANAIS BRASILIENSIS.—Pedes antici crassi, manu ad basin paulo angustiore, pollice non crassiore quam digitus. Antennæ primæ paulo majores, corpore quadruplo breviores, 5-articulatæ; secundæ 6-articulatæ, articulis duobus basalibus paulo crassioribus. Abdomen 6-articulatum, posticè rotundatum et medio apiculatum, segmentis subæquis, ultimo non majore, ad apicem apiculato. Styli caudales 6-articulati. Segmentum thoracis septimum sexto brevius.

Hab. in portu Rio de Janeiro.

2. TANAIS ELONGATUS.—Gracilior. Pedes antici crassi, manu ad basin non angustiore, pollice crassiore quam digitus intus angulato et setam gerente. Antennæ primæ 4-articulatæ; secundæ 4-articulatæ, paulo breviores. Abdomen pubescens, 6-articulatum, posticè rotundatum, segmento ultimo majore, semicirculari. Styli caudales biramei ramo longiore 2-articulato, altero 1-articulato. Segmenta thoracis quatuor postica subæqua, fere quadrata.

Hab. in mari Sulu.

Genus 2. LEPTOCHELIA, *Dana.*—*Tanai* similis. Pedes antici longissimi, tenuissimi, manu valde elongatâ. Antennæ superiores longæ, flagello confectæ. Abdomen 6-articulatum, stylis caudalibus articulatis.

LEPTOCHELIA MINUTA.—Corpus lineare. Pedes antici corpore valde longiores, manu fere corporis longitudine, digito polliceque tenuissimis, incurvatis, nudis, pollice prope apicem intus dentigero. Antennæ superiores corpore paulo longiores, basi elongato, 4-articulato, articulo secundo longiore, flagello 6–7-articulato, vix longiore quam articulus basalis secundus.

Hab. prope insulas "Viti" in mari Pacifico.

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* *Arcturo*, antennis inferioribus flagello non confectis et segmento thoracis quarto prælongo, differt.

II. ISOPODA AMBULATORIA.*

Pedes seriei posticæ octo in his et totis Isopodis normalibus. Membra buccalia nullo modo suctoria. Abdominis appendices sexti sive operculiformes sive styliformes, nunquam ad natandum apti.

Familia 1. IDOTÆIDÆ.

Abdomen pauci-articulatum, articulo ultimo maximo, laminis duobus operculiformibus infra opertum, stylis caudalibus carens. Mandibulæ non palpigeræ.

Subfamilia 1. IDOTÆINÆ.

Pedes toti subsimiles, plerumque ambulatorii.

Genus IDOTÆA, *Fabricius.*—Segmenta thoracis subæqua. Antennæ externæ (vel inferiores) valde longiores, non geniculatæ, flagello multiarticulato confectæ. Abdominis opercula simplicissima, prope apicem articulati. Pedes quarti tertiique non valde inæqui.

1. IDOTÆA ARGENTEA.—Angusto-subelliptica anticè truncata vel obsoletè excavata, superficie æqua et lævis. Epimeræ latiusculæ. Abdomen 3-articulatum, segmentis duobus transversis, tertio oblongo, ad apicem paulo angustiore et truncato-rotundato, prope basin utrinque suturâ notato. Antennæ internæ dimidio basis externarum vix longiores. Antennæ externæ fere dimidii corporis longitudine, flagello 7-articulato, breviore quam basis, articulis 2 ultimis minutis.—Long. 5‴. Argentea et ad latera cærulescens.

Hab. in mare Pacifico, lat. aust. 77°, long. occid. 109°, super Porpitam.

2. IDOTÆA ANNULATA.—Angusto-subelliptica, fronte truncata, obsoletè arcuata, superficie annulatâ segmentis prominulis. Epimeræ latiusculæ. Abdomen 3-articulatum, segmentis duobus transversis, tertio oblongo, lateribus fere parallelis, ad apicem truncato cum angulis rotundatis, prope basin suturâ utrinque notato. Antennæ internæ dimidio basis externarum non longiores. Antennæ externæ fermè dimidii corporis longitudine, flagello breviore quam basis, 7-articulato, articulis 2 ultimis non breviores.—Long. 9‴. Brunnescens.

Hab. in mare Antarctica.

3. IDOTÆA BREVICAUDA.—Angustè ovato-elliptica, anticè posticèque truncata et medio minutè apiculata. Caput transversum, posticè segmento proximo amplexum. Abdomen 3-articulatum, segmentis duobus breviter transversis, tertio oblongo, posticè paulo angustiore, angulis rotundatis, prope basin suturâ notato. Antennæ internæ dimidio basis externarum non longiores. Antennæ externæ dimidium corporis longitudine vix superantes, articulo secundo brevi et ad apicem externum producto, flagello 9–10-articulato, paulo longiore quam basis.—Long. 6‴—9‴. Brunnescens.

Hab. in portu "Rio de Janeiro."

Genus EPELYS, *Dana.*—Antennæ breves subæquæ, externæ non geniculatæ, flagello non confectæ. Pedes subæqui, quarti tertiique non valde inæqui. Oculi minuti, remoti.

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* "Isopodes Marcheurs," Edwardsii, *Arcturo, Leachiâ, Tanai* et affinibus exclusis.

Epelys annulatus.—Angusto-subelliptica. Caput transversum, mediâ fronte apiculatâ, angulis rotundatis. Segmenta thoracis transversa, subæqua, prominentia. Abdomen 2-articulatum; segmento primo brevissimo, fere obsoleto, valde angustiore quam secundum; secundo scutellato, posticè triangulato, obtuso, lateribus mediis fere parallelis. Antennæ breves, latitudine capitis non longiores; internæ parce breviores, 4-articulatæ; externæ 5-articulatæ.—Long. $2\frac{1}{2}'''$.

Hab. ad oras prope Valparaiso, super corpus speciei Asterias.

Genus CLEANTIS, *Dana.*—Antennæ externæ valde longiores, non geniculatæ, 5–6-articulatæ, flagello non confectæ. Pedes quarti paris tertiis valde breviores, et parium quartuor ultimorum sensim longitudine increscentes. Abdominis opercula prope apicem articulata et ad articulationem laminam parvulam internam gerentia.

Cleantis linearis.—Angusto-linearis, fronte truncata et parce excavata. Caput paulo transversum, posticè profundè arcuatum, segmento proximo amplexum. Oculi mediocres, reniformes, remoti. Segmenta thoracis paulo transversa. Abdomen 3-articulatum, segmentis duobus transversis, tertio lineari, angulis posticis truncatis, apice truncato aut obsoletè excavato, prope basin suturâ notato. Antennæ internæ parvulæ, dimidio externarum valde breviores; externæ crassiusculæ, articulo ultimo ovato, pubescente. Pedes tertii primis duplo longiores.

Hab. ad oras prope Rio Negro Patagoniæ.

Genus ERICHSONIA, *Dana.*—Antennæ externæ valde longiores, geniculatæ, 6-articulatæ, flagello nullo. Pedes subæqui, similes.

Erichsonia angulata.—Elongato-elliptica. Caput et segmenta thoracis ad margines angulata, transversa. Frons excavata, duobis tuberculis supra armata. Segmenta thoracis quatuor antica tuberculum medianum gerentia. Oculi laterales. Abdomen uni-articulatum, oblongum, subscutellatum, margines sinuosum, posticè paulo latius, deinde triangulatum, obtusum. Antennæ internæ fere quadruplo breviores, 4-articulatæ; externæ clavatæ, dimidio corporis longiores, 5–6-articulatæ, articulis tribus ultimis subæquis, penultimo breviore, ultimo obtuso clavato breviter hirsuto. Pedis articulus basalis crassus et tuberculatus.

Hab. in portu Rio de Janeiro.

Subfamilia 2. Chætilinæ.

Pedes sexti longissimi, setiformes et multiarticulati, non unguiculati; septimi fere similes.

Genus CHÆTILIA, *Dana.*—Antennæ primæ super secundas insitæ; superiores longiores; inferiores flagello multiarticulato confectæ. Pedes septimi sextis valde breviores, non unguiculati, parce multiarticulati. Abdominis opercula prope apicem articulata et ad articulationem lamellam parvulam internam gerentia.

Chætilia ovata.—Ovata, posticè acuminata. Thorax 7-articulatus, segmento septimo parvulo et partim celato, sexto utrinque acuto. Abdomen 4-articulatum, tribus segmentis transversis, quarto angusto-triangulato, ad apicem subacuto et ciliato. Antennæ lateraliter reflexæ; superiores fere dimidii corporis longitudine, 5-articulatæ, articulis duobus perbrevibus et crassis, tribus reliquis tenuibus, longis, ultimo extus subtiliter setuloso. Antennæ inferiores valde breviores, flagello fermè 10-articulato, articulis basis duobus ultimis anticè setulosis, posticè pubescentibus. Pedes sexti corpore fere duplo longiores, minutè multiarticulati. Pedes septimi perbreves.—Long. 9‴.

Hab. in mari prope Rio Negro Patagoniæ.

New Haven, October, 1849.

2. *Gammaracea.*—The following recent genus is not included in the Synopsis of Gammaracea given in this volume, p. 135.

"Ephippphora, *White*, (Phil. Mag., [3], i, 226, 1848.)—Head rather large; antennæ distant from each other, the upper pair with the basal joints very thick and corneous, inserted in a deep notch in front of head; two setæ at the end of each, the outer the thicker. Lower pair of antennæ with the basal joint somewhat elongated and furnished with hairs.

"Body much compressed, the lateral appendages on the first eight joints very large, and nearly concealing the legs; the appendage of the fourth joint much dilated behind at the end; eighth to eleventh joints slightly keeled on the back; appendages of the three last joints of the abdomen longish, with short spines on the edge behind.

"A genus allied to *Orchestia* and *Talitrus.*

"Sp. Ephipphora Kröyeri." * * * *

The description is hardly full enough to decide whether the genus is related most closely to the Orchestidæ or Gammaridæ. The large size of the basal joint of the upper antennæ, together with the large epimerals appear to show that it belongs with the Callianassinæ; and it may be identical with one of the genera in which the superior antennæ are appendiculate. J. D. Dana.

IV. Astronomy.

1. *Elements of the planet Hygeia,* (Comptes Rendus, July 2, 1849.)—M. Gasparis, of Naples, who discovered this planet April 12, 1849, has furnished the following elements of its orbit, derived from the observations of April 29, May 7 and 16, 1849.

Epoch, May 1, 1849.	
Mean Anomaly, . . .	326° 34′ 22″·44
Longitude of perihelion, . .	242 47 3 ·44
" " node, . . .	285 32 29 ·72
Inclination, . . .	3 46 51 ·27
Log. a, ...	0·5192506
Log. e, ...	9·2478343
Mean daily motion, . . .	590″·3784

2. *Second Comet of* 1849, (Comptes Rendus, May 14, 1849.)—The telescopic comet discovered April 11, 1849, by Geo. P. Bond of the Cambridge (Mass.) Observatory, (vii, 449) was detected the same night by M. Schweizer of Moscow. From the observations of April 14, 20 and 24, M. Sonntag has computed the following parabolic elements:

Perihelion passage, 1849, June .	8·20514 Berl. m. t.
Longitude of perihelion, . . .	267° 7′ 6″
" " asc. node, . .	30 32 36
Inclination, ...	66 54 5
Perihelion distance, . . .	0·89391
Motion, ...	Direct.

These elements agree quite well with those of the second comet of 1748.

3. *Goujon's Comet*, (Comptes Rendus, May 14, 1849.)—A telescopic comet was discovered in the constellation Crater, by M. Goujon of Paris, April 15, 1849, who has published the following parabolic elements of its orbit:

Perihelion passage, 1849, May .	26·65161. Paris m. t.
Longitude of perihelion, .	235° 54′ 46″
" " asc. node, . .	202 33 28
Inclination, . . .	67 0 18
Perihelion distance, . . .	1·15816
Motion, ...	Direct.

4. *Shooting Stars of April* 20, 1849.—Messrs. George C. Murray, Edmond R. Smith and myself, made arrangements for watching the heavens, Thursday night, April 19, 1849, hoping that some recurrence of the meteoric shower of the morning of April 20, 1803, might be observed.

At midnight the sky was nearly overcast. After about three quarters of an hour we again went into the open air and found the sky almost clear. We did not begin our count until 1 A. M. (20th), although we saw a few meteors before this time.

Within the hour ending at 2 A. M., we observed *fifty-four* different shooting stars, as follows; viz., in N.W. 23; in S. 21; in N.E. 10. There was nothing remarkable in these as to brilliancy, nor was there any decided point of radiation. As usual there was a general motion towards the west. Some left trains, but on the whole the meteors were very much like those of common times. No aurora borealis was visible during the hour.

At 2 A. M. we left the field, having come to the conclusion that the number of meteors was not greatly beyond the average.

On the subsequent morning (21st), Mr. Smith watched from his window, for one hour ending at 2 A. M., and saw only four meteors.

E. C. H.

5. *Shooting Stars of August* 10, 1849.—At New Haven, the heavens were almost wholly overcast during the nights of the 9th, 10th and 11th of August, 1849, so that we were unable to observe the meteors expected at this period. The following testimony shows however quite satisfactorily that the meteors of August 10th, appeared the present year in their usual numbers. E. C. H.

(1.) *Canonsburg, Penn.*, (letter to the editors of this Journal, from Prof. S. R. Williams.)—On the evening of the 10th inst., I procured the aid of three competent assistants and made careful observations for meteors. The sky was cloudless, and until the moon arose (about 11 P. M.) a more suitable evening for our purpose could not be desired. Having obtained a favorable position, one observer faced the N.W., another N.E., a third the S.E., and the fourth the S.W., each counting only such meteors as appeared to originate in his quarter of the heavens. From 10 P. M. to 12½ A. M. of the 11th, we observed in all, *two hundred and sixty* meteors. They appeared with great regularity, about an equal number in each quarter of the heavens, and in each successive half-hour. About $\frac{9}{10}$ of all observed, moved towards the southwest, the remaining $\frac{1}{10}$ traversed the heavens in all directions.

There was no "central point" of emanation, though a majority perhaps, of the whole, appeared to originate in the directions of "Cassiopœia" and "Ursa Minor."

None were seen of startling brilliancy, though many were exceedingly beautiful. We should have continued our observations until day-dawn, had not the light of the moon interfered. On the night of the 11th also, the meteors were more than usually abundant, but by no means so numerous as on the evening preceding.

(2.) *Mineral Point*, *Wisc.*—A notice in the Tribune, signed "Sperry," and dated Mineral Point, August 9, 1849, states that *seventy-eight* shooting stars were seen there in "over an hour," probably before midnight, seventy-three of which appeared to start from a point near the *Swan*, a little S.E. of the zenith, and passed off in a southwesterly direction. The number of observers is not mentioned.

V. Miscellaneous Intelligence.

1. *On the Magnetic Relations of the Positive and Negative Optic Axes of Crystals;* by Professor Plücker *of Bonn*, *in a letter to* Dr. Faraday, (Phil. Mag., [3], xxxiv, 450.)—Allow me, sir, to communicate to you several new facts which, I hope, will spread some light over the action of the magnet upon the optic and magnecrystallic axes.

I. The first and general law I deduced from my last experiments is the following:—"There will be *either repulsion or attraction* of the optic axes by the poles of a magnet, according to the crystalline structure of the crystal. If the crystal is a *negative* one, there will be *repulsion;* if it is a *positive* one, there will be *attraction.*"

The crystals most fitted to give the evidence of this law are *diopside* (a positive crystal), *cyanite*, *topaz* (both negative), and other ones, crystallizing in a similar way. In these crystals the line (A) bisecting the acute angles made by the two optic axes, is neither perpendicular nor parallel to the axis (B) of the prism. Such a crystal, suspended horizontally like a prism of tourmaline, staurotide, or "red ferridcyanid of potassium," in my former experiments, will point neither axially nor equatorially, but will take always a fixed intermediate direction. This direction will continually change if the prism be turned round its own axis B. It may be proved by a simple geometrical construction, which shows that during one revolution of the prism round its axis (B), this axis, without passing out of two fixed limits C and D, will go through all intermediate positions. The directions C and D, where the crystal returns, make, *either* with the line joining the two poles, *or* with the line perpendicular to it, on both sides of these lines, angles equal to the angle included by A and B; the first being the case if the crystal is a *positive* one, the last if a *negative one.* Thence it follows, that if the crystal by any kind of horizontal suspension should point to the poles of a magnet, it is a *positive* one; if it should point equatorially, it is a *negative* one. This last reasoning conducted me at first to the law mentioned above.

The magnecrystallic axis, I think is optically speaking the line bisecting the (acute) angles made by the two optic axes; or in the case of one single axis, this axis itself. The crystals of bismuth and arsenic are positive crystals; antimony, according to my experiments, is a negative one: all are uniaxal.

II. Cyanite is by far the most interesting crystal I have examined. If suspended horizontally, it points very well to the north, *by the magnetic power of the earth only.* It is a true compass-needle, and more than that, you may obtain its declination. If, for instance, you suspend it in such a way that the line A bisecting the two optic axes of the crystal be in the vertical plane passing through the axis B of the prism, the crystal will point exactly as a compass-needle does. By turning the crystal round the line B you may make it point exactly to the north of the earth, &c. The crystal does not point according to the magnetism of its substance, *but only in obedience to the magnetic action upon its optical axes.* This is in full accordance with the different law of diminution by distance of the pure magnetic and opto-magnetic action. If you approach to the north end of the suspended crystal the south pole of a permanent magnetic bar, strong enough to overpower the magnetism of the earth, the axis B of the prism will make with the axis of the bar (this bar having any direction whatever in the horizontal plane) an angle exactly *the same* it made before with the meridian plane, the crystal being directed either more towards the east or more towards the west.

The crystal showed, resembling in that also a magnetic needle, strong polarity; the same end being always directed to the north. I think this may be a *polarity of the opto-magnetic power.* Two questions too may easily be answered.—1st. Is the north pole indicated by the forms of crystallization? 2nd. Did the crystal obtain, when formed, its polarity by the magnetism of the earth? Between the poles of the strong electro-magnet the permanent polarity disappeared as long as the magnetism was excited.

I am obliged, by the new facts mentioned above, to take up my former memoir; I must reproduce it under quite a new shape. I will examine again the rock-crystal, which, being acted upon weakly by a magnet, induced me to deny in that memoir, what I ascertain now and what I thought most probable, as soon as I received the first notice of your recent researches. [That you will find in the memoir given to M. Poggendorff two or three months ago.] Perhaps the exceptional molecular condition of rock-crystal, as indicated by the passage of light through it, will produce a peculiar magnetic action.

I should be very much obliged to you, if you would give notice of the contents of my present letter to M. De la Rive, when he calls on you, as he intended to do. I showed him several of my experiments when he passed through Bonn the 12th of May. The following day I obtained the different results mentioned above.

Bonn, 20th of May, 1849.

2. *Some facts relative to the Spheroidal State of Bodies, Fire-Ordeal, Incombustible Man, &c.;* by P. H. Boutigny (d'Evreux), (Comptes Rendus, May, 1849; Phil. Mag., [3], xxxv, 60.)—In the year 241, Sapor or Chapour ordered the Magi to do all in their power to persuade them and bring them back to the faith of their ancestors. It was then that one of the pontiffs of the dominant religion, Adurabâd-Mabrasphand, offered to submit to the fiery ordeal. . . . "He proposed that eighteen

pounds of melted copper, issuing from the furnace, all hot, should be poured on his naked body, on condition that if he was not injured by it, the unbelievers should yield to so great a miracle. The trial was said to be attended with such success, that they were all converted." The historian adds, with an air of doubt, certainly allowable in such a matter, "We see that the religion of Zoroaster had also its miracles and its legends."*

Now this fiery ordeal, undergone with such success by Adurabâd-Mabrasphand, is in plain truth an experiment of primitive facility and simplicity, and which is anything but miraculous.

I stop here an instant, for I fancy that I see the smile of incredulity rise on the lips of some who do me the honor of listening to me;—that smile, so discouraging to one who is insincere, but which only heightens the ardor of him who intends to practice no deception, and who does all in his power not to deceive himself.

To such persons then I would offer this encouragement; the little that I have still to relate appears improbable, but it is true, and that is enough. Having said this, I continue.

In France, in England, in Italy, wherever I have had occasion to speak of bodies in the spheroidal state, I have met with persons who have put to me this question: May there not be some connection between these phenomena and that presented by men who run barefooted over liquid metal (?) still incandescent, or who plunge their hand into molten lead, &c.?† To all I have answered, Yes, I believe that there is an intimate relation between all these facts and the spheroidal state. And then, in my turn, I put this question: Have you witnessed the fact which you tell me? And the answer has invariably been in the negative.

I avow that all these *on-dits* and the marvelous legends which I had read in various works‡ on the fiery ordeal and incombustible men, admitted without reserve by some, obstinately denied by others, excited my curiosity greatly, and gave me a strong desire to verify all these phenomena, and to recall them to the recollection of contemporary observers; for, alas! all this is as old as the world; *nil sub sole novum.*

I wrote first to my friend Dr. Roché, who passes his life in the midst of the blast furnaces of the Eure, and who is the physician of a portion of the Cyclopean population who feed them. I requested of him precise particulars. All that he could ascertain was, that a man named La Forge, of from thirty-five to thirty-six years of age, very corpulent, walked step by step barefooted on the pigs after the casting: but he had not seen this. This was not enough to dispel my doubts.

I then applied to a foundry at Paris, where I was laughed at and shown the door. I retired, hanging down my ears, thinking over the difficulties of verifying a single fact, and such a simple one.

Subsequently I was fortunate enough to meet with M. Alph. Michel, who lives in the midst of the forges of Franche-Comté. M. Michel

* Dictionaire historique, critique et bibliographique, t. xxvii, p. 417.

† I have alluded to these facts in the work entitled, *Nouvelle branche de Physique,* or *Etudes sur les Corps à l'Etat sphéroïdal,* p. 36.

‡ *Des Erreurs et des Préjugés répandus dans les diverses classes de la Société,* t. xii, p. 183.

promised me, with the greatest kindness, to inquire into these facts, and to report upon them if desired.

The following is an extract from the letter which he did me the honor to write to me, dated the 26th of last March :—

"On my return home, I did not fail to obtain information from the workmen of the facts of the case (the immersion of the finger in the incandescent melted metal), and most of them laughed in my face, which did not deter me. Lastly, being one day at the *forge of Magny*, near Lure, I put the question again to a workman, who answered that nothing was more simple; and, to prove it, at the moment when the metal in a state of fusion issued from a Wilkinson, he passed his finger into the incandescent jet. A person employed in the establishment repeated the experiment with impunity: and I myself, emboldened by what I saw, did the same. . . . I may observe, that, in making this trial, none of us moistened his finger.

"I hasten, sir, to acquaint you with this fact, which seems to support your ideas on the globular state of liquids; for the fingers being naturally more or less humid, it is, I think, to this moisture passing to the spheroidal state, that we must ascribe their momentary incombustibility."

The following are the experiments which I have made :—

I divided or cut with my hand a jet of melted metal of five to six centimetres, which escaped by the tap, then I immediately plunged the other hand in a pot filled with incandescent metal, which was truly frightful to look at. I involuntarily shuddered. But both hands came out of the ordeal victorious. And now, if any thing astonishes me, it is that such experiments are not quite common.

I shall of course be asked, what precautions are necessary to preserve oneself from the disorganizing action of the incandescent matter? I answer, None ;—only to have no fear, to make the experiment with confidence, to pass the hand rapidly, but not too rapidly, in the metal in full fusion.

Otherwise, if the experiment were performed with fear, or with too great rapidity, the repulsive force which exists in incandescent bodies might be overcome, and thus the contact with the skin be effected, which would undoubtedly remain in a state easy to understand.

To form a conception of the danger there would be in passing the hand too rapidly into the metal in fusion, it will suffice to recollect that the resistance is proportionate to the square of the velocity, and, in so compact a fluid as liquid iron, this resistance increases certainly in a higher ratio.

The experiment succeeds especially when the skin is humid; and the involuntary dread which one feels at facing these masses of fire, almost always puts the body into that state of moisture so necessary to success; but by taking some precautions, one becomes veritably invulnerable. The following is what has succeeded best with me: I rub my hands with soap, so as to give them a polished surface; then, at the moment of making the experiment, I dip my hand into a cold solution of sal-ammoniac saturated with sulphurous acid, or simply into water containing some sal-ammoniac, and, in default of that, into fresh water.

Regnault, who has occupied himself with this subject, says, "Those who make a trade of fire handling, and holding it in the mouth, sometimes employ an equal mixture of spirit of sulphur, of sal-ammoniac, of essence of rosemary, and onion-juice." All volatile substances, we see, which, in evaporating, render a certain portion of heat latent.

Let us now seek the rational explanation of these facts.

We have the formula $m\,c\,t$, which gives the quantity of heat contained in any body.

Let m be the mass expressed in kilogrammes,
c the specific heat of the body,
t its temperature.

But here the factor m must be abstracted, because there is no contact between the hand and the metal in fusion, and the experiment presents no difference, being made either with 10 kilogrammes of metal, or with 1000 kilogrammes. The sensation which is felt is the same in either case, and this is readily conceived, knowing the repulsive force of incandescent surfaces which is opposed to the contact of any body.

The finger or the hand is then isolated in the midst of the mass in fusion, and thus preserved from the disorganizing action of the incandescent matter. I repeat, that the mass must be abstracted.

There remain the two factors c, t. I will suppose, and it is a sufficient approximation, that the value of $c = 0{\cdot}15$, and that of $t = 1500$ degrees, the temperature of the metal in fusion; now the product of 1500 degrees $\times 0{\cdot}15 = 225$. Thus the epidermis of the experimenter would only be exposed to 225 degrees of heat. Undoubtedly this is a respectable quantity of caloric, but it is too high, as we shall see.

There is no contact between the hand and the metal; this, in my estimation, is a fact positively established. If there is no contact, the heating can only take place by radiation, and it is enormous, it must be acknowledged; but if the radiation is annulled by reflexion, and it is so, it is as if it did not exist, and, definitively, the operator is, so to say, placed in normal conditions.

I think that I have established, a long time ago, the fact that water in the spheroidal state has the property of reflecting radiating heat,* and that its temperature never attains that of its ebullition; whence it follows that the finger or the hand being humid, cannot rise to the temperature of 100° Centig., the experiment not continuing long enough to permit the humidity to evaporate entirely.

To recapitulate what I have stated on this point, I say,—in passing the hand into any metal in fusion, it becomes isolated; the humidity which covers it passes into the spheroidal state, reflects the radiating caloric, and does not become heated enough to boil. This is all.

I was right then in saying at the outset, this experiment, dangerous in appearance, is almost insignificant in reality.

I have often repeated it with lead, with bronze, &c., and always with the same success.†

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* Nouvelle branche de Physique, or Etudes sur les Corps à l'Etat sphéroïdal, pp. 24 *et seq.* and 132 *et seq.* See also our two letters to the Académie des Sciences, dated the 14th and 21st of July, 1845. In the places indicated will be found the explanation of this phenomenon.

† The experiments on the cast iron were made in the foundry of M. Davidson, at La Villette; and, on the bronze, in that of M. Nérat, Rue Pierre-Levée. I am happy to have an opportunity of publicly thanking these gentlemen for their kind assistance.

3. *Practical application of the Law pointed out by Dr. R. D. Thomson, of the proper Balance of the Food in Nutrition;* by Dr. C. Remigius Fresenius, Professor of Chemistry at the Agricultural Institute of Weisbaden,* (Phil. Mag., [3], xxxv, 127, 1849.)—In reference to the question concerning the relation which must subsist between the nitrogenous and non-nitrogenous nutritive substances in the food of men and animals, it is but due to Dr. R. D. Thomson to acknowledge, that he considers this the most important circumstance in nutrition, and was the first to call attention to it.

This relation is obviously different in various classes of animals, and besides it must be different even in the same class of animals, according to their mode of life and to the amount of exercise they undergo.

An animal which is hard worked will require a different proportion from one which stands at rest in a stable; still more different must be the proportion when our object is to fatten the animal. I consider it to be one of the most important tasks of dietary and the feeding of cattle, to fix the requisite proportions suited to the various modes of life, for it may be understood that these limits cannot be overstepped on either side without injury.

Let us suppose, for instance, an animal requires under certain circumstances the proportion of one nitrogenous (nutritive) to five non-nitrogenous (calorifiant) constituents in its food; but if we give it food in which the proportion of one to ten prevails, there will be, in the process of nutrition, for every one part nitrogenous only five parts non-nitrogenous assimilated; the other half of the non-nitrogenous (calorifiant) aliment will be wasted.†

But it is not the pecuniary loss alone which arises through this, that deserves consideration; for it is clear that the animal will be burdened with the process of getting rid of the unassimilated half; for this object strength is required, which might otherwise have been spared.

If we give it food containing too large a proportion of nitrogenous aliment, in favorable circumstances it will consume the dearer instead of the cheaper non-nitrogenous aliment; but in unfavorable circumstances it will become diseased, by being compelled to act in opposition to nature.

Taking it for granted that the requisite proportions for different circumstances were ascertained, the choice of aliment could be regulated on the most rational basis.

[We speak here primarily only of the absolute strength of nourishment, without noticing the greater or less degree of digestibility possessed by equally nutritious substances, and the proportion of unassimilable constituents which they contain.]

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* Translated from the *Lehrbuch der Chemie für Landwirthe, Forstmänner und Cameralisten von* Dr. C. Remigius Fresenius (1847), page 480, by William Augustus Perston.

† The original passage is "So wird es beim Ernährungsprocesse auf je 1 Thl stickstoffhaltige eben doch nur 5 Thle stickstoffreie Besthandtheile verwenden, die andere Hälfte der stickstoffhaltigen Nahrungsmittel wird vergeudet." The true reading it is apprehended ought to be *stickstoffreie Nahrungsmittel,* and it has been thus rendered in the English version.—Trans.

We observe, for instance, that cows on a meadow, feeding only upon grass, enjoy good health. Now let us endeavor to ascertain how we can produce the same proportion of non-nitrogenous and nitrogenous aliment with other descriptions of food.

The proportion which exists in grass or hay is 1 to 8·3, as in the following Table:—

	Relation of 1 part nitrogenous to non-nitrogenous. I.	Relation of 1 part nitrogenous to salts. II.	The following quantities contain 1 part of nitrogenous matter.			
			Nitrogenous, non-nitrogenous and salts. III.	Dried at 212°. IV.	Dried in air. V.	Fresh substances. VI.
French beans	1·81	0·15	2·96	3·45	4·00	
Lentils	1·87	0·09	2·96	3·45	4·00	
Field beans	2·08	0·15	3·23	3·66	4·29	
Peas	2·14	0·11	3·25	3·66	4·28	
Wheat	2·42	0·11	3·53	4·21	4·85	
Oats	4·08	0·24	5·32	6·41	7·35	
Barley	4·25	0·27	5·52	6·53	7·57	
Rye	4·42	0·13	5·55	6·29	7·24	
Red turnips	5·08	0·42	6·50	6·45	....	35·3
Red clover	6·08	0·60	7·68	7·68	9·72	32·0
White turnips	6·39	0·55	7·94	7·91	....	65·1
Indian corn	6·55	0·10	7·65	8·13	9·34	
Mangel-wurzel	7·26	0·44	8·70	8·65	....	48·8
Carrots	7·84	0·55	9·39	9·39	....	67·6
Meadow-grass	8·30	0·73	10·03	10·73	12·47	32·8
Potatoes	9·	0·40	10·40	....	....	41·2
Oat-straw	12·5	2·04	15·54	40·00	55·55	
Wheat-straw	14·2	2·48	17·68	40·00	54·05	
Rice	14·8	0·10	15·90	16·61	18·41	
Rye-straw	24·4	1·93	27·33	53·48	65·79	
Barley-straw	29·3	3·08	33·38	52·35	58·82	
Cherries	41·	0·18	42·18	....	....	175·4
Pears	121·6	0·40	123·00	....	....	1250·

This Table, as given by Fresenius, is derived from German authorities, including several results obtained and published by Dr. Thomson in his Researches on Food, p. 167. See also Phil. Mag., vol. xxxii, p. 459. There is therefore some discrepancy when compared with English grain, the German grain being richer in nitrogen. See Dr. Thomson on the Composition of German and English Bread, Phil. Mag., vol. xxiii, p. 321.

Were we then to give them carrots, in which 1 part nitrogenous is contained for every 7·84 parts of non-nitrogenous constituents, the proportion would not be materially disturbed; but were we to give them potatoes (1 : 9), we disturb the proportion somewhat more. It is therefore expedient to feed them with a substance which is richer in nitrogen; this proper proportion may be obtained with exactness by mixing 1 nutritious equivalent of red clover with 3 nutritious equivalents of potatoes:—

$$1\times1:6 \quad =1:\ 6$$
$$1\times1:9{\cdot}00=3:27$$
$$\overline{\quad 4:33} \text{ or } 1:8{\cdot}25.$$

To produce this mixture, we feed them by giving them 9·7 lbs. of dried clover for every 123·6 lbs. of potatoes.

If we wished to give them the same proportion in white turnips and oat-straw, we must supply for every 2 nutritious equivalents of the former, 1 nutritious equivalent of the latter; for this mixture gives the proportion of 1 to 8·4; that is, they must be fed with 130 lbs. of fresh white turnips for every 55·55 lbs. of dried oat-straw.

A horse that works hard requires the proportion of 1 to 4. For this we give him oats which represent that proportion. But if we wished to give him the same proportion in field beans and hay, we must take for every 2 alimentary equivalents of the former 1 alimentary equivalent of hay, for such a mixture has the proportion of 1 to 4·1. We feed him therefore with 8·58 lbs. of dry field beans for every 12·47 lbs. of dry hay.

A man requires for a certain mode of life the proportion of 1 to 3. He wishes to eat beef and potatoes; he must, therefore, for every 2 alimentary equivalents of beef eat 1 alimentary equivalent of potatoes, for this mixture gives the proportion of 1 to 3·01; he must therefore use for every 2 lbs. of boiled beef (reckoned without water) 41 lbs. of potatoes (reckoned in the fresh state.)

If he wished to produce the proportion of 1 to 4 with carrots and raw bacon, he will attain it by mixing 5 alimentary equivalents of the former with 6 alimentary equivalents of the latter, which represent the proportion of 1 to 3·99. For this purpose he must eat 338 parts of fresh carrots for every 11 parts of raw bacon (reckoned free from water.)

Concerning the question, as to what is the proper quantity of aliment (possessing the due proportions) which is to be given under different circumstances, experience alone can determine it. For the computation, how the necessary quantity may be given in the diverse properly assorted alimentary mixtures, we would refer to the divisions III, IV, V, and VI, of the foregoing table.

If a cow requires in twenty-four hours 10 kilogrammes (22·05 lbs. avoirdupois) of air-dried hay, how many kilogrammes of the mixture given above of clover and potatoes would it require to replace it?

10 kilogrammes of air-dried clover contain in all 8·04 kilogrammes (17·728 lbs. avoirdupois) of nutritious matter, for

$$12{\cdot}47 : 10{\cdot}03 = 10 : x$$
$$x = 8{\cdot}04.$$

That mixture will consist of 9·7 kilogrammes (21·38 lbs. avoirdupois) of dry clover, which contain in all 7·68 kilogrammes (16·93 lbs.) of nutritious matter and 123·6 kilogrammes (272 5 lbs.) of potatoes, which contain in all 31·20 kilogrammes (68·79 lbs.) of nutritious matter.

133·3 kilogrammes (293·93 lbs.) of the mixture contain accordingly 38·88 kilogrammes (85·72 lbs.) of nutritious matter.

38·88 kilogrammes (85·72 lbs.) of the joint nutritious matters are equal to 133·3 kilogrammes (293·93 lbs.) of the mixture. How many are 8·04 equal to? $x = 27{\cdot}5$ (60·63 lbs.)

27·5 kilogrammes (60·63 lbs.) of the mixture in question are equivalent to 10 kilogrammes (22·05 lbs.) of hay in the proportion and quantity of nitrogenous and non-nitrogenous alimentary substances. In a precisely similar manner the kind and quantity of the salts must be attended to in practice.

Conclusions from the foregoing.—We have approximated much more closely to the object we had in view, viz., a completely rational system of nutrition, than it has hitherto been possible to do, and can answer the proposed questions with perfectly accurate average numbers; and we have now only duly to consider the influence which the unappropriated portions of food exert on the body (the getting rid of them involves a waste of strength;) and further, the greater or less degree of digestibility (*der leichteren oder schwereren, schnelleren oder langsameren Verdaulichkeit*) of each species of aliment, in order to do it with perfect precision.

But we can even now, from what has already been stated, educe safe and weighty conclusions, namely, the following:—

1. It is an impossibility to sustain either a man or a beast on food entirely devoid of nitrogen, however great in quantity it may be.

2. All that has been said in the older as well as in many of the newer books on husbandry, respecting the relative nutritive value of different kinds of forage, cannot, inasmuch as it was not arrived at by experience but deduced from theoretical views, possibly be correct, because these views do not accord with facts.

3. The discovery of the true relative value of aliment, and of the proportion in which it may be replaced, may be ascertained without much difficulty, so long as chemists and farmers work hand in hand for the exact solution of the above questions.

4. A completely rational system of nutrition, that is such an one as combines the greatest amount of strength with the least consumption of nourishment, will then be possible.

5. A loss of nutritious matter and of strength often takes place where it would be least expected, namely, by the consumption of all kinds of food (or forage) where the due proportion between nitrogenous and non-nitrogenous constituents does not exist, say by eating only fruit or potatoes.

6. It can with safety be decided by the above, under what circumstances substitutes for bread may be employed, and what is their respective value for each desired proportion.

Raw and cooked Articles of Food.—Many kinds of food cannot be eaten raw by man; others, although they may be eaten raw, agree much better with us when cooked.

Hence boiling, roasting, baking, &c. has a twofold effect; primarily, it converts indigestible food or that difficult of digestion into a digestible or more easily digestible condition. Thus, starch is converted into gelatinous starch, into dextrine or sugar; cartilaginous substances into glue; and chondrine, fibrine, into changed fibrine, &c. Secondly, it frequently confers upon them an agreeable taste.

But can the real nutritive value of food be augmented by cooking? Impossible! Still it may be of the greatest benefit in feeding cattle to cook their food. The advantage accrues in this way: that potatoes, turnips, &c. are more quickly and more easily digested when boiled than raw; and thus there is much less chance for any portion to be thrown off in an undigested state (unassimilated). Its warmth gives also a slight advantage to cooked food; it deprives the body of no heat; and the non-nitrogenous substances, which in the cold food would have been required to afford heat, can be used for the production of fat. But whether cold or warm food is to be preferred in a practical point of view, cannot from all this be conclusively deduced. It is a question only to be answered by experience, for the result is entirely dependent on the nature and requirements of the animal.

4. *Meteorite of Arva*, (from the Oesterreische Blätt. für Lit. Kunst, &c., No. 169.)—At a meeting of the "Friends of Science," at Vienna, in 1847, A. PATERA presented the results of the chemical analysis of the meteoric iron of Arva, made by him in the laboratory of A. Löwe. The description of the place where it had been found and of the iron itself, had already been published in the Vienna Zeitung of the 17th of April, 1844, and of March, 1845. The fragments of the pure iron employed in the analysis had a specific gravity of 7·814. The iron contained according to the qualitative examination, iron, nickel, a trace of cobalt, and an extremely small quantity of copper. The oxydized surface contained in addition, sulphur, carbon, silica, phosphorus and potassium, probably as unessential ingredients. The results of these analyses were:

Iron,	89·42	93·13	94·12
Nickel,	8·61	5·94	5·43
Residuum containing silica and carbon,	1·41	. .	. .
	99·41	99·07	99·55

A. Löwe has had the kindness to furnish also his own results of two quantitative analyses. He found,

Iron,	90·471	91·361
Nickel,	7·321	7·323
Cobalt residuum,* carbon, silicia,	1·404	0·938
	99·196	99·622

At the meeting of the Society the following week, Franz von Hauer presented a series of communications from the Royal Counsellor of Mines, W. Haidinger, the first of which related to the chemical examination of the *Meteoric Iron of Arva*, communicated by A. Patera. A part of the results obtained was at that time reserved, and as M. Patera had since enjoyed the opportunity of visiting several interesting geological localities of Lower Hungary, he was now prepared to bring forward the portion omitted. Berzelius, it is known, had found in the meteoric iron of Bohumilitz, a peculiar metallic combination in clear steel-gray folia and grains, composed of iron, nickel and sulphur. Something altogether similar is found in the meteoric iron of Arva. Patera was enabled to collect a sufficient quantity of it to make three analyses, which agreed tolerably well with each other. The folia are flexible and strongly magnetic. Their hardness was 6·5; specific gravity 7·01–7·22.

Phosphorus,	7·26
Iron,	87·20
Nickel,	4·24
	98·70

* Traces of sulphur.

Some carbon was also obtained, but the amount could not be definitely ascertained.

As Berzelius had given no name to this substance, Haidinger, in concurrence with M. Patera, proposed for it the specific name of *Schreibersite.*

At a subsequent session (loc. cit. No. 231) Haidinger, referring to the name of Schreibersite, says he has since learned that the American mineralogist and chemist, Prof. Shepard, at the session of the Association of Science at New York, on the 2d of September, 1847, had given, in a very interesting paper on Meteorites, *this same name* to a mineral, also of meteoric origin, which occurs in small brown striated prisms in the meteoric stone of Bishopville, S. C., which fell in March, 1843, and was described by Prof. Shepard.

Undoubtedly this latter name has the priority, but yet priority is only a general rule which may in particular cases be deviated from.

Haidinger, therefore, would be pleased to continue the name of *Schreibersite* to the Arva Species, and would propose for Shepard's new species, the name of *Shepardite*, which very properly will connect the discovery of the American species with the American naturalist, while in a native species it will express our high regard for the worthy naturalist of our own land.

5. *On the Preparation of a Glaze for Porcelain resembling Aventurine;* by A. Wæchter, (Liebig's Annalen, April, 1849; Chem. Gaz., Aug. 1, 1849, p. 305.)—According to Wöhler's examination, aventurine glass owes its golden iridescence to a crystalline separation of metallic copper from the mass colored brown by the peroxyd of iron.

In the aventurine glaze for porcelain a crystalline separation of green oxyd of chromium from the brown ferruginous mass of the glaze produces a similar effect. I prepare this glaze as follows:—

31 parts of fine lixiviated dry porcelain earth from Halle,
43 ... ... dry quartz sand,
14 ... ... gypsum,
12 ... ... fragments of porcelain,

are stirred up with 300 parts of water, and by repeated straining through a linen sieve uniformly suspended in it, and intimately mixed. To this paste I add, under constant agitation and one after the other, aqueous solutions of

19 parts bichromate of potash,
100 parts protosulphate of iron,
47 parts of acetate of lead,

and then add so much solution of ammonia that the iron is completely separated. The salts of potash and ammonia are removed by frequent decantation with spring water.

The baked porcelain vessels are dipped into the pasty mixture obtained as above described in the same manner as with other glazes, and then fired in the porcelain furnace. After this they appear covered with a brown glaze, which in reflected light appears to be filled with a countless number of little gold spangles.

A thin fragment of the glaze appears, under the microscope, by transmitted light, as a clear brownish glass, in which numerous transparent green six-sided prisms of oxyd of chromium, and some brownish crystals, probably of oxyd of chromium and peroxyd of iron, are suspended. The oxyd of chromium therefore separates on the slow cooling of the glaze in the porcelain furnace, from the substance of the glaze—a silicate of potash, lime and alumina—saturated with the peroxyd of iron, and shines through the brownish mass with a golden color. When the aventurine glaze is mixed with an equal amount of colorless porcelain glaze, the glassy mass no longer has a brown color after the burning, but a light greenish gray, and the eliminated crystalline spangles likewise exhibit in reflected light their natural green color.

6. *On Chicory-Coffee, its History, Manufacture, Adulterations and means of detecting them;* by A. Chevalier, (Jour. de Pharm., July, 1849; Chem. Gaz., Aug. 1, 1849, p. 306.)—*History and Manufacture.* The manufacture of a factitious coffee from the roasted root of chicory appears to have originated in Holland, where it has been practised for more than a century. It remained secret until 1801, when it was introduced into France by M. Orban of Liege and M. Giraud of Horning a short distance from Valenciennes.

In a memoir upon coffee by M. Payssè, some details are given on the preparation of chicory-coffee in Holland. These were printed by Parmentier in the "Annales de Chimie" for 1806, and are as follows:

"The chicory for this purpose is collected in spring; the roots are conveyed to the manufactory, stripped of their leaves and washed to remove the soil.* They are cut into six parts, and then divided and dried. When dry, they are roasted in great cylinders like coffee. After the roasting, the chicory is reduced to a coarse powder.

"In Holland this chicory is then mixed in variable proportions with coffee; the resulting product is very bitter, which is considered by the common people to be a very salutary refreshment, which modifies the stimulant action of the coffee. Such a favorable idea has been formed of it, that of late this preparation has been employed alone, without any addition of coffee; and nevertheless it possesses no other virtue than that of coloring more or less readily the water in which it is boiled or infused, of communicating to the liquid the bitter taste of the extractive substances contained in chicory, and of being far less expensive than coffee."

M. Payssè adds, that "peas, lupins, beans, beet-root, carrot, &c., have been employed as substitutes for coffee."

The manufacture of chicory-coffee however remained for a long time stationary and of little importance; but for the last twenty years it has extended considerably, and has become an object of commerce of great importance. Till within the last few years it was carried on principally near Valenciennes; but since then manufactories have sprung up in several localities, especially at Arras, Cambray, Lille, Paris, Senlis in Normandy, Brittany and in England.†

The cultivation of chicory, to obtain the root for the purpose of converting it into coffee, has become a source of great prosperity for these districts. The plant requires a deep soil of good quality, and

* The roots are now no longer washed, as this operation is said to injure their value.

† For the last two years very large quantities of dry chicory have been exported from France into England.

well-prepared ; the seed is sown in May, and the harvest takes place in October. Some time before collecting the roots, the leaves are mowed, and cows fed with them.* The roots are dug up with a spade, placed in heaps, and covered with straw to preserve them from frost.

The roots, thus collected, are cut at first longitudinally, and then transversely, in pieces from 5 to 10 centimetres in size ; they are then carried into the drying chambers, which are heated with a kind of anthracite which produces no smoke. The roots are placed in layers of about 40 centimetres ; they are frequently stirred to prevent them from burning and to facilitate the drying. Four such operations are made in about twenty-four hours. The roots dried by the above process are known by the name of *Cossétes.* They are kept in granaries ; but in general sold almost immediately to the manufacturers, who roast them according to the demand. When the roasting is nearly complete, two per cent. of butter is added, and a couple of turns given to the roasting machine. This addition is made in order to impart lustre to the chicory, and to give it the appearance of roasted coffee. The substance is then emptied into iron vessels, and after cooling is crushed in vertical stone mills or between iron cylinders ; it is then sifted, and during this operation a small quantity of reddish coloring substance (*rouge brun de Prusse*) is added to give it the color of coffee. The product is then weighed off, and sold in packets under a variety of names, but very rarely under its own ; for instance, among others, *Mocha powder*, *Ladies' coffee*, *cream of Mocha*, *pectoral coffee*, *Chinese coffee*, *Tom Thumb coffee*, *Polka coffee*, *and colonial coffee.*

We have stated that it forms a very important object of commerce ; in fact, 12,000,000 lbs. are consumed in France, and a large quantity is exported. On consulting the tables of the commerce in France, it will be seen that from 1827 to 1836 there was exported from France 458,971 kilogrammes of chicory coffee of the value of 321,282 francs ; and since this period the amount has vastly increased.

Adulteration.—This substance is very frequently mixed with other ingredients, the means for detecting which consequently vary. We shall briefly notice them.

I. Brick-dust, ochre and earth may be detected by incineration and determining the amount of ash ; 100 grms. of pure chicory coffee furnish from four to five per cent. of residue ; an excess would indicate fraud.

II. Adulteration with coffee-grounds. This is carried on upon a great scale in Paris. It is easily detected. A sample of the suspected chicory is dried in a water-bath, and a pinch thrown upon the surface of a glass of water ; the chicory almost immediately absorbs the water and sinks to the bottom of the vessel, whilst the coffee-grounds remain on the surface.

III. Adulteration with roasted bread, dirt and remains from vermicelli, &c. This adulteration is generally made with crusts of bread collected in the streets, crusts which are not always very clean. They are roasted or rather burnt in the oven, ground and mixed with the chicory-powder. This adulteration can be detected by iodine-water,

* It forms an excellent fodder ; but when given alone, communicates a very disagreeable flavor to the milk of animals.

as the product resulting from the decoction of pure chicory does not strike a blue color.

IV. Adulteration with roasted acorns, which may be detected by iodine-water and by persulphate of iron, which in such a case strikes a black color.

V. Adulteration with roasted corn, haricots and peas may be detected by means of iodine-water.

There is no method as yet known of detecting the adulteration by roasted beet-root and carrot.

7. *On an unnoticed kind of abnormal vision;* by Prof. C. Dewey.—There are two well known kinds of *abnormal* vision in eyes not diseased, the *far-sighted*, and the *near*-sighted. The former occurs in good eyes, as persons advance in life, beginning about the age of forty, and is remedied by *plane*, or better, by *convex* spectacles. The latter is found in youth or young persons, and finds its remedy in *concave* glasses. The *far-sighted* are unable to see near and small objects, and remove them at an inconvenient distance, while they see remoter objects perfectly well without glasses. The *near-sighted* are unable to see small objects unless they are brought inconveniently near, and have no distinct vision of remote objects.

There is a kind of abnormal vision, different from either of these, which is *not far-sighted* nor *near-sighted*, but in which near small objects, or larger distant objects, are not seen with distinctness. This imperfection occurs in children and young persons, and is remedied by *convex* spectacles which are suited to the eyes of persons from sixty-five to seventy years of age. The *younger* eyes require the *older* glasses, and with advancing years *less convex* glasses are required. At the age of forty-five or more, this kind of abnormal vision becomes much diminished.

As the young use the glasses of the farsighted, this kind may be called *neo-macropia*. It is evident that *convex glasses produce that change in the rays of light which fits such eyes to see distinctly small and large objects at varying distances.* This fact proves that there is no defect in the *adjusting power* of the eyes.

The cause then is to be sought in the *structure* of the eye. As this kind of eyes does not appear to be too much or too little convex, and as the image is not formed soon enough in the eye or is too far back, either or all of the three following may be the cause: 1, too little convexity of the crystalline lens, or 2, its position too near the retina, or 3, its too little density. The second is the probable cause. Spectacles sufficiently convex would bring the rays to a focus, let either or all of of the three causes operate, and with the usual adjusting power of the eye give distinct vision for near or remoter objects.

Though this kind of abnormal vision seems not to have attracted attention, for I have found but one *allusion* to it in consulting authors on optics, it is relatively common. In New England and New York, more than fifty instances of it have come to my knowledge in the five or six years past. A child of fifteen was able to see distinctly for the first time by the use of his grandfather's spectacles. A young man of eighteen required convex glasses of ten inch focus, while persons of seventy years use those of fourteen to eighteen inch focus. Children often make little progress in study, because they do not see objects distinctly, though the defect is not suspected by them and is utterly unknown to parents and teachers. The knowledge of this subject will make spectacles a still greater benefit to our race.

8. *Analysis of the Waters of the Dead Sea;* by R. P. F. Marchand,* (Poggendorff's Ann. der Phys. u. Chimie, lxxvi, 462, 1849.) —A quantity of water from the Dead Sea was brought by Kunowski to Berlin, which he obtained at the north end not far from the mouth of the Jordan. Its specific gravity at 19° C., was 1·18415; at 13°, 1·1859. The analyses afforded—

Chlorid of calcium,	2·894
" magnesium,	10 543
" potassium,	1·398
" sodium,	6·578
" aluminium,	0·018
Bromid of magnesium,	0·251
Sulphate of lime,	0·088
Silica,	0·003
	21·729

9. *American Association for the Advancement of Science.*—We had intended to have given extracts of the proceedings of the recent Session at Cambridge in this number of the Journal. But as a pamphlet is now in course of publication, containing abstracts of the reports corrected throughout by the authors, we defer it for the present.

The proceedings were published at length in the *Boston Evening Traveller*, from whose office the pamphlet will soon be issued, and whence copies may be procured. We may add a word in behalf of this daily paper, published at Boston, as we have long appreciated its excellence. The various scientific and literary addresses and lectures of Boston and its vicinity are reported by it in full, and by stenographers that rarely miss a word that falls from the speaker's mouth. We are indebted to the editors in this way for the publication of Agassiz's lectures on Embryology, which we have been assured by those who know, are given with remarkable accuracy. The Lowell Lectures of Boston, by men of the hightest standing in their departments, may, through this paper, be enjoyed in distant portions of our country. We may hope therefore that the Boston Evening Traveller will widely travel, for it is one of the most important means in our country of disseminating scientific and literary information.—Eds.

10. *British Association.*—The British Association has just held its annual meeting at Birmingham, commencing with Sept. 12. We copy here the Report of the General Committee, as it will interest those who would promote the progress of the kindred associations in this country.

Report of the Council to the General Committee.—I. With reference to the subjects referred to the Council by the General Committee assembled at Swansea, the Council have to report—

1st. That they communicated the recommendation of the General Committee, for the continuance of the Magnetical and Meteorological Observatory at Toronto to the 31st of December, 1850, to Lord John

* Other analyses are cited in this Journal, xlviii, 12, together with an analysis by B. Silliman, Jr.

Russell through the President, the Marquis of Northampton. They have the pleasure of stating that the Observatory has been continued.

2nd. Pursuant to the request of the General Committee, the Council have taken into consideration the expediency of inserting in the Rules of the British Association, a paragraph to the effect that those gentlemen who have held the office of President of the Association should subsequently be *ex officio* members of the Council; and the Council now recommend that a paragraph to that effect should be inserted in the Rules of the Association.

3rd. The sum of 100*l.* placed by the General Committee at the disposal of the Council for the disbursements connected with the Kew Observatory has sufficed, under Mr. Ronalds's general superintendence, for the maintenance of the Observatory in the past year as a depository for the books and instruments belonging to the Association; and also for the preparation of the self-registering magnetical instruments, on Mr. Ronalds's plan, for the Toronto Colonial Observatory. Mr. Birt has completed the reduction and discussion of the series of electrical observations made at Kew; and Mr. Ronalds has drawn up a report describing the modifications and improvements which he has introduced in the self-registering apparatus during the last year. Both these reports will be read to Section A. preparatory to a consideration of any further recommendation which it may appear desirable to make for the continued maintenance of the Observatory. In connexion with this subject, the Council have great pleasure in announcing to the General Committee that Her Majesty's government, on the joint application of the Marquis of Northampton and Sir John Herschel, have granted to Mr. Ronalds a pecuniary recompense of 250*l.* for the invention of his method of constructing self-registering magnetical and meteorological apparatus. It will be recollected by many members of the General Committee that the subject of self-registering instruments was discussed at the meeting of the British Association at Cambridge, in 1845, upon the application for a grant of money from the funds of the Association to enable Mr. Ronalds to complete an apparatus for that purpose at Kew; and that a recommendation was made on that occasion by the Association to government—which recommendation was concurred in by the President and Council of the Royal Society—of the expediency of encouraging, by specific pecuniary rewards, the improvement of self-recording magnetical and meteorological apparatus.

As the grant to Mr. Ronalds has been made in consequence of that original recommendation and the favorable reply that was returned to it, and as the apparatus itself has been constructed and its successful operation shown at the Observatory of the Association, of which Mr. Ronalds is the Honorary Superintendent, the Council have deemed it proper to make this formal, and as they are sure acceptable, announcement of the favorable reception which has been given to the application on Mr. Ronalds's behalf; but they are glad, at the same time, to take the opportunity of expressing the satisfaction with which they have learned that the ingenious invention of Mr. Brooke, for similar purposes, have also received a pecuniary recompense from the government.

II. The Council regret that they are still unable to announce the publication either of Professor Edward Forbes's Researches on the Ægean

Sea, or of the Mountjoy Observations, for which purposes grants of public money have been sanctioned by Her Majesty's government at the recommendation of the British Association.

III. The Council have added the following names to the list of Corresponding Members of the British Association:—Prof. Plücker, of Bonn; Dr. Siljeström, of Stockholm; Prof. H. D. Rogers, of Philadelphia.

IV. Prof. Dove, of Berlin, Corresponding Member of the British Association, having offered to supply the Association with as many copies as might be desired of his Maps of the monthly Isothermal Lines of the Globe, founded upon the Temperature Tables printed in the volume of the Reports of the British Association for 1848, which maps have been partly engraved and partly lithographed at the expense of the Royal Academy of Sciences at Berlin, the Council directed that Prof. Dove should be requested to supply the Association with 500 copies, on the understanding that the Association should pay for the paper and for taking off the impressions; and that the copies thus furnished should be sold, under the direction of the officers, to members of the Association at cost price, with the translation of a report from Prof. Dove explanatory of the Maps and of a more obvious conclusion deduced from them. The Maps have been completed, but from accidental circumstances the packet containing the first 200 copies prepared for the Association, has not yet been despatched from Berlin, and cannot be expected to reach England until after the meeting at Birmingham is over; but copies of the Maps and Report will be forwarded immediately after they arrive, to members who may be desirous of purchasing them, and who give their names for that purpose in the Reception Room. The cost of each copy will be 5*s.* for the three Maps.

V. The Council has directed that the following additions should be made to the Regulations, according to which the volumes of the Reports are distributed to the Members:—

1. That members who have formerly paid 5*l.* as a life composition, and shall at any future time pay an additional sum of 5*l.*, shall be entitled to receive (gratis) the volumes of the Transactions which shall be published after the date of such additional payments.

2. That Members shall have the opportunity of purchasing any of the already published volumes of the Association, of which more than one hundred copies remain, at half the price at which the volumes were issued to the public.

VI. The Council have great pleasure in submitting to the General Committee the following list of invitations from which the General Committee will have to select the place of meeting of the Association in 1850.

a. Invitations received at Swansea by the General Committee, and which stood over after the selection of Birmingham, 1849:—

From Ipswich, for 1849,—signed by the high sheriff, the Bishop of Norwich and eighty gentlemen of the eastern counties.

From Bath, for 1850,—signed by the Mayor.

From Derby, for 1850.

b. Invitations received since the Swansea Meeting and communicated to the Council:—

From Edinburgh, for 1850,—from the Lord Provost, Magistrates and Council—from the Senatus Academicus, and from the Royal Society of Edinburgh.

From Belfast for 1850 or 1851—from the Town Council—the Royal Academical Institution—the Natural History and Philosophical Society, and from the Harbor Commissioners.

From Manchester, for 1852,—from the Royal Institution—the Geological Society—the Natural History Society—the School of Design, and the Mechanics Institution.

From Hull, for an early meeting—from the Literary and Philosophical Institution.

VII. The Council have received and submit to the General Committee the following letter from Lieut. Col. Sabine :—

" *To the President and Council of the British Association.*

" Gentlemen,—I beg leave to acquaint you that it is my intention, at the meeting of the Association at Birmingham, to resign into the hands of the General Committee the office of General Secretary, with which I have been honored, by annual re-election, for ten successive years."

[We omit the continuation of Col. Edward Sabine's communication.]

The Treasurer's Report is as follows :—

The General Treasurer's account, from 8th of August, 1848 (*at Swansea*), *to the 12th of September,* 1849 (*at Birmingham*).

RECEIPTS.

		£. s. d.
Life Compositions at Swansea,		30 0 0
Annual subscriptions, " and since,		150 0 0
Associates' "		376 0 0
Ladies' Tickets, "		197 0 0
Book compositions,		6 0 0
Dividends on stock,		116 10 1
Sale of stock (1,000*l.* three per cent. consols,)		917 9 2
From sale of publications :—		
Of the 2d volume,	£0 7 2	
" 3d "	1 8 0	
" 4th "	1 4 4	
" 5th "	0 15 2	
" 6th "	2 2 11	
" 7th "	2 6 0	
" 8th "	3 0 4	
" 9th "	1 18 0	
" 10th "	3 7 6	
" 11th "	1 19 11	
" 12th "	3 0 9	
" 13th "	5 12 0	
" 14th "	5 4 0	
" 15th "	15 10 0	
" 16th "	80 0 0	
" 17th "	0 6 0	
British Association Catalogue of Stars,	28 1 10	
Lalande's "	9 8 2	
Lacaille's "	1 16 5	
Lithograph signatures,	0 15 0	
		168 3 6
		£1,961 2 9

		£.	s.	d.
Balance brought on from last account, ...		9	7	10

PAYMENTS.

		£.	s.	d.
For sundry printing, advertising, expenses of the meeting at Swansea, and sundry disbursements made by the General and Local Treasurers, ...		287	1	9
Printing, &c., the 16th vol. (17th Report), . . .		644	6	8
Salaries—Assistant General Secretary and Accountant, 18 months, ...		500	0	0
Paid by order of Committee on account of grants for scientific purposes:—				
Electrical observations at Kew, .	£50 0 0			
Vitality of seeds, ...	5 8 1			
Acid on the growth of plants, . .	5 0 0			
Registration of periodical phenomena,	10 0 0			
Bills on account of anemometrical observations, ...	13 9 0			
		83	17	1
Maintaining the establishment at Kew Observatory:—				
Balance of grant of 1847, . . .	20 15 7			
Part of grant of 1848, ...	55 6 10			
		76	2	5
Balance in the bankers' hands, . . .	335 13 4			
" in General and Local Treasurers' hands, ...	24 13 8			
		360	7	0
		£1,961	2	9

Edinburgh has been accepted as the place for the next annual meeting of the Association, and Sir David Brewster has been chosen President for the session.

11. *Total Quantity of Lead Ore raised and Lead smelted in the United Kingdom in* 1848, (Official Report by R. Hunt, keeper of mining records, Mining Journal, Aug. 25, 1849.)

England,	Lead ore.	Lead	Wales,	Lead ore.	Lead.
Cornwall, ...	10,494 tons	6,614	Cardiganshire, ...	4,902 tons	3,180
Devonshire, ...	1,334	844	Carnarvonshire, ...	21	14
Cumberland, ...	8,272	5,684	Carmarthenshire, ..	307	204
Durham and Northumberland,	18,815	14,658	Denbigshire, ...	....	....
			Flintshire, ...	10,056	7,069
Westmoreland, ..	519	388	Montgomeryshire, .	927	601
Derbyshire, ...	5,185	3,370	Merionethshire, ...	92	54
Shropshire, ...	4,130	2,762			
Somersetshire, ...	41	29	Total, ...	16,305	11,122
Yorkshire, ...	6,848	4,793			
			Ireland, ...	1,912	1,188
Total, ...	55,638	39,142	Scotland, ...	2,588	1,736
			Isle of Man, ...	2,521	1,665

Making a total of 78,964 tons of lead ore, and 54,853 tons of lead.

Imported, 1,298 tons lead ore; pig and sheet lead, 3,788 tons; retained for home consumption, 2,157 tons.—*Exported*, 135 tons lead ore; pig and rolled lead 4,977 tons; shot 1,151; litharge, red and white lead 2,292; foreign lead in sheet and pig, 3,747 tons.

12. *California Gold.*—The gold of California has been analyzed by Dr. Hofman and found to consist of gold 89·61, silver 10·05=99·66, the loss being some copper and iron, which was not determined.

13. *Coal in Egypt.*—The discovery of mineral coal in Egypt has recently been made by a French civil engineer. It occurs in the vicinity of the Nile, towards Upper Egypt. Excavations are to be made on a large scale.

14. *Astronomical Journal.*—The following Prospectus of a new Astronomical Journal to be established in this country has recently been issued; and we would commend the undertaking to all interested in the progress of science. Astronomy has gathered the brightest laurels for the nations of Europe; and the success which has already attended American effort may well incite us onward. The Journal will necessarily be a dry one for the reader, if truly valuable; yet from its importance it demands the widest encouragement and support. The Prospectus was drawn up by a committee of the American Association for the Advancement of Science, held at Cambridge August 21, 1849, to whom the subject was submitted by Prof. J. S. Hubbard.

"An Astronomical Journal, for the publication of original researches, has long been needed in the United States, and the want is growing more urgent every day. American Astronomy demands an organ, in which important investigations and observations may be published without delay, and which may serve especially as a magazine for astronomical researches made in this country, as a vehicle of information concerning the labors of individuals, and as an exponent of the general progress of science. An admirable model for such a publication is to be found in the celebrated *Astronomische Nachrichten* of Prof. Schumacher.

Our astronomers and mathematicians have been hitherto compelled to resort to the columns of foreign journals, or to those at home which are expressly designed for other purposes. The extremely valuable journal of Prof. Silliman has lent them important assistance, notwithstanding that this is devoted to general science, and the diffusion of scientific information.

The aim of the journal now proposed is the advancement, rather than the diffusion, of astronomical learning; and it is hoped that the lovers of astronomy throughout the country will join in sustaining it. A publication of this kind—not claiming to possess special interest for the community in general—appeals for support to those lovers of truth who desire to contribute their share to whatever may develop and foster science in America; and it cannot succeed without their hearty coöperation.

The plan of the proposed journal contemplates not only researches in every department of Physical, Theoretical, and Practical Astronomy, but also investigations on all subjects directly connected with these, such as Pure Mathematics, Geodesy, the theory of instruments, &c.;—to the exclusion, however, of popular articles and general speculations.

It is thought best that the successive numbers of the Journal should appear, not at stated periods, but irregularly, at such intervals as the amount of matter at hand, or the importance of information to be communicated, may require. It is also contemplated to issue circulars in cases where the prompt dissemination of intelligence may be important.

The Editor expects no remuneration, and it is estimated that one hundred and eighty subscribers will defray the necessary expenses of the work. The committee hope that the several universities and colleges of the Union will offer their assistance.

A volume will consist of twenty-four sheets (eight pages) in quarto, and the price is fixed at $5.00 the volume, payable in advance. All subscription and communications may be addressed to the Editor, B. A. Gould, Jr., Cambridge,—or to the publishers, Messrs. James Munroe & Co., Cambridge and Boston.

B. A. Gould, Jr.,	Sears C. Walker,	M. F. Maury,
J. S. Hubbard,	Joseph Henry,	C. H. Davis,
John H. C. Coffin,	A. D. Bache,	Benj. Peirce."

October 1, 1849.

15. *Geological Surveys of the United States.*—At the recent meeting of the American Association for the Advancement of Science, resolutions were offered, strongly urging the completion of geological surveys of the several states of the Union which still remain unfinished. There are several cases of this kind, and the interests of the State, the Country, and of Knowledge, strongly demand that the work be carried forward. Large portions of our territory, rich it may be in wealth of minerals, building material, fertile soil, and various productions valuable in the arts, remain unexplored, and where explorations have been made, there have been delays in the publication of Reports, which are not creditable to the Legislatures that have this matter in control, nor just to those who have been laboring in the surveys.

OBITUARY.

16. Ludwig Frederick Wilhelm August Seebeck died at Dresden on the night of the 18th and 19th of March last. He was a prominent member of the Berlin Academy, the author of works on Optics and Acoustics, and Professor of Natural Philosophy at Leipsic. He was born at Jena, the 27th of December, 1805.

17. Johann Wolfgang Döbereiner, the distinguished chemist, died at Jena on the 24th of March. He was born on the 13th of December, 1780, at Cur in Bayreuth.

18. Wilhelm Ferdinand Erichson, died on the 18th of November, 1848. For seven years he had conducted Wiegman's Archiv, a zoological journal of the highest rank in science. He was especially distinguished in the department of Entomology, and enjoyed the highest reputation for thorough and extensive knowledge.

The *Archiv* will be issued hereafter under the editorship of Dr. Troschel of Berlin.

VI. Bibliography.

1. *Iconographic Encyclopædia of Science, Literature and Art, systematically arranged;* by G. Heck. With 500 steel engravings, by the most distinguished artists of Germany: the text translated and edited by Spencer F. Baird, A.M., M.D., Professor of Natural Sciences in Dickinson College, Carlisle, Pa. Rudolph Garrigue, N. Y., 2 Barclay street.—This elaborate work is an illustrated Encyclopædia of Science and the Arts. The plates are in 4to, and are issued in portfolios of twenty plates, along with about 80 pages of text. The engraving is exquisite in style, and each plate is crowded with figures and equivalent to a volume of learning. The first of this series contains nearly 100 distinct figures, and the second over 150, illustrative of various problems in plain and solid geometry. Another is occupied with about 65 figures relating to problems in surveying, measuring heights, &c., to leveling, topographical drawing, projection, conic sections, &c., projection of shadows, perspective. The next includes drawings of various mathematical instruments, elaborately detailed, as the following: Hair compasses, proportional compasses, beam compasses, triangular compasses, Farey's elliptograph, pantograph, eidograph, parallel ruler and spring compasses, protractor, measuring staff and chain with arrows and pickets, plane table, Thayer's plane table, level, diopter ruler, astrolabe, compass, repeating circle, graphometer, sextant, leveling instruments. Another plate illustrates in beautiful style the change of the seasons upon the earth, the forms and appearances of comets, different nebulas, Saturn and his belt, &c.; and this is but one of ten plates devoted to astronomy, among which No. 11 is a very elegant map of the moon's surface, with enlarged drawings, around the margin, of many of the great craters. The same completeness and delicacy of delineation extends to all departments.

The text contains a brief statement of the principles of the sciences under consideration, enunciations of problems usually without full demonstrations, descriptions of instruments, and explanations of their modes of use, &c. &c. The translation from the German is by Prof. Baird, of Carlisle, Pennsylvania, a man of accurate learning, and extensive knowledge of science. We take the following from the Prospectus, issued with the first number, the only part yet out.

The Iconographic Encyclopædia will embrace (in a series of 500 quarto steel engravings, and upwards of 2000 pages of letter-press in large 8vo,) all the branches of human knowledge which can be illustrated by pictorial representations, viz:—

I. Mathematics. II. Natural and Medical Sciences. III. Geography. IV. Ethnology. V. Military Sciences. VI. Naval Sciences. VII. Architecture. VIII. Mythology, &c. IX. The Fine Arts. X. Technology, with all their respective subdivisions.

The work will be published in 25 monthly portfolios, each containing 20 engravings and eighty pages of letter-press. Price one dollar each part. Subscriptions taken for the whole work only.

As the different departments of science, from their varying natures, will demand more or less detailed explanations in letter-press, eighty pages of text will not always be sufficient to explain thoroughly the representations of twenty engravings, whilst in other instances less than that space will be required. Thus the explanatory text belonging to 20 plates, but exceeding eighty pages, will be furnished with the following 20 plates, so that at the end of the work text and plates will run together, and form a complete manual of the enumerated sciences, with a full collection of pictorial illustrations, executed on steel with the greatest care and accuracy.

It having been deemed of great importance to unite the greatest possible cheapness with beauty and intrinsic value, the great expense of re-engraving the plates has been avoided, and a contract made to secure good impressions, taken under the immediate supervision of Mr. Heck, the original framer of the work, from the highly finished German plates; and the specimens now before the public will prove that they could not have been produced in this country at less than double the price for which they are now offered.

A small proportion of the 500 engravings constituting the whole work (about 50, representing astronomy and geography) have inscriptions (chiefly astronomical and geographical names) in the German language, which could not have been altered except at a very great expense. This circumstance will, however, in no way interfere with the perfect clearness of the matter represented, as the accompanying English text, referring strictly to the designs of the plates, gives every explanation required. Besides, a full glossary of all foreign words occurring on the plates will be issued at the end of the work for the benefit of those who wish to make themselves acquainted with the several names and expressions.

Indexes and tables of contents will be issued with the last part of the work, adapting it to practical use, and facilitating reference to any of the branches of science it embraces.

After the description of the work given, it is needless to add words of commendation. It will be found very widely useful, and we doubt not will command an extensive circulation.

2. *Genera Floræ Americæ Boreali-orientalis illustrata:* The Genera of the Plants of the United States; illustrated by figures and analyses from nature, by Isaac Sprague, Mem. Bost. Nat. Hist. Soc.; superintended and with descriptions, &c., by Asa Gray, M.D., Prof. Harvard Univ., &c. Vol. II, plates 101 to 186. 8vo, pp. 230. New York, 1849. G. P. Putnam.—We take pleasure in announcing the second volume of this truly national work. The authors have undertaken to illustrate all the genera of the plants of the United States with detailed figures and descriptions, and the work should meet not only with approbation, but with substantial proofs of favor on every side. This volume includes the orders from Caryophyllaceæ and Malvaceæ, to Polygalaceæ and Krameriaceæ. The plates are elegant specimens of the art of engraving, and may delight the eye that cannot appreciate all the minute scientific detail so carefully wrought out by dissections and careful scrutiny; the number included in the volume is 87.

In the descriptive portion of the work, the generic character of each genus is briefly given in Latin, and is followed by a full synonymy. Then follows a detailed description in English of the parts of the plants, their characteristics, habits, geographical distribution, properties, together with critical remarks, and the etymology of the name. Under each family, there is a tabular view of the genera with their distinctive characters. The work is of great importance to the student of Botany. A glance at a figure may resolve the most stubborn doubts left on the mind by the mere description, besides giving an insight into the structure of a plant and its fructification which none but a master could unfold.

3. *The Sea Side Book, being an Introduction to the Natural History of the British Coast;* by Dr. W. H. Harvey. 1 vol. 12mo. With numerous wood cuts.—If we had not been upon the sea shore when we first perused this delightful little volume, we could scarcely have resisted the temptation to repair thither at once, so vividly are depicted in it the attractions which the productions of the sea present to the naturalist. Although written especially for the British Islands, it contains much that is applicable to our own shores. As the first edition is already exhausted, it is to be hoped that a second may soon appear to win, as it cannot fail to do, new recruits to the ranks of science.

J. W. B.

4. *Phycologia Britannica: or, History of the British Sea Weeds, including Colored Figures of each Species, with Growth, Fructification, &c.;* by Dr. W. H. Harvey, M.R.I.A., Keeper of the Herbarium of the University of Dublin. Price per No. 2s. 6d. col.—Upwards of forty numbers of this very beautiful work have already appeared, and they justify the high expectations which were excited on its first announcement. Each number contains a number of admirably executed colored lithograph plates of British Algæ, accompanied by descriptions. When completed it will include all the British Marine Algæ now known, and will be indispensable to all who wish to study the Algæ of either the British or North American shores.

It is to be hoped the distinguished author, who is now in our country, may be induced to illustrate our American species in a similar style. They could not be in better hands. J. W. B.

5. *Nereis Australis: or, Illustrations of the Sea Weeds of the Southern Ocean, including figures of Growth and Fructification, &c.;* by Dr. W. H. Harvey, M.R.I.A., &c. In four parts, (two of which are published.)—These volumes rival in beauty the Phycologia Britannica. They contain many new genera and species and should be in the hands of every student of general Phycology. The beauty of the plates would make the work an ornament for any library. J. W. B.

6. *A Manual of the British Marine Algæ;* by Dr. W. H. Harvey, M.R.I.A., &c. Second edition. With plates. 1 volume.—We have as yet only seen the plates to this volume which is about to issue from the press. We learn that it is completely re-written and embraces all the British *marine* Algæ, a great number of which are inhabitants of our own shores. The plates illustrate the structure of one or more species of each genus, and will be a great aid to beginners. J. W. B.

7. *Species, Genera et Ordines Algarum, seu Descriptiones Succinctæ Specierum Generum et Ordinum quibus Algarum Regnum constituitur;* auctore Jacobo Georgio Agardh. Volumen Primum. Algas Fucoideas complectens. 1 vol. 8vo. pp. 363.—This volume is sufficiently

recommended by the name of Agardh, which is as much identified with Algology as that of Linnaeus is with Botany. Since the elder Agardh published his Systema Algarum, there have been such vast additions to the knowledge of this difficult tribe of plants that an attempt to arrange the chaotic materials by such an experienced hand as that of the younger Agardh cannot but be welcome. This volume contains a full description of all the Fucoideæ (Melanospermeæ of Harvey) and appears to be written with great care and judicious discrimination. The second and third volumes which are to contain the Zoospermeæ and Florideæ will be eagerly looked for. J. W. B.

8. *Species Algarum;* auctore FRIDERICO TRAUG. KÜTZING, Prof. NORDHUSANO. 1 vol. 8vo. pp. 922.—This is a handsomely printed volume embracing the whole range of Algæ and even including those obscure organisms, the *Diatomeæ* and *Desmidieæ*, which seem "to hover between two worlds," the vegetable and the animal. About 600 genera are described, of which, as well as of the species, many are new. Much valuable information is contained in this volume as well as in the Phycologia Generalis, and "die kieselschaligen Bacillarien oder die Diatomen" of the same author. J. W. B.

9. *Tabulæ Phycologicæ, oder Abbildungen der Tange, herausgegeben* von F. T. KÜTZING. I. bis V. Lieferung, Gr. 8. Preis einer Lieferung mit 10 schwarzen Tafeln 1 Thlr., colorirt 2 Thlr.—We have not seen any portion of this work, but we learn that as the Diatomeæ have been figured in the author's work on "die kieselschaligen Bacillarien," and the Desmidieæ in Ralf's unrivaled volume, "the British Desmideæ," they will be omitted in this work, which will give representations of the remaining portions of the Algæ. Executed with the skill displayed in the plates to the author's Phycologia Generalis, the work cannot but be a most valuable addition to science.

J. W. B.

10. *Geology of the United States Exploring Expedition under* C. WILKES, U. S. N.; by JAMES D. DANA, Geologist of the Expedition, 750 pp. 4to, with 4 maps, numerous wood-cuts, and an atlas of 21 folio plates. This work which has just appeared from the press, treats of the following subjects.

I. General remarks on the Pacific Ocean—topography and trends of islands—geological structure. pp. 9–26.

II. On Coral Formations—features, structure, origin, distribution and geological deductions. pp. 29–154.

III. On the Hawaiian (Sandwich) Islands—including deductions on volcanic action. pp. 155–284.

IV. V. VI. Society Islands,—Samoan or Navigator Islands,—Viti or Feejee Islands. pp. 285–352.

VII. Pacific Ocean,—1, General view of volcanic action; 2. Origin of some peculiarities in the lithological character of the Islands; 3. Origin of Valleys; 4. Changes of level as indicated by the distribution of Coral reefs, and other evidences; 5. On the general arrangement of land in the Pacific; 6. Origin of the general features of the Pacific and of the Globe. pp. 353–436.

VIII. On New Zealand, particularly the vicinity of the Bay of Islands. pp. 437–538.

IX. On New South Wales, its sandstones, coal formation, fossils, basaltic and allied rocks, degradation and denudation, evidences of change of level. pp. 449–538.

X. XI. XII. On the Philippine and Sooloo Islands—Deception Island—Madeira. pp. 539–556.

XIII. XIV. On a part of Chili.—On the vicinity of Lima, Peru, and the islands of San Lorenzo. pp. 557–600.

XV. On the vicinity of Nassau Bay, Tierra del Fuego.

XVI. On the vicinity of Rio Negro.

XVII. On Oregon and Northern California.

APPENDIX.—1. Fossils of New South Wales; 2. Fossils of Tierra del Fuego and Peru; 3. Fossils (tertiary) of Oregon.

The Atlas is occupied with the drawings of Fossils, 14 folio plates being devoted to New South Wales, 1 to Tierra del Fuego and Peru, and the remaining 6 to Oregon.

There are but 85 copies of this work on sale, and these are in the hands of Mr. G. P. Putnam, publisher, &c., New York City. Only 100 were printed besides the 100 ordered by government.

11. *Report on Zoophytes, of the Exploring Expedition under* C. WILKES, U. S. N.; by JAMES D. DANA.—The atlas of this work has just appeared. The text, a volume of 740 pages in 4to, was announced by us in 1846. The atlas consists of 61 plates in large folio, containing representations of the corals described in the text, very many of which are colored, and exhibit the coral animals drawn from the living Zoophyte. The first 5 plates are devoted to Actiniæ, the elegant figures of which are by Mr. J. Drayton, Artist of the Expedition. The remaining 56 plates with one exception, are from drawings by the author of the work. The volume of plates owes much, artistically, to the superintendence and taste of Mr. Drayton. Less than 100 copies of the work on Zoophytes, have been on sale by Lea & Blanchard, of Philadelphia.

12. *Principles of the Mechanics of Machinery and Engineering;* by JULIUS WEISBACH, Professor of Mechanics and applied Mathematics in the Royal Mining Academy of Freiberg. First American edition, edited by WALTER R. JOHNSON, A.M., Civ. and Min. Eng., Washington, D.C. 2 vols. Vol. II, Applied Mechanics, 364 pp. 8vo. Lea & Blanchard.—This volume, like volume I, is elegantly illustrated with numerous wood-cuts. It treats in a masterly manner of the equilibrium and pressure of fluids, theory of arches; of framings of wood and iron; strength of materials; rigidity of cordage; measure of moving powers and their effects; of animal power and its recipient machines; of collecting and leading water, and on water wheels, vertical and horizontal; on windmills.

13. *The Progress of the Development of the Law of Storms and of the Variable Winds, with the Practical Application of the subject to Navigation;* illustrated by charts and wood-cuts. By Lieut. Colonel WILLIAM REID, C.B., F.R.S., 424 pp. 8vo. *London*, 1849.—The labors of Lieut Col. Reid are adding largely to the amount of information on the nature of storms, and confirming the laws laid down by Mr. Wm. C. Redfield. Another volume from his hands of over 400 pages exhibits the increasing interest which the investigations are receiving, as well as the untiring spirit of investigation and careful research of

the author. This work reviews the subject of storms, explains principles, gives practical directions for navigators, and details many examples of storms in different seas, showing their conformity to the system exposed, and pointing out the lessons which they teach. If with the aid of this work and Piddington's Hornbook of Storms (which is perhaps more convenient and simple), and also the writings of Mr. Redfield, navigators do not learn the character of the winds and gales they have to encounter, they deserve certainly no better fate than the hurricane has in store for careless or willful ignorance.

14. *Outlines of Astronomy;* by Sir JOHN F. W. HERSCHEL, Bart. K. H.—620 pp., with plates and wood-cuts. Philadelphia, 1849: Lea and Blanchard.—This work is a text-book of astronomy, from one of the highest names in the science. It takes up the elements of the science, and leads the student along through the simple principles of motion, refraction, celestial perspective, and terminology relating to our own globe, to the particular survey of the motions of the bodies of the planetary system, comets, planetary perturbations, and sidereal astronomy; and concludes with a chapter on the account of time, and an appendix of four tables, the last of which contains the Elements of Periodical comets at their last appearance.

15. *Patent Office Report for* 1848; 816 pp. 8vo, with plates. Washington, 1849.—The Patent Office Report continues to prove itself a store-house of knowledge on the practical arts. The number of applications for patents during the four years past, exceeds that for the four preceding years by 2,205, the number of caveats by 670, the number of patents granted by 289, the amount of receipts from all sources by $77,284 45, the balance paid into the treasury to the credit of the patent fund, by $21,389 95. Among the patents we observe a fire proof safe with running water as the non-combustible material, to be used when a city is supplied with water by aqueducts—grooved bricks, so made with dovetailed grooves upon their faces that the mortar will lock them effectually together—a varnish of gutta percha and chloroform—a new mode of manufacturing alkaline chromates, by means of the power of a current of steam to take up and carry away the acids of certain salts when brought in contact with them at a strong red heat. The review of patents for the year is followed by a synopsis of the statistical history of the Patent office—a tabular estimate of the crops in 1848; and next detailed observations on the different kinds of products in the several portions of the country, causes of failure or success, with much information on the modes of cultivation and prevention of injuries to crops and domestic animals, including long reports on dairies, sugar cane and its treatment, potato disease, ice trade, U. S. imports and exports of various kinds, and statistics of home trade.

16. *Memorials of John Bartram and Humphrey Marshall, with notices of their Botanical contemporaries;* by WM. DARLINGTON, M.D., LL.D., 586 pp. 8vo, with illustrations.—This work will be gladly welcomed by all interested in the history of American Botany. Bartram was the earliest native American botanist, and the founder of the first Botanical Garden on the continent. His grandfather John Bartram, joined William Penn and removed from England to Pennsylvania in 1682. The botanist was the son of William Bartram, and was born at

Darby, Delaware County, Penn., the 23d of March, 1699. Marshall was born in West Bradford, Chester County, Pennsylvania, in 1722; his mother was a daughter of James Hunt, of Kingsessing, a sister of the mother of Bartram. Bartram lived to the age of 78 years and 6 months, and Marshall to 79 years and 25 days. Our readers might find pleasure in large citations from this elegant volume by Dr. Darlington; but its arrival only at the last moment before closing our number, compels us to give it only a brief notice.

17. *Report on Railroad and Canal Routes between the Atlantic and Pacific Oceans;* by Hon. JOHN A. ROCKWELL. 680 pp. 8vo, with several maps. Report No. 145, made February 20, 1849. House of Representatives, 30th Congress, 2nd Session.—This voluminous document is the result of great research, and embodies a large amount of information upon the resources of the countries through which the proposed routes pass, besides facts bearing upon the feasibility of the courses and plans proposed.

A. LEYMERIE: Du Terrain crétacé de l'Aube, 1 vol. 4to. 2 maps and 18 plates. *Paris.* 18 *fr.*

A. LEYMERIE: Mémoire sur le terrain à nummulites de Corbières et de la montagne Noire, in 4to, with one map and five plates. *Paris.* 7*fr.* 50*c.*

ALBIN GRAS: Description des Mollusques fluviatiles et terrestres de la France, et plus particulièrement de l'Isère, in 8vo. with 6 plates. *Paris.* 5 *fr.*

ALBIN GRAS: Description des Oursins fossiles du départment de l'Isère, in 8vo. 6 plates. *Paris.* 5*fr.*

J. B. POULET: Mémoire sur quelques Coquilles fossiles nouvelles, découvertes dans la région aquitanique du bassin sous-pyrénéen, in 8vo, 6 plates. *Paris,* 4*fr.* 50*c.*

G. P. DESHAYES: Traité élémentaire de conchyliologie, Xe livraison.—This work will form 20 livraisons, in 8vo, constituting 3 vols., of 130 plates.

PLATTNER: On the Blowpipe, edited by Dr. Sheridan Muspratt. 8vo, pp. 432. *London.* 10*s.* 6*d.*

Rev. W. SCORESBY: Zoistic magnetism. 8vo, pp. 144. *London,* 1849. Cloth, 6*s.*

JAHRESBERICHT über die Fortschritte der reinen, pharmaceutischen und technischen Chemie, Physik, Mineralogie und Geologie; unter Mitwirkung von H. Buff, E. Dieffenbach, C. Ettling, F. Knapp, H. Will, F. Zamminer, herausgegeben von Justus Liebig und Hermann Kopp.—For 1847 and 1848.—This is a continuation of Berzelius's Annual of the progress of Chemical Science, published under a new form and plan. The work is issued in parts, and includes notices of all works and articles of the year preceding on the sciences reviewed, and it should be in the hands of every chemist. Parts 1 and 2 have reached us. An English Translation of Part 1, has appeared in London.

E. MILLON ET J. REISET: Annuaire de Chimie, comprenant les applications de cette Science à la Médécine et à la Pharmacie. *Paris.* This annual commenced in 1845. It gives abstracts of the chemical articles of all Journals, and like the annual from Giessen is a work of great value to Chemists. It would seem probable that with a little more effort the authors might succeed in procuring a copy of this Journal for citation, instead of quoting its articles or abstracts of them from reprints in the English Journals.

G. G. PUSCH: Polens Palæontologie, or descriptions and drawings of the fossils of Poland, Volhynia and Carpathia, with 16 lithographic plates in 4to. *Stuttgart.*

BURKHART JOS.: Aufenthalt und Risen in Mexico in den Jahren 1825 bis 1834; containing observations on the surface of the country, its productions, mineralogy, geognosy, mines, meteorology, geography, with an introduction by Prof. J. Noggerath. 2 vols., with 11 colored plates and sections and charts. *Stuttgart.*

A. MOUSSON: Lie Land-und Süsswasser Mollusken von Java. 4to, iv and 126 pages with 22 lithographic plates. *Zurich.* 1849.

C. MÜLLER: Synopsis muscorum frondosorum omnium hucusque cognitorum. Fasc. 4, gr. 8 (pages 481 to 640.) *Berlin.* 1849.

P. M. Opiz: Herbarium floræ Boëmicæ; viii–ix Hundert. Nr. 422-424 fol. *Prag*, (Kronberger.) 1849.

E. Boissier: Diagnoses plantarum orientalium novarum. Nr. 8–11, gr. 8 (517 pp.) *Paris.* 1849.

Dr. H. Koeler: Einige Beobachtungen über die Temperatur der See-Oberfläche im Nord-Atlant. Meere. Gr. 8 (vi and 81 pp.) *Göttingen.* 1849.

Dr. L. Rabenhorst: Deutchslands Kryptogamen-Flora. gr. 8. xvi and 161 to 352 pp. *Leipzig.* 1848.

Dr. R. A. Philippi: Abbildungen und Beschreibungen neuer oder wenig conchylien. 3d volume, 3d and 4th parts, 60 pp. in 4to, with 12 colored lithographic plates. *Cassel.* 1849.

Proceedings of the American Academy of Arts and Sciences, vol. II,—Nov., 1848. p. 9–61. Conspectus of Crustacea collected on the cruise of the Exploring Expedition; *James D. Dana.*—p. 62–99, Action of water on lead pipe; *E. N. Horsford.*—p. 100, Geological action of Tidal and other Currents; *C. H. Davis.*—p. 101, Tornado of Providence; *U. Parsons.*—*Nov.* 14. p. 105, On the causes of differences of strength in magnets of same size and shape; *Lovering.*—*Jan.* 2, 1849. p. 111, On the planet Metis; *B. A. Gould.*—p. 120, On the law of continuity; *Lovering.*—*Feb.* 6. p. 129, Expansion of Steam in review of a memoir by J. Frost.—p. 130, Rise and fall of waters in Lake Superior; *Foster.*—p. 136, On the satellite of Neptune—Encke's Comet in 1848,—eighth satellite of Saturn—Petersen's Second Comet—Moon culminations observed at Cambridge; *Bond.*—*May* 8. p. 148, Memoir on the Bryology and Hepatacology of United States, presented by *W. S. Sullivant.*—Observations on Medusæ; *Agassiz.*—p. 144, On the Comet now visible; *B. A. Gould.*—*Aug.* 8. p. 159, On Argyroxiphium a genus of Compositæ, and on the new genus Wilkesia; *A. A. Gray.*

Annales des Sciences Naturelles, NOVEMBER, 1848.—Researches on Corals, continued.—Astræidæ; *M. Edwards* and *J. Haime.*—On the Ulmaceæ, continued; *J. E. Planchon.*—DECEMBER. On Corals, continued; *M. Edwards and J. Haime.*—On Annelida; *E. Blanchard.*—On the contractile substance in the lower animals; *A. Ecker.*—On the Ulmaceæ; *J. E. Planchon.*—Cryptogamia of France; *Desmazières.*—On Fucus Wigghii and Atractophora hypnoides; *Crouan.*—Voyage in the Province of Goyaz; *A. de St. Hilaire.*—On some genera of Verbenaceæ; *D. Clos.*—On Calceolaria and Jovellana; *D. Clos.*—JANUARY, 1849. New Experiments on the two movements of the brain; *Flourens.*—On the Development of the Tetrarhynchi; *J. P. Van Beneden.*—On the genus Teredo; *A. de Quatrefages.*—On the antheridia of Ferns; *G. Thuret.*—Conclusions on the vegetation of the Féroe as compared with that of the Shetlands and Iceland; *Ch. Martins.*—On some species of Tribuli; *L. Kralik.*—Sixth century of New cellular Plants; *C. Montagne.*—FEBRUARY. On the Anacharis alsinastrum, and a synopsis of the species of Anacharis and Apalanthus; *J. E. Planchon.*—Monograph of the Podostemaceæ; *Tulasne.*—Development of Ferns; *Leszczyesuminski.*—Ibid; *A. Wigand.*—On the genus Teredo, continued; *A. de Quatrefages.*—Organization of the "Opistobranches," Gasteropodous Mollusca, continued; *E. Blanchard.*—New Hymenoptera of Spain; *L. Dufour.*—New species of Dyctiophora; *L. Dufour.*—On Annelida; *E. Blanchard.*

Archiv für Naturgeschichte, No. V, 1847.—Relations of animals to Endozoa; *Creplin.*—Conspectus of the Crustacea of the Exploring Expedition under C. Wilkes, U.S.N.; *J. D. Dana.*—Review of works on Physiological Botany; *J. Münter.*—No. VI, 1847. Conspectus of Crustacea, continued; *J. D. Dana.*—Ornithological notices; *J. Cabanis.*—Review of works on Botany for 1846; *Münter.*—Ibid on Herpetology, Ichthyology and Mollusca; *Dr. F. H. Troschel.*—Ibid on Geographical Botany; *A. Grisebach.*—No. I, 1848.—On the Egg of Snails; *H. Rathke.*—Observations on the Entozoa, Cysticercus and Echinococcus; *R. Leuckart.*—On new Helminthes; *R. Leuckart.*—Light vessel in Porpita and Velella; *A. Krohn.*—New or little known Annelida; *E. Grube.*—Orchestra euchorus and gryphus, new species; *F. Müller.*—On mode of multiplication in the Chlorogonium euchlorum, *Ehr.*; *J. F. Weisse.*—Species of Ctenomys; *A. Wagner.*—On an original drawing of the Dodo by Roland Savery at Vienna; *L. J. Fitzinger.*—Birds of Upper California; *W. Gambel*, with remarks by *J. Cabanis.*—No. II, 1848. Birds of Upper California; *W. Gambel.*—On the Dodo; *Hamel.*—On the egg of Snails, continued; *H. Rathke.*—Review of works on Ornithology; *G. Hartlaub.*—Review of works on Insects and Crustacea; *Erichson.*

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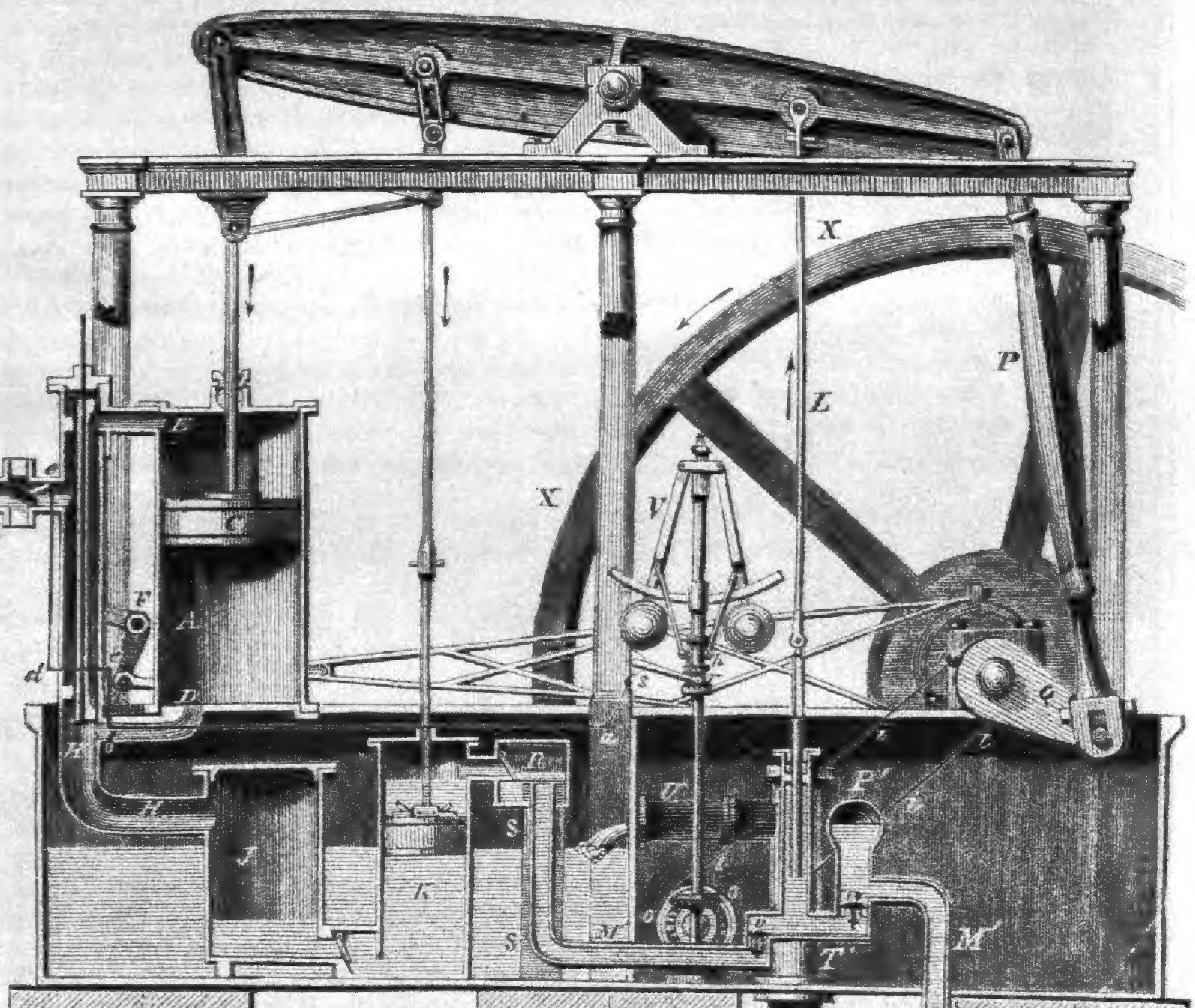

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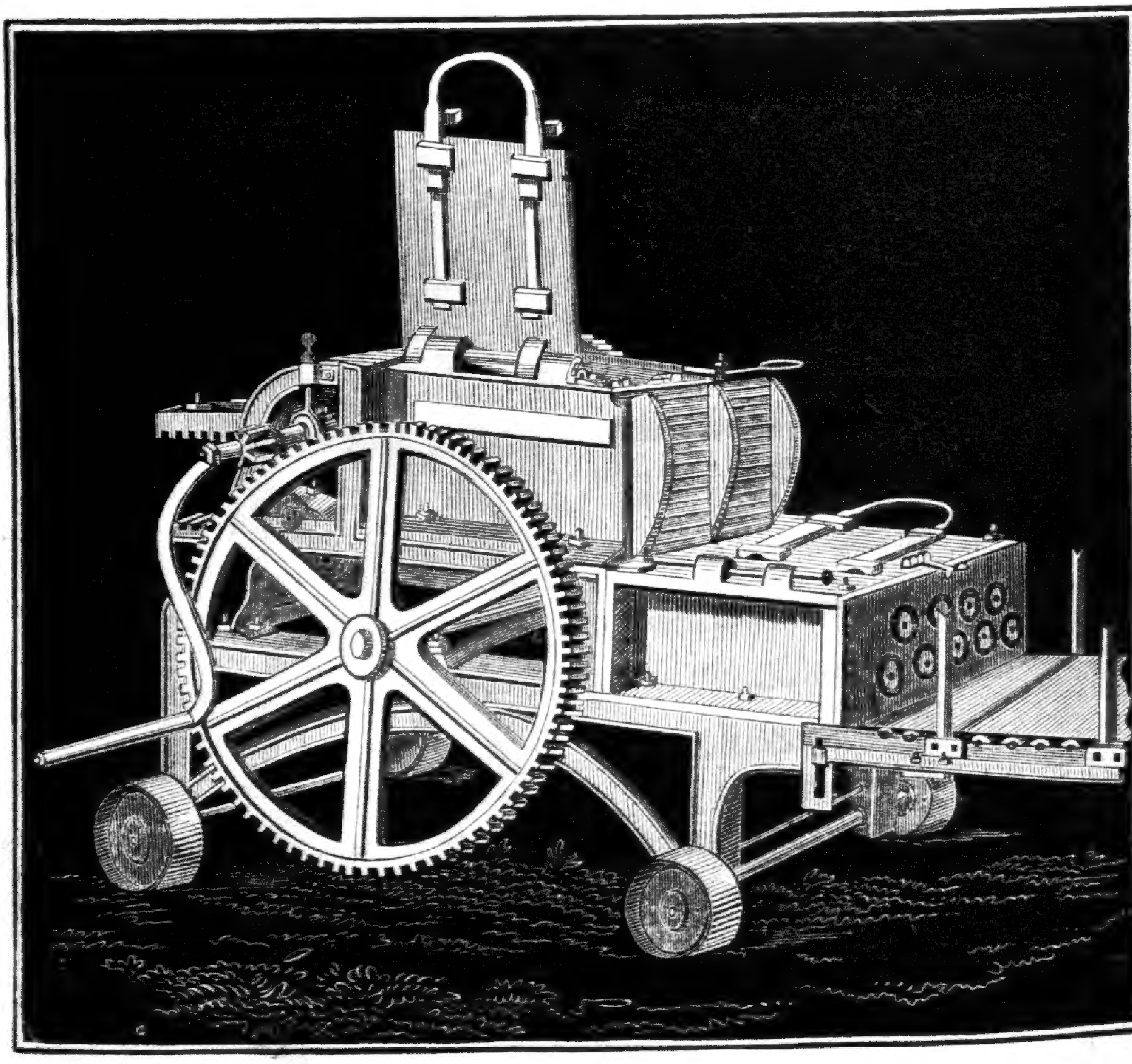

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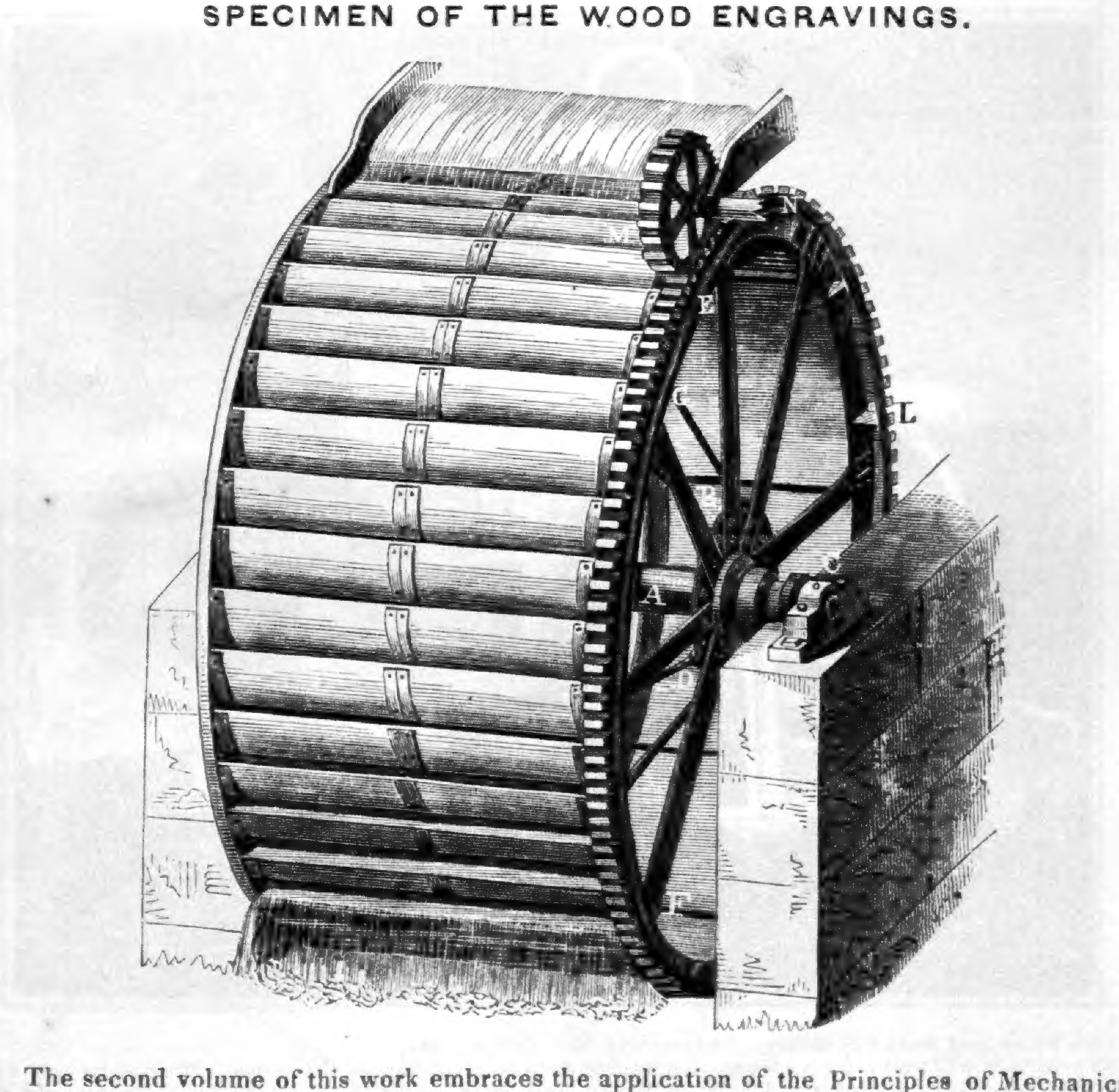
We had the pleasure of noticing, in a former number, the first volume of this excellent work, and of expressing our high sense of its value. We need say little more, therefore, of its continuation, than that it fully sustains the character of its predecessor, both in regard to the value of the original treatise, and the number and importance of the additions which have been made to it by the English editors.—*The British and Foreign Medico Chirurgical Review.*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