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CONDUCTED BY

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CONTENTS OF VOLUME XXIII.

NUMBER I.

Page.

ART. I. Geological and Mineralogical Account of the Mining Districts in the State of Georgia—western part of North Carolina and of East Tennessee, with a map; by Hon. Judge JACOB PECK, - - - - - - - 1

II. On the temperature and Saltness of the Waters of the Ocean at different depths, - - - - - - 10

III. Note on the Progressive Increase of Temperature beneath the surface of the Earth, - - - - 14

IV. Universal Terms—Disputes concerning them and their Causes; by EMMA WILLARD, - - - - - - 18

V. On the action of the second surfaces of transparent plates upon light; by DAVID BREWSTER, LL. D. F. R. S. - 28

VI. On Hail Storms; by A. JONES, M. D., of Augusta, Georgia, - - - - - - - - - 35

VII. Improvement in Field Surveying, - - - - - 37

VIII. On the Origin, Extension and Continuance of Prairies; by Dr. RUSH NUTT, of Rodney, State of Mississippi, 40

IX. Observations on depriving Flowers of their Anthers, to produce Double Flowers; by E. T. LEITNER, - 45

X. Miscellaneous Geological Topics relating to the lower part of the vale of the Mississippi; by Dr. RUSH NUTT, of Rodney, Mississippi, - - - - - - 49

XI. Notice of an Ancient American Utensil; by Prof. WALTER R. JOHNSON, - - - - - - - - 65

XII. Remarks on the Strength of Cylindrical Steam Boilers; by Prof. WALTER R. JOHNSON, - - - - - 68

XIII. A simplification of Dr. Wollaston's Reflective Goniometer; by R. GRAVES, Jr. Civil Engineer, - - - 75

XIV. List of the Plants of Chile; translated from the "Mercurio Chileno," by W. S. W. RUSCHENBERGER, M. D. U. S. Navy, - - - - - - - - - 78

XV. Notice of a Fountain of Petroleum, called the Oil Spring. —EDITOR, - - - - - - - - - 97

XVI. Notice of Wood's Inking Machine, - - - - 103

XVII. Observations on Inclined Planes; by J. THOMSON, - 107

171107

Page.
XVIII. Notice of an improved instrument for Venous Injection, with a figure; by Dr. J. Mauran, of Providence, R. I. - 114
XIX. Francis Huber.—Notice of his Life and Writings; by A. P. De Candolle, - - - - - - - - 117
XX. On the Uses of Chlorides and Chlorine; by A. Chevallier, - - - - - - - - - - - 129
XXI. Action of Chloride of Lime on Alcohol; by M. E. Soubeiran, - - - - - - - - - 134
XXII. Vegetable Physiology in relation to Rotation of Crops; by M. Macaire, - - - - - - - - 138
XXIII. Facts in relation to several Remarkable Deaths attributed to Hydrophobia, - - - - - - - 143

MISCELLANIES—FOREIGN AND DOMESTIC.

1. Museum of Gideon Mantell, Esq. of Lewes, in Sussex, Eng. 162
2. British Association for the advancement of Science, - 179
3. Leipsic Fair, Autumn, 1831, - - - - - - 182

CHEMISTRY.

1. New Experiments in Caloric, performed by means of the Thermo-multiplier, - - - - - - - 185
2. New process for obtaining Morphine, - - - - 190
3. Action of Oils upon Oxygen gas, at the temperature of the atmosphere, - - - - - - - - - 190
4. On the injurious action of gases on Vegetation, - - 193
5. On the Distillation of Bread, - - - - - 194
6. Imitation Silver, - - - - - - - - 195

GEOLOGY.

Cuvier and Brongniart's report on M. Deshayes' "Tableau comparatif des coquilles vivantes avec les fossiles des terrains tertiaires de l'Europe," - - - - - 196

NECROLOGY.

Batavia.—Count Charles Vidua le Gonzano, - - - 198

OTHER NOTICES.

1. Case of treatment by carded Cotton, - - - - - 198
2, 3. Preservation against rust, dampness, &c.—Coating for the preservation of Cordage, Leather and Wood, from the effects of moisture, - - - - - - - - 199
4. Economy of Sealing Wax, - - - - - - - 200
5, 6, 7. Composition for mending crystals, glass, porcelain and crockery—Indelible Ink for marking Linen—How to boil Potatoes, - - - - - - - - - - 201

Page.
8, 9, 10. How to boil Rice—Potatoe Cheese—Collecting swarms of Bees, - - - - - - - - - - 202
11. Trilobite, - - - - - - - - - - - - - 203

DOMESTIC.

1. Fossil Shells of the Tertiary Formations of North America, illustrated by figures drawn on stone, from nature, 204
2. Declination of the Magnetic Needle, - - - - 205
3. Boring for Water, - - - - - - - - - 206
4, 5. Alluvial deposits of the Mohawk—Detection of Corrosive Sublimate, - - - - - - - - - - 207

NUMBER II.

Art. I. Experiments upon the Solidification of raw Gypsum; by John P. Emmet, Prof. of Chemistry in the Univ. of Virginia, - - - - - - - - - - 209
II. The Practical Tourist, or sketches of the useful arts, and of Society, Scenery, &c. &c. in Great Britain, France and Holland. In two volumes; by Z. Allen, Providence, R. I. 1832, - - - - - - - - - 213
III. On the laws of the polarization of light by refraction; by David Brewster, LL. D. F. R. S. L. & E. - 225
IV. The Microscopic Compass; invented by John Locke, M. D., Principal of Cincinnati Female Academy, 237
V. Facts relating to Diluvial Action; by the Hon. Wm. A. Thompson, - - - - - - - - - 243
VI. List of the Plants of Chile; translated from the "Mercurio Chileno," by W. S. W. Ruschenberger, M. D., U. S. Navy, - - - - - - - - - 250
VII. On the Vitality of Toads enclose in Stone and Wood; by the Rev. W. Buckland, F. R. S. F. L. S. F. G. S., and Prof. of Geol. and Min. Univ. Oxford, - - - 272
VIII. On the process of Memory; by Isaac Orr, - - 278
IX. Memoir on the Chemical Analysis of the Atmosphere; by M. Brunner, Prof. of Chemistry at Berne. Translated for this Journal by Prof. Griscom, - - 280
X. Supplement to the "Synopsis of the Organic Remains of the Ferruginous Sand Formation of the United States," contained in Vols. XVII and XVIII of this Journal; by S. G. Morton, M. D., &c. - - - - 288
XI. Account of the Russian Vapor Bath: by T. S. Traill. M. D. - - - - - - - - - 295

Page.
XII. Notice of a Cetaceous Animal supposed to be new to the American coast; by WILLIAM SAMPSON, - 301
XIII. Documents in Commemoration of BARON CUVIER, - 303
XIV. Notices of American Steam Boats; by W. C. REDFIELD, of New York, - - - - - - - - 311
XV. On the Economy of Fuel with reference to its domestic applications; by WALTER R. JOHNSON, Prof. of Mech. and Nat. Phil., Franklin Institute, Philadelphia, 318
XVI. The Rattle Snake disarmed by the leaves of the White Ash; by Judge WOODRUFF, - - - - 337
XVII. On some new Fossil and Recent Shells of the United States; by T. A. CONRAD, - - - - 339
XVIII. Report on the Filter and Prepared Charcoal of M. Dumont; by FRANKLIN R. SMITH, of Philadelphia, - 346
XIX. Notice of Prof. Olmsted's Introduction to Natural Philosophy, for the students in Yale College, - 351
XX. Obituary Notice of Dr. GASPAR SPURZHEIM, - - 356

MISCELLANIES.—FOREIGN AND DOMESTIC.

NECROLOGY.

1. Notice of the deaths of eminent men, - - - - 370
2. Sketches of the lives of Louis Simond and Charles-Victor Bonstetten, - - - - - - - - 371

CHEMISTRY.

1. Combinations of carburetted hydrogen, - - - - 377
2, 3. Separation of the protoxide from the oxide of iron—Narceine, a new substance discovered in opium, - - 379
4. Meconine, - - - - - - - - 380
5. Effects of the thermo-multiplicator, - - - - 381
6, 7. Oxygenated water—Two chlorides of sulphur, - 382
8, 9. Density of the vapor of sulphur and of phosphorus—Preservation of substances by means of alkalies, - - 383
10, 11. Crucible for fusion—Researches relative to the azote formed in animal substances, - - - - 384
12. Process for silvering copper so as to polish, - - 386
13, 14. Glass syphons for transferring corrosive fluids—Carbonate of lime and its compounds, - - - - 387

GEOLOGY.

1. New cave of bones, - - - - - - - - 388
2. Notice of Prof. Hitchcock's Report on the Geology of Massachusetts, - - - - - - - - - 389

ASTRONOMY AND MECHANICAL SCIENCE.

Page.
1, 2. Biela's comet—Observatory of Geneva, - - 390
3, 4, 5. Medal for discovery of Comets—Maximum density of water—On the simultaneous motions of a pendulum and the surrounding air, - - - - - - - 391

AGRICULTURE AND DOMESTIC ECONOMY.

1. On the cultivation of beets and the manufactory of sugar, 392
2. Relative values of different kinds of food for sheep, - 393

DOMESTIC.

1. Professor Jacob Green's Monograph of the Trilobites of North America, with colored models of the species, 395
2. The Herbarium of the late Zaccheus Collins of Philadelphia, 398
3. The coal beds of Pennsylvania equivalent to the great secondary coal measures of Europe, - - - - 399
4. Correction of an error in Prof. Green's Monograph of North American Trilobites; with additional explanations, 400
5. Caution addressed to manufacturers and venders of inflammable substances, especially if volatile, - - - 401
6. The Cabinet of Natural History and American Rural Sports, with illustrations, - - - - - - 402
7, 8. Manufacture of Telescopes, &c.—Phosphate of Lime in Edenville, N. Y., - - - - - - 403
9. Geological Map, - - - - - - - - 404
10, 11, 12. Fossil Shells of the Tertiary Formations of the United States—Anthracite in Wrentham, Mass.—Comparison of weights and measures of length and capacity, reported to the Senate of the United States by the Treasury Department in 1832, - - - - - - - 405
13. Revised editions of Spurzheim's Works, - - - 406

ERRATA.

Corrections and Alterations from copy.

Page 1, l. 4 from top, for *Wuaka*, read *Unaka*, and so at the several places where the word occurs.—p. 3, l. 9 fr. top, for *Waldeus*, read *Waldens;* l. 15 fr. bottom, for *Wilhero*, read *Withero;* l. 10 fr. bottom, for *strong*, read *stronger*.—p. 4, l. 10 fr. bottom, for *view*, read *vein;* l. 5 fr. bottom, for *Six*, read *Six's*.—p. 5, l. 7 fr. top, dele *and;* l. 27 fr. top, for *this substance*, read *this latter substance*.—p. 6, l. 11 fr. bot. after *smell*, read *of copperas;* l. 8 fr. bot. for *and thus*, read *had thus*.—p. 7, l. 7 fr. bot. for *is*, read *are;* l. 5 fr. bot. insert a period after *deep;* l. 3 fr. bot. erase the period after *Town*, and insert it after *law;* l. 2 fr. bot. erase the period after *River*, and insert *and*.—p. 8, l. 11 fr. top, for *veins are placed*, read *views are placid;* in the note at bottom, for *Cone*, read *Cane*.—p. 10, l. 9 fr. top, for *cave*, read *cove;* l. 15 fr. top, for *Chitteawee*, read *Chilhawee*.—p. 177, l. 7 fr. bot. for *familiar*, read *peculiar*.—p. 191, l. 13 fr. top, for *observed*, read *absorbed*.—p. 210, l. 12 fr. top, after water, omit the , *and*.—p. 237, l. 7 fr. top, after *a*, insert *pocket*.—p. 239, lines 2d and 5th fr. bot. for *the degrees on the card, and the object*, read *the object and the degrees on the card*.—p. 240, l. 7 fr. top, for *lens*, read *lines*.—p. 241, l. 13 fr. bot. for *several*, read *open*.—p. 242, l. 5 fr. top, for *on*, read *one;* l. 14 fr. top, after *described*, read *the reflector M should be one tenth of an inch wide;* l. 17 fr. bot. for *screen*, read *screw;* l. 16 fr. bot. for PHP, read EP.—p. 244 l. I, for *cellars, of*, read *cellars, in*.—p. 246, l. 11 fr. top, for *Hill*, read *Kill*.—p. 248, l. 7 fr. bot. for *Crawford*, read *Crawford's*.

☞ The Editor was absent on a journey, when the abstract of the experiments, p. 185 of this Vol., by MM. Nobili and Melloni, by the thermo-multiplier, was inserted; it was not observed, that a notice of these experiments had been already given in the preceding No., Vol. XXII, p. 370.

Vol. XXII, pp. 134 and 135. The expressions marked (8), (9), (A), (B), (C), should each be put $= 0$.

The following alteration, came to hand too late for insertion in the proper place. This Vol. p. 397, l. 3 fr. top, and p. 398, l. 1, for *Myrmecoïdes*, read *Myrmecophorus*.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Geological and Mineralogical Account of the Mining Districts in the State of Georgia—western part of North Carolina and of East Tennessee, with a map;* by Hon. Judge Jacob Peck.

The most remarkable geological features presented in traversing the country from *Knoxville*, on a line south-east through the mining regions, are three principal ranges of mountains. The first is the Wuaka, more frequently called Smoky mountain. This eminence is the line between North Carolina and Tennessee. The next is the Coweta range; and between thirty and forty miles in the same direction, the *Blue ridge*. The first and second of these ranges are broken by the waters running into the Tennessee river, as they pass off in a north and north-western direction. The Blue ridge divides the waters emptying into the Ohio, and those passing directly south-east into the Atlantic.

To these mountains there are subordinate hills and spurs of the main ranges. Most of them have a general parallel direction conforming to the range of the main mountains.

It seems to me that nothing will strike the inquirer into the geology of this section, as more impressive or worthy of remark, than this general parallelism of the principal mountains, and of the *strata* which accompany, and may be said to form them.

The range runs north-east and south-west, and although deviations are observable; still, in the main direction, the feature is distinct and not to be overlooked.

The principal mountains are of considerable elevation. Some admeasurements have been made to ascertain the height of Smoky mountain and the Blue ridge; but I am not apprised of any observations which may be relied upon as fixing the probable medium elevation. Professor Troost, who has explored part of Smoky or the Wuaka range, comparing it with other mountains he has visited, the altitude of which has been ascertained, believes this mountain may be safely stated at four thousand feet above the level of the sea. The Blue ridge is still more elevated; though the approach to this elevation is so gradual at most of the places where the road passes, that we might at first doubt of its having a superior elevation. The very great fall of the waters having their source in the Blue ridge to the point where the Wuaka is broken down by their current, and also views taken from midway elevations between those mountains are satisfactory to prove the superior elevation of the range dividing the waters.

Smoky mountain separates the transition from the primitive formation. This may however not be uniformly true; in Washington county, the primitive is found at one place on the north-west side, and some of the graywackes may be found in places south-east; still without descending to minutiæ, the mountain, may well serve for this boundary.

From the Chilhowee mountain, which ranges north-west of the Wuaka, and about twelve miles from it, until one has passed over the Blue Ridge in Georgia, there is presented a series of mountains. The larger streams winding amongst them afford narrow bottoms, and with the exception of three or four small vallies at the heads of the large streams next the Blue ridge, the country may be said to be almost uninhabitable; each side of the *Wuaka* mountain presents nature in her most romantic aspect—

"Alps on Alps arise!—"

He who delights in the wild and picturesque will have before him an ample field. To me it seemed strange that so little had been known of this section, where each remove and change of position always presented something new and charming to the naturalist. Streams, waterfalls, towering cliffs, peaks and hills of every degree of acclivity, as we ascend the mountain; these features present a pleasing and striking assemblage of the beautiful and sublime. The field for the painter is infinite. I might dwell upon trees, plants, flowers, animals and reptiles, but my business is with the rocks.

The natural division of the country between Chilhowee and the Yeona range gives three separate sections; one in Tennessee, one in western North Carolina, and the other east of the Blue ridge in

Georgia. A remarkable chain of mountains lies along the course of the heads of Frenchbroad. Some of the highest peaks in this chain have been described in the American Journal of Science. At the other extremity of the bounds I have allotted myself, the parallel position of mountain ranges is in some measure lost. The Blue ridge and the Wuaka approach each other and form jointly the separation of the eastern from the western waters. As this new formed range continues west, another range not less formidable approaches from the north, Waldeus ridge and Cumberland mountain; these unite themselves with the former, and this union takes the name of the Lookout mountain. At this point of intersection, where the union of immense mountains on either side once formed a barrier to the streams which flowed from fifty thousand square miles of country; the evidence at this place of the war of elements is the admiration of all who pass the broken mountain, through the *suck* and boiling *chaldron*, near the confines of the state of Tennessee. The power that gave such magic to the scene at Harper's ferry, had operated here also; and while the trident made in the one place, a passage for the slippery element to the east; another stroke at one thousand miles distance, cleared a passage for the same element to the west, equally romantic and not less sublime.

Leaving for the present further delineations in outline, let us turn to the section in Georgia, east of the Blue ridge. The discovery of gold in Habersham county has been so recent, not more than two years since, that but little has been done to develop the metals concealed there. A gentleman of the name of Wilhero, made researches by comparing the face of the country and appearance of the branches and streams with the gold section in North Carolina, and found deposits of gold through Habersham and Hall counties, and then discovery followed discovery. In the Cherokee nation which was separated by the Chestetee river, the indications of gold were not strong, but research caused it to be proclaimed richer than any part of the region hitherto explored. The nation was intruded on as a common, and for a time, not less than five thousand adventurers dug up the face of the country; rich, as it certainly was, it is questionable whether the counties spoken of were not equally so; the lands in the latter being private property, were not overrun as was the nation; and all the hands employed in collecting gold on the lands granted, amounted, it is believed, to not more than one thousand; the owners of the land were many of them poor and destitute of enterprise. With the exception of a few deposits, the most valuable tracts were sold to speculating adventurers; many of these have frequently changed owners at enhanced prices; a few companies, not exceeding four, have commenced regular operations with a view to gold.

In a few instances, in the vicinity of rich deposits, veins had been discovered and opened, but more skill has pointed out other indications of gold veins; they are founded principally upon the fact that every branch contains gold arising evidently from the disintegration of veins. The veins in this country must be numerous; and it has been remarked by miners from Spanish America, that until they operated in North Carolina and Georgia, they had not been enabled to find veins at the surface; one cause of the hazard in mining for gold in Mexico, is said to be the absence of the indications so abundant here. While the Georgian finds the vein with the gold visible at the surface, the Mexican miner at the base of a mountain searches for a slate, (the talcose,) and when found, he drives in a tunnel with the hope of striking a gold vein traversing its bed. Perhaps other striking differences may have been produced by the volcanic action in Mexico, breaking, distorting, or forever concealing the vein, while in Georgia no such agent has operated. Here the veins have a regularity, a uniformity of position wholly inconsistent with the supposition of fire having been the agent in giving laws to the veins and strata of the country which I have examined. This I speak with due deference to the friends of the god of fire. To prove Vulcan the agent, his advocates must draw distinctions between his manner of working where his fires have been long extinct, and where at present he heaves to the skies his confused masses; and to escape lashings for my infidelity, I will not venture to give all the credit to Neptune, although he has left more visible marks than any which may be placed to the credit of the former.

A view of hornblende slate, (diabase,) passing throughout the gold region of Georgia, though it produces little or no elevation of the surface is remarked by every gold hunter; it occupies a middle space between the Yeona and Horse range mountains. It is used as an index to the gold country, and has been traced from Alabama, through the Cherokee country near the Six, passing Cane creek, the corner of Hall county through Habersham and Rayburn, into the Blue ridge, in a direction to reach the gold works in Burke county, North Carolina. The general course is between north 35° and 40° east. For miles on both sides of this vein has been found the greatest abundance of gold; most of the veins opened, are near and lie parallel to it; thus have been discovered the finest deposits.

At some distance on either side, the granite rears its wedge like top in lines generally parallel. This rock, by disintegration, is usually rounded off. Gneiss and mica slate are common; these alternate with diabase. Veins of talcose slate, hornblende, garnet, quartz, euphotide, imperfect soapstone, and with veins and beds of kaolin. Most, if not all these lie in parallels, (to use the workmen's phrase,) like the leaves of a book; their relative position I was not enabled satisfactorily to fix. The strata are generally vertical, though when a dip is observed, it is to the north-west toward the base of the Blue ridge.

When it is in veins, more gold has been found in quartz rock than in any other substance. The vein of quartz may be found at the surface, usually running with the talcose slate, and sometimes with that slate passing into mica slate. Very frequently it is associated with hepatic pyrites, often greatly decomposed, (particularly at the surface.) Such is the quantity of iron in some veins, that it would seem to be the gangue; but much as it may predominate, still a portion of quartz is present; and the same remark applies to the talcose slate where it is found to contain gold; there is always a portion of quartz associated with it; usually it is granular, and disseminated with the gold; and with this rock there is less of the pyrites, and if any, the cubes are small.

Gold is found in veins of quartz, running with greenstone, passing into chlorite; often the quartz is diffused and splintery, with a trace of iron and kaolin; but in general this substance is in the wall of the vein on one side. Some of the best deposits seem to have had their supplies from such sources. Loud's and Hughes's deposits may be placed to this latter class of veins. They are rich; the gold is in large and rough pieces, holding in its filaments and thin plates, portions of finely granular quartz. I did not see any vein of this character so far opened as to develop a satisfactory view of its association; *one*, in which the writer had an interest, contained much gold, but it was hard to penetrate the gangue, and for the first ten or twelve feet, was found in confusion: my opinion is, that should these veins in the descent become ochery, they might be easily worked.

Humphrey's vein on the Chatahoochy, was quartz, walled with talcose slate. The masses of quartz containing the gold were reniform; it is rich; it had not been opened to the water. At the base of the hill, where the stream had laid bare the formation, the hornblende slate crops out, affording evidence that the talcose slate rests upon it. This I have remarked in many places, as well where digging has made the disclosure, as where the streams have broken the hills. A Mr. Lyon has opened at least two veins exemplifyiug this position; and Loud's *vein* is another example. The end of the Horse range mountain, broken down by Duke's creek, gives still further proof of the superposition of the talcose slate, upon the diabase, the gneiss and mica slate.

While penetrating the talcose slate, the veins of quartz are seldom found in situ; reaching the diabase in the descent, the vein is usually larger and richer in gold. This rock, the base of the talcose slate being compact, holds the water above it; it doubtless rests upon gneiss or granite. If it be true, as some suppose, that the depth of veins is somewhat proportionate to their length, we may in this country anticipate very deep mining before veins are exhausted or wedged out.

Before I quit the subject of the gold veins of Habersham, I will mention one differing in structure from those treated of; it is on the Tesantee; the wall is talcose slate; next the vein it is a protogene or talcose slate, passing into mica slate with quartz. The center of the vein contained quartzose blocks, or thin flag, lying parallel to the wall; the whole was very dark and ferruginous, and full of gold finely diffused through it: the wall and vein could be separated in thin pieces, and was easily reduced, [broken?]

The variety observable in the veins of Georgia, consisted more in the form in which the substances were associated, than in the substances themselves. The black crust observable on the rock taken out near the surface, could best be accounted for by examining one of the veins opened below the water. At Loud's, a strong smell was given off as soon as the rock was exposed to the air; this arose from decomposing pyrites, the ore containing this substance in its own gangue, and thus produced the black stain and apparent scoriæ, supposed by the diggers to have some resemblance to lava or cinders; and it is attributable to this mineral that the stain on the boulders is produced in branches, and the smaller pebbles are conglomerated together by this ferruginous matter.

Of the other metals, and of the crystals of this region, I can say little: there is iron and oxide of titanium in great abundance; also, copper pyrites in Rayburn; of these the specimens shown me were beautiful; its locality was kept a secret, but it was said to be abundant. There is lead on the head of Mill creek, Habersham. The specimens of the ore furnished to me were in cubical crystals. There is a report of mercury taken out of deposits with gold at places where mercury had not been used in the stream by the washers. I had no ocular proof of the fact, but must rely upon the information of respectable gentlemen, who affirmed their knowledge of its existence. Silver is associated with the gold at New Potosi, on the Chistitee. Garnet, tourmaline, small staurotides, prismatic quartz, zircon, &c., and varieties of pyrites, are also found.

I shall enter into no speculations on the probable results to the community from the new pursuit of mining. So far as it may be seen in Georgia, I will not anticipate an unfavorable issue to adventurers, or to the country; in a country where monopolies are unknown, every new enterprise is likely to be carried by some beyond the point of discretion; and where sobriety and education are both upon the advance, I may hope that the profligacy which has been the bane of society in other mining countries, will not find place, or at least take deep root in this. The section described is immensely rich in metals, and the wise will no doubt turn this gift of providence into a blessing; the country has as fine water and air as is drunk or breathed in the world, and there is much good land.

I now pass from Georgia over the Blue ridge, into the western parts of North Carolina. This mining section is mostly in the Cherokee country. I will not pretend to enumerate all the places where gold has been found. Immediately bordering on the north-west side of the Blue ridge, there are fine table lands; the country is high, and a northern exposure renders it cold, and the season short for the latitude. Twelve miles out of the valley, in Habersham, over the ridge to the head of the western waters, makes a change equal to several degrees of latitude, arising from the eastern declivity meeting the sun's rays, and having the western winds broken off by the mountain. These lands are formed by the disintegration of hills of the Blue ridge; the rocks and base of the formation is much covered up; where the surface is so formed, it would be natural to suppose that gold in deposit would lie deep in these western parts, situate in Georgia, which includes the upper waters of Highwassa and Brass Town. The digging for gold is forbidden by law on the Nantiale, Valley River. On the head waters of Little Tennessee and the Tuckasage, all in North Carolina, gold has been found; how far, in general, it may be called a country rich in that metal, I will not pretend to say. The whole region is like Habersham, primitive, and the rock and ferruginous hue of the soil are the same; being alike in geology, and but little as yet developed, I would not pronounce it less interesting; in extent, it surpasses the region described in Georgia.

VALLEY RIVER, if viewed in any respect, is very interesting. The scenery is picturesque beyond description. The talcose slate predominating in the hills, leaves them barren of timber, but clothed with grass, rounded off and destitute of those bold cliffs, so common in the smoky mountain ranges; the veins are placed, with remote mountains in the back ground, which ever way the view is taken.

But to the rocks again. The formation in which the gold is found differs from any thing I had before seen. It is a protogene mica slate, passing into talcose slate, holding within its masses the largest staurotides, many of these crystals are of the size of a man's wrist,* most distinctly crossed and interwoven and of every size, from that of a straw up to several inches in diameter. The slate rock which I now mention breaks up into rhomboidal portions. The quartz is in great masses, very compact and of a yellow hue, the gold is large and I confess I could not fix its gangue; much deposit gold is found in the bottom of the river. Every part of the valley did not present like appearances. There were ferruginous spots of deposit, where the gold was abundant and in fine particles, but the value of it was depressed by an alledged alloy; one of the localities where it was thus found gave signs of much labor having been performed. An Indian occupied and claimed the spot.

In this vicinity are the remains of ancient works; many shafts have been sunk, and (judging from the masses thrown up) to great depths; one of those was through quartz rock. About thirty feet of it in depth lay open to the view; there is also a deep and difficult cut crossing a very bold vein of quartz, it is much filled up having been used for an Indian burying place. Not far from this work of art where nothing short of the steel pick, could have left the traces found, are the remains of a small furnace; the walls had been of soapstone; out of the inner wall I broke off cinders. In connexion with these

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* Staurotides are found with the gold, in Cone creek.

remains of art *found here*, I will mention some relics discovered in *Habersham*. From Richardson's deposit, not far from Yeona mountain, there were taken out of the washed mass hundreds of *Gun flints*, perfect and beautifully fashioned; they are very large, and Dr. Troost says of French manufacture; I presented him one for his museum. Lately out of another deposit a small vessel in form of a skillet, was dug up at the depth of fifteen feet. It is a compound of tin and copper with a trace of iron, and this it is said by the assayer Dr. Troost, is an evidence of its antiquity. A stone wall remains on the top of Yeona mountain; it exhibits the angles of a fortification, and guards the only accessible points of ascent to the top. Timbers in the Cherokee Country bearing marks of the axe have been taken up at the depth of ten feet below the surface. Indian tradition reaches none of these remains. I leave them to the antiquarian.

In the order of my return to Smoky mountain from Valley River, a passing notice of the prospect of mines on Nauteale and Tennessee, above the mountain must not be omitted. Both these streams and their lower branches contain gold. At Wealch's below the mouth of the Tuchasage there is much deposit gold, of which I procured some very fine specimens. The rock formation in this section, is a fine grained gneiss, mica slate and an indurated talcose slate mixed with quartz and garnet, with small cubic iron.

Between the Smoky mountain and Blue ridge, and its transverse from the upper waters of the French bread to the Lookout mountain, containing five thousand square miles, there is a field presented to the mineralogist not perhaps equalled for extent and interest in the United States. The whole range of Smoky mountain is interesting; as before remarked it is the line between the primitive and transition, its acclivity is very steep, and its top extremely narrow. Quartz, talcose slate and greywacke are the principal rocks. Gold has been taken out of all the streams descending from it, on either side. Dr. Troost has explored a portion of it, thirty miles, and so far as he has examined, pronounces it a gold region. The formation on the Tennessee side being different, I cannot hazard an opinion whether it will yield other valuable metals, besides gold. Iron ore in many of its varieties, titanium and native silver with the gold washed out at Coco creek, may be taken as favorable indications. The rocks of this mountain are unlike those of the Blue ridge. That mountain is gneiss, with few veins of quartz, but Smoky mountain contains immense masses of quartz rock, and where the quartz does not predominate, the graywacke takes its place. Where the spurs and belts of this mountain have been broken away, veins of quartz running with the talcose slate are observable. Here, as in Georgia, gold has been found in quartz rock out of place, but no vein has been opened. Coco creek is a very rich deposit, but as yet few deposits have been opened or washed. In Washington county near this mountain, an interesting cave produces out of the same bank, iron, lead, zinc and copper, but the mine has not been explored to any considerable depth. That science and enterprise should not have been awakened, to explore this whole region, may well be a matter of some surprise; mining however, is but just begun, and countries thought to be richer, have called off adventurers.

Leaving the auriferous regions, we reach the Chitteawee range of mountains; here roofing slate of a superior quality may be traced for fifty miles. Marbles of many and very beautiful varieties are traced parallel to the strata, which, as we observed through our excursions, have never lost their position. We have next the graywacke slate, and with it the red sandstone formation; lead, in a line parallel with the range of mountains, may be traced from Washington county into the Highwassa district.

Conscious that my sketch must be imperfect, I with diffidence, resign it into the hands of more scientific observers, with the earnest hope, that while it awakens curiosity, it may call into the field those who have more time and superior means for investigation.

Art. II.—*On the temperature and Saltness of the Waters of the Ocean at different depths.*

From the Edinburgh Journal of Science for April, 1832.

M. Lenz, naturalist to the expedition of Kotzebue, made a series of well conducted experiments on the temperature and saltness of the ocean in different latitudes and at various depths. The instrument he employed for ascertaining the temperatures was an improvement upon that of Hales, being a large cylinder closed at both ends by valves opening inwards, to one of which was attached a thermometer, and surrounded by a highly non-conducting substance.—The results are contained in the following table :—

	Time of observation.		PLACES.			Depth in toises.*	TEMPERATURE.	
			Lenz.	Lat. N.	Lon. W.		At surface.	At depths indic.
1	1823.	Oct. 10,	Atlant. Oc.	7° 21′	21° 59′	539	25°,80C.	2°,20
2	1824.	May 18,	South Sea.	21 14	196 1	140,7	26,40	16,36
3	"	"	"	"	"	413,0	"	3,18
4	"	"	"	"	"	665,1	"	2,92
5	"	"	"	"	"	914,9	"	2,44
6	1825.	Feb. 8,	"	25 6	155 58	167	21,50	14,00
7	"	Aug. 31,	"	32 6	136 48	89,8	21,45	13,35
8	"	"	"	"	"	214,0	"	6,51
9	"	"	"	"	"	450,2	"	3,75
10	"	"	"	"	"	592,6	"	2,21
11	1826.	Mar. 6,	Atlant. Oc.	32 20	42 30	1014,8	20,86	2,24
12	1825.	Aug. 24,	South Sea.	41 12	141 58	205,0	19,20	5,16
13	"	"	"	"	"	512,1	"	2,14
14	1826.	Mar. 24,	Atlant. Oc.	45 53	15 17	197,7	14,64	10,36
15	"	"	"	"	"	396,4	"	9,95

From this table the following conclusions may be drawn :

1. Between the equator and 45° the temperature of the ocean decreases regularly to the depth of a thousand fathoms,—beyond this no experiments have been made.

2. The decrease of temperature is at first rapid, it gradually decreases, and becomes at last insensible.

3. The point where the decrease becomes insensible appears to rise with the latitude. At 41° and 31° it is between two hundred and three hundred fathoms, at 21° it is near four hundred. To this remark there appears to be a slight exception at 45° 53′, when the temperature at four hundred fathoms is still at 10° C. but perhaps that observation is modified by the proximity of the land, since it was made in the Atlantic Ocean only 15° W. from Greenwich, and consequently near the coast of Europe, while the others were made in the south sea far from any continent; but even in this case the point where the decrease of temperature becomes insensible is still evidently near two hundred fathoms.

4. The lowest temperature observed is 2.2° C (36° F.) and it is perhaps that of all the depths at which the decrease is insensible. The locality of that temperature rises with the latitude; and it would be interesting to know at what latitude it reaches the surface.

The results of M. Lenz, in regard to the saltness of the sea, have been deduced from its specific gravity. It had previously been

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* A toise = 1.066 English fathoms.

shown by M. Ermann that salt water having a specific gravity of 1.027, the mean of that of the sea, diminishes in bulk gradually down to 25° F., and does not reach its maximum density before congelation. M. Ermann's experiments on this contraction extended from 59° F. to 25°, M. Lenz extended them up to 86°, and thence deduced a law for reducing the specific gravity at any one temperature to what it would be at any other. The following table exhibits the specific gravity corrected to the temperature of 63.5° F., distilled water at that temperature being reckoned unity.

No.	Lat. N.	Lon. E.	Depth in toises.	SPECIFIC GRAVITY.		Difference.
				At surface.	Beneath.	
1	7°20′	21°59′	539,0	1,02574	1,02645	−0,00070
2	21 14	196 1	665,1	1,02701	1,02666	+0,00035
"	"	"	929,4	"	1,02659	+0,00042
3	25 6	156 58	167,0	1,02706	1,02674	+0,00032
4	41 12	141 58	205,0	1,02562	1,02609	−0,00047
"	"	"	512,1	"	1,02658	−0,00096
5	32 6	136 48	214,0	1,02678	1,02624	+0,00054
"	"	"	450,2	"	1,02651	+0,00027
"	"	"	592,6	"	1,02629	+0,00049
6	32 20	42 30	1014,7	1,02825	1,02714	+0,00111
7	45 53	15 17	396,4	1,02738	1,02732	+0,00006

From this table we see that in the experiments No. 1 and 4 the specific gravity of sea water towards the bottom is a little greater than at the surface, but that the contrary holds in Nos. 2, 3, and 5. In experiment 7 the specific gravity of the surface differs so little from that of the bottom that we may consider them as equal. For the first two cases we may suppose that a rapid evaporation had at that time determined the slight increase of density at the surface, as abundant rains may have diminished it in experiments 2, 3, and 5. It is remarkable that in the same place the specific gravities are almost exactly the same for different depths, if we except that of the surface. No. 6 alone offers a striking exception, giving at the depth of a thousand fathoms a specific gravity much less than at the surface. We cannot suppose this difference to be due to an error of observation, the specific gravity at the bottom being the mean of three observations agreeing with each other, and that of the surface corresponding with the observations of the day before and the day after. The irregularity may perhaps be due to a current of colder and less salt water flowing at the bottom from the pole to the equator,—a point, however, which can be determined only by repeated observations. Leaving out this latter observation, we may conclude that *from the equator to 45° N. lat. the water of the sea to the depth of one thousand fathoms possesses the same degree of saltness.*

M. Lenz gives also two tables exhibiting the results of 258 observations made on the saltness of the sea at the surface, 105 of them made in the Atlantic Ocean, between 56° 41′ S., and 50° 25′ N. lat., and 153 in the South Sea and Indian Ocean, between 57° 27′ S. and 56° 22′ N. Lat. From these tables he deduces the following results:—

1. The Atlantic Ocean is salter than the South Sea; and the Indian Ocean, being the transition from the one to the other, is salter towards the Atlantic on the west than towards the South Sea on the east.

2. In each of these great oceans there exists a maximum of saltness towards the north, and another towards the south,—the first is farther from the equator than the second. The minimum between these two points is a few degrees south of the equator in the Atlantic Ocean, and probably also in the South Sea, though Mr. Lenz's observations do not extend to latitudes sufficiently low in the South Sea.

3. In the Atlantic Ocean the western portion is more salt than the eastern,—in the South Sea the saltness does not appear to differ with the longitude.

4. The greatest specific gravity is found in the Atlantic at the maximum point above alluded to, at 40° W. Long—1.02856.
In the South Sea at 11° 9′ = 1.028084.

This last is the only one in the South Sea giving a specific gravity reaching 1.028.

5. In going north from the northern maximum, and south from the southern maximum, the specific gravity diminishes constantly as the latitude increases.

Whence then, says M. Lenz, come these maxima towards the north and south, why is the maximum not rather at the equator? To answer this question, we must inquire what chiefly determines the saltness of the surface. Evaporation exercises the greatest influence, and by this evaporation the occurrence of these maxima may be explained. In fact, evaporation is influenced both by the heat of the sun, and by the more or less rapid motion of the currents of air. The solar heat is greatest on the equator, but there, on the other hand, the motion of the air is least. It is remarkable that in the Atlantic Ocean the minimum coincides precisely with the locality of almost constant calms. The vapors raised by the heat of the sun remain suspended above the surface of the water, and prevent farther evaporation. The sea loses thus less of its aqueous particles, and it is consequently less salt than at 12° N. and 18° S. Lat. In these regions the trade winds carry off immediately the vapors formed by the solar heat, which is here little less than at the equator, and give place to other vapors which rise immediately. In this way evaporation proceeds, and the saltness increases rapidly. This consideration would explain also the greater saltness of the western part of the Atlantic Ocean, for we know that the more we approach the coasts of Africa, the more frequent and more continued are the calms. In the South Sea, great calms are not experienced towards the east, and hence the longitude has no influence on the saltness of its waters.

Art. III.—*Note on the Progressive Increase of Temperature as we descend beneath the surface of the Earth.*

From the Edinburgh Journal of Science for April, 1832.

It is long since the attention of scientific men was first directed to the observation of the high temperatures of mines, and the natural inference it appears to suggest. The deeper the mine, the higher in general is the temperature; and data have been carefully collected, and an expression deduced from them, of the rate at which the temperature increases as we descend from the surface into the bowels of the earth. The mean rate of increase, calculated from experiments made in six of the deepest coal mines in Durham and Northumberland, is 1° F. for a descent of forty four English feet. Cordier found it in some French mines to increase more rapidly; and the latest and apparently most carefully deduced result, that of Kupffer,* makes the temperature to increase 1° for every 36.81 English feet.

But objections of various kinds have been made to this result. Some have even refused to believe that the high temperature of mines indicates any increase of heat in the centre of the earth. They have affected to discover in the presence of many workmen,—in the candles burned,—in the gunpowder frequently employed for blasting, —and more lately† in the condensation of the air constantly rushing

* Pog. An. xv. p. 159. † Edin. Review, No. ciii.

from the surface, sources of heat amply sufficient to raise the air and water to the temperature they are found to possess at great depths. These objections have been severally and satisfactorily answered, and the last and most ingenious of them has been ably refuted by Mr. Fox,* who has shown, that in the Cornish mines the *ascending* has generally a *higher* temperature than the *descending* currents. The difference varied from 9° to 17°, showing that, instead of imparting heat, the currents of air actually carry off a large quantity of heat from the interior of the mines.

It has been objected also to the doctrine of a central fire, that we perceive no traces of increase of temperature in the ocean at great depths. Now, in the consideration of this point, two principles are involved, *first*, that to which Mr. Fox has adverted, that the strata at the bottom of the ocean, were they composed of solid rock the most favorable for transmitting heat, would yet propagate it much more slowly than the water which covers it, and thus all accumulation must necessarily be prevented; *second*, the principle of the maximum density of water.

All the observations hitherto made on masses of fresh water show, that at great depths† the temperature differs only a very few degrees from the point of maximum density. At greater depths it will probably be found to be very near that point. The latest experiments make the maximum density of pure water at about 38.75°, while those of Hällstrom make it, 39.38°. If the water be impure the point of maximum density will fall more or less, according to the nature and amount of the foreign bodies it may hold in solution. The experiments of Ermann show that the point of greatest density sinks very rapidly as we add any saline ingredient.

Now, as the heaviest parts of any fluid will always find their way to the bottom, the deeper we descend in a mass of water, either salt or fresh, we must find it the colder until we come to the limit of greatest density. In fresh water lakes of great depth the temperature of the water will decrease as we descend till we reach the limit of 39° Fah. when the temperature will undergo no farther change. In salt water the point of maximum density increases with its saltness towards the poles,‡ so that the depth at which the temperature be-

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* Phil. Mag. and An. Feb. 1830.

† At 1000 feet Saussure found the lake of Geneva to have a temperature of 42° F.

‡ See this Number, page 11.

comes stationary at about 36° Fah. varies from two hundred to five hundred fathoms. Below this there is probably no change of temperature. M. Lenz found it to sink no lower as far down as one thousand fathoms; but we can expect no *increase* of temperature without a complete subversion of the law of nature, by which a maximum of density is imparted to water.

It would appear, then, that the evidence at present is decidedly in favor of a great central heat in the globe, even leaving out of consideration the easy explanation it affords of so many geological phenomena. But a new source of evidence has lately been opened, and one much less liable to objections than the high temperature of mines,—in the borings for water lately practised to such an extent in France and Germany.

It was an important observation of Mr. Fox, that the water which gushed out from springs at the bottom of the Cornish mines had already the temperature of the air in the places where it appeared, and was completely convincing as to the source of the heat so long observed. The Artesian springs of the continent confirm his observation. In general, the water which flows from them is of a higher temperature than the mean of the earth at the place, and is warmer as its source is deeper. At Vienna forty or fifty have been formed, and the water of all has a temperature varying from 52° to 58°, the mean temperature, according to Humboldt, being 50.54° F. At Heilbronn in Wurtemberg, five borings sunk to supply a paper mill to the depth of from sixty to one hundred and twelve feet, deliver water having a temperature of about 55°; and the proprietor has taken advantage of it to warm his works in the winter, and succeeded in keeping the apartments at a temperature of 46° when that of the air was 25° below zero of Fah.

There are, however, many exceptions and anomalies which are not to be wondered at, when we consider, that, from the inclination of the strata and other causes, the depth of the boring is no sure indication of the true level from which the water comes. It is only when we are sure beforehand of the nature of the strata, that we can come to correct conclusions in regard to the true temperature of the earth at any given depth.

One of the most interesting of the exceptions we have met with, and which illustrates best the nature of the anomalies we may expect to meet with, is the case of a tube of three inches and a quarter in diameter, sunk to the depth of three hundred and thirty five feet at the city of Tours in the basin of the Loire.* The spring ceasing to flow so freely, it became necessary to draw out the tube to within twelve feet of the surface. Immediately the water gushed out one third more plentifully, and continued so for several hours, carrying with it a large quantity of fine sand, and many remains of plants and shells. Among these were twigs of several inches in length blackened by the action of the water; fresh stems and roots of marsh plants, —of one species in particular so fresh, that they could not have lain more than three or four months in the water; seeds of five or six different species; and fresh water and land shells, (*Planorbis marginatus*, *Helix rotundata* and *striata.*) All these are such remains as are found after a flood on the banks of small streams.

The water in this remarkable case, therefore, must proceed from some subterranean stream, the source of which is to be sought for at a distance among the higher grounds of Auvergne and Vivarais, and from the temperature of such sources, it is evident we can infer nothing regarding the interor temperature of the earth.

M. Magnus† has made some observations on the temperature of a boring at Rudensdorf, about five German miles from Berlin, which seem entitled to some confidence. It passes through limestone, gypsum, and sandstone, alternating with clay-slate, to a depth of sixty five English feet. The mean temperature of the place on which no experiments have been made is assumed to differ very little from that of Berlin, 49.1° F., and the results are as follows:

	Temper.	Diff. from mean.	For 1° F.
At 675 feet	67.66	+18.56	36.3 feet.
516	63.95	+14.85	34.7
392	62.82	13.72	28.5

The first of these results is the only one to which we can look for any approximation to the truth. And it comes very near 36.81, the result of Kupffer. The other determinations, however, are not without their value, they all indicate a more rapid increase of temperature than the truth, as we should naturally expect. For though the water as it gushes from the bottom of the tube must undergo considerable cooling on its way to the surface, yet it must still retain a considerable excess over the temperature of the strata through which it passes, and thus indicate a less distance for each degree of the thermometer, as

* Pogg. Ann. xxi. p. 353.

† Pog. Ann. xxii. p. 146.

in the results above quoted. The same fact is also evident from the high temperature of many of these springs when they reach the surface.

M. Magnus has prefaced his paper with an account of a very ingenious maximum thermometer, with which it is highly desirable that frequent observations should be made in favorable circumstances, where borings to great depths are effected. J.

ART. IV.—*Universal Terms—Disputes concerning them and their Causes; by* EMMA WILLARD.

A CURIOUS and knotty question in metaphysics is still pending, which has been in discussion more than two thousand years. Among its disputants were numbered the master spirits of the ancient world, Plato, Aristotle, and Zeno. The controversy slumbered during the dark ages, but revived with the first dawn of light which broke their gloom; and not only mustered the philosophical talents of Roscellinus, Peter Abelard and William Occum, but the regal power of the sovereigns of France and Germany; and blood was shed and accusations bandied of the unpardonable sin against the Holy Ghost.

We are astonished that a simple question of fact concerning the philosophy of the human mind should have been thus keenly disputed in former days; and still more so, when we find, that notwithstanding all the light of modern philosophy, it is this very point which is more warmly contested than any other, by the first metaphysicians of our own times, Stewart and Brown. What then is this wonderful question? Simply this. What is the object of our thoughts when we employ general terms? Is it ideas or words? Is a portion of the mental imagery called up by their use, or do we employ ourselves merely with significant sounds?

The most celebrated pneumatologist of our times, Dugald Stewart, maintains the doctrine of Roscellinus and Abelard, said to have been derived from Zeno, that, in the use of general terms, the object of our thoughts is not ideas, but words or names. Hence this sect is called Nominalists. A doctrine opposite to this was held by Plato, Aristotle, and their followers, down to the time of the improvement in the theory of perception, attributed by Mr. Stewart to Dr. Reid. These philosophers supposed that the mental images derived from external perception, (keeping in view the sense of sight,) were received into the mind, as the furniture into a house, and were there real existences, called ideas;—existing in the mind, but separate from it, and constituting the objects of our thoughts: and they farther believed, that some of these real existences corresponded to general terms. Hence this sect were called Realists. When, in later times, it was shown that the supposition of ideas or existences in the mind, distinct from the mind itself, was gratuitous and unfounded, the doctrine of the Realists concerning the nature of universals, was of course overturned. But still, as the mental eye turns inward, it sees a splendid imagery, the transcripts of things beheld by the bodily organ of sight. It is now the common belief that these are not *in* the mind, but that they are mind itself—mysterious mind! from its very nature in perpetual action, and forever shifting the intellectual scene. But call these pictures by what name we will, and be they *in* the mind or *of* the mind, still they are there. The home of my childhood, the flowers that I tended, the venerable forms of my father and mother, I see them at this instant; and thus things that I have perceived, become wrought into the very texture of my mind. My intellectual eye sees them not always, but words have power to call them forth, although I am, before their utterance, unconscious of their existence. But have that class of words called universals, a power to call up mental pictures, or have they not? This is still the question, although we have introduced the new term *conceptions* as the technical word to express these internal and mental transcripts, of external and material things. Here then our later philosophers take their point of divergency. Mr. Stewart maintains that we have no conceptions or *ideas*, (for the word is retained though the signification is changed,) corresponding to general terms; that the object of our thoughts, when we speculate or reason concerning them, is not ideas but words; consequently we can neither speculate nor reason concerning universals but by means of words.

After Mr. Stewart had thus, as he supposed, settled this question, having treated it at great length, Dr. Brown came before the public, in his celebrated lectures, and with the air of a man who marches to certain victory, attempted to establish the doctrine of general conceptions, formerly maintained by Locke, Reid, and others. He states the theory of the Nominalists, in the formation of universals, to include merely the perception of the objects, and the invention of a name by which to designate them as a class. He adds, to this process of two steps, a third, which he supposes nature places between them—as thus. In the formation of classes, we first, says he, perceive the objects; secondly, have a feeling of their resemblance;

and thirdly, invent their common name. After the death of Dr. Brown, Mr. Stewart published a continuation of his great work on the philosophy of the human mind, on the very first page of which we find that he is unconvinced by the arguments of Dr. Brown, and still contends for his former opinions; or rather takes for granted that he has established them.*

Let a class of unbiassed young persons, who are sufficiently advanced in the study of intellectual philosophy to understand its terms, be asked, what occupies your mind when you use general terms, is it ideas or mere words? All will be puzzled; and about half will incline to one side of the argument, and half to the other.

This question, then, has bewildered both acute and ordinary minds, for more than two thousand years. Is not this a proof that there is some latent fallacy contained in the question itself? It is the nature of truth—of all which springs from truth—of all which tends to truth, to enlighten—to clear from doubt; but this question casts doubt and darkness. May we not, therefore, conclude that it springs not from truth but from error? But where it its fallacy? Suppose you are asked, are the human race white or black? and required to answer directly in the words of the question. You can not, without asserting a falsehood; because, in order to do so, you must rank under one head objects which in the respects alluded to are dissimilar. So, in this celebrated question, (are ideas or words the object of our thoughts, when we employ general terms?) is there not a similar error? Are there not, plainly, two sorts of universal terms—the one expressing natural classes, the other artificial classifications? We believe there are, and that with respect to the former, the doctrine of the Conceptualists is true; with regard to the latter, that of the Nominalists.

To explain the subject more fully;—natural classes of objects are those which, from a feeling of resemblance, arising as soon as they are presented, every human mind from its inherent constitution ranks together as things of the same sort. Such are sheep, trees, horses, and men. Concerning these classes, we think it may clearly be shown, that agreeably to the opinions of the Conceptualists, we have general ideas or conceptions; and further, that respecting these, the

* "It is," says Mr. S. "to the use of artificial signs, (as was formerly shown,) that we are indebted for all our general conclusions; and without it all our knowledge would have been entirely limited to individuals."—See Vol. III, p. 1.

doctrine of the Nominalists, that we can neither speculate nor reason concerning universals without words, is erroneous.

Artificial classifications are composed of objects which, not resembling each other in appearance, are yet ranked together from some principle of resemblance, or some resembling relation. Such words as subjects, things, articles, agents, and generally the technical terms of the sciences, express artificial classifications. In the use of these words, we believe, with the Nominalists, that no image in the mind corresponds to them, that when we reason or speculate by their aid our attention is occupied with the words themselves, much in the manner in which it is given to the signs and letters of an algebraical process; and with regard to these, we also consider the theory of the Nominalists concerning the formation of universals true; and that the third step of the process introduced by Dr. Brown is here incorrect. To invent, arrange and define, in this department, constitutes no inconsiderable portion of the labors of science and philosophy. That man is endowed with a capacity to go on forming classifications more and more general, in one of the most wonderful and useful parts of his nature, contributing perhaps more than any other faculty, as Mr. Stewart has ably shown, to the continual advancement of the species.

Botany affords an excellent illustration of the different kinds of classes supposed; the system of Jussieu expressing the natural, that of Linnæus the artificial. How could Linnæus have made his classification, unless he had invented terms? Or who can say, that in reference to calling up ideas, it is the same thing whether we use the words Monandria, Diandria, &c. or mention roses, grape-vines and oaks.

We now bring forward what we consider incontestible proof that we have, with regard to natural classes, general conceptions. Conception is, by definition, a transcript of perception, and we think it can be shown that we have *general perceptions*. A hawthorn bush is before me. Who will say that every one of its white blossoms and green leaves is to me an individual subject of consideration? and that the reason of their being ranked under the same head is because that in the infancy of language some person, happening to become acquainted with one hawthorn blossom or leaf gave it this name, and afterwards finding others which agreed in appearance with it he called them by the same name?

On the contrary, nature presents these objects before us, not single, but in groups, and we see them *generally*, as many objects of the same kind, and as such afterwards conceive of them. The same thing occurs in numberless classes of objects, especially in things considerably smaller than ourselves. Nor does it at all affect the nature of the argument, if we find that individuals of a class sometimes, from certain peculiarities, so strike the mind as to be recalled, as such, among numbers of undistinguishable similar things.

To illustrate farther the subject of general perceptions, and its bearing on the question proposed: suppose you are seated in a contemplative mood, at the hour when twilight is giving place to darkness—a frightened child enters—you enquire the cause of his fears. As I was coming, says he, a man suddenly started from behind a tree. What man? Indeed, I do not know; it was so dark that I could not distinguish whether he was white or black; all that I could see was that it was a man. But what tree was it? I cannot tell that either; I merely remarked that it was a tree, but could not distinguish of what kind; but I know that I saw a man and a tree; I have them now in my mind. The possibility of such an occurrence none will dispute. The child then had actual perception of a tree and a man in general, and of course its transcript conception; and he needed no name of the thing or sort of thing conceived, to reason or speculate concerning it, so far as regarded his own mind, though without words he could not communicate his conceptions to others. That we do, even in such cases, use words in our mental operations, there is no doubt, but is it not owing chiefly to our social nature? We delight in fancied conversations with those we love. We like to contend with those who give us an opportunity to display our wit, in our own mental field, where we are sure of the victory; or if startled friendship sees tokens of moral aberration, we plan the pathetic address which shall recall the wanderer to virtue. Hence we perpetually use words in our thoughts, not always because we cannot think without them, but because we perpetually recur to the communication of our thoughts to others.

The perception of things according to their general characteristic marks, is what always occurs when objects are seen at certain distances, or by dim lights. When we look up a long street or avenue, we may see hundreds of human beings whom we know to be men, women and children, merely by means of general characters. The size of the objects is to be regarded, when we treat of the distances at which we cease to distinguish by particular marks. But how should we ever recognise new objects, as belonging to certain classes, but by their correspondence to our general ideas. Can it be doubted that the deaf and dumb as perfectly conceive of men, horses, trees, &c. as classes of objects, as those who know their names in various languages? and could they be taught a visible sign by which to express these classes, unless they had such conceptions previously in their minds? Mr. Stewart informs us that James Mitchel, the poor boy who was from his birth destitute of the senses of sight and hearing, was fond of horses. He knew them by the perceptions of his other senses; and their consequent conceptions. Even the brutes have knowledge (or instinct, it here matters not which) of natural classes and their general properties. A dog will avoid the horns of the ox and the heels of the horse, and he resigns himself with affection and trust, to no animal but that erect and lordly being, to whom alone of his lower works, the Creator has imparted conscience and reason. Yet hear the language of Mr. Stewart:—"Whether it might not have been possible for the Deity to have so formed us, that we might have been capable of reasoning, concerning classes of objects, without the use of signs, (i. e. general terms,) I shall not take upon me to determine. But this we may venture to affirm, with confidence, that man is not such a being." "It has been already shown, that without the use of signs, all our knowledge must necessarily have been limited to individuals, and that we should have been perfectly incapable both of classification and general reasoning." "Some authors have maintained that without the power of generalization,) which I have endeavored to show means nothing more than the capacity of employing general terms,) it would have been impossible for us to have carried on any species of reasoning whatever."

Profoundly as we venerate the name and genius of Dugald Stewart, we cannot but feel that here he lends them to perpetuate absurdities. From hence we may derive two lessons—the first, to search the nature of things, rather than to look for authorities; the second, to be humble respecting what we may fancy to be our own discoveries, since we find that even minds like his may sometimes be mistaken, and there too, where they are most confident.

As an additional proof that some such distinction of universals as we have made is correct, we adduce the very fact of the dispute so long and warmly kept up. Error, as Mr. Stewart justly observes, does not take a permanent hold of the mind, except by being associated and blended with truth. The mind being fully persuaded of the truth, receives without examination, whatever is conceived to be its necessary concomitants. So in the case under discussion, to recur to a former example, let it be supposed proper to demand a direct answer to the question, whether the human race be white or black. If this question should be put to an Icelander, he would say they were white, to an African, he would declare them to be black. Those who had seen both would answer the question generally as their attention has been most drawn to examples of the one class or the other. So when the inquirer into the intellectual philosophy has searched his own mind to find whether general terms call up images, or whether his attention has been given to words as to algebraic signs, he has been led either to the doctrine of the conceptualists or to that of the nominalists as he has stated to himself examples of natural classes or artificial classifications. Let him propose to himself such examples as men, horses, apples, roses, and he will be a conceptualist; but let him consider such words as things, subjects, facts, &c. and he will be a nominalist.

That some distinction of the subject ought therefore to be made, appears clear: the absolute terminations to be given to the distinctions made, are not equally so. In the question concerning the color of our race, none would say we should not make any distinction of color, because there are some of an intermediate hue partaking of both black and white, so in this question, examples may be given of classes of which it is difficult to say whether they should be called natural or artificial, because they partake of the nature of both. And where do we undertake to divide and distinguish even in the natural world, without meeting similar difficulties; much more must we expect them in the finer and more subtle fields of intellect.

It would not injure the argument, if it should be found that in the series commencing with the plainest natural classes, and going on to the most abstruse artificial classifications, there were reasons for dividing general terms, into more than two sorts. No other division is needed for the solution of the problem* we have been discussing, although for other purposes, it may be proper to take notice of other

* Since this article was put in type, the writer has had the satisfaction to find the following passage in Sir James Mackintosh's history of Ethics, p. 45.—"The controversy between the Nominalists and Realists, treated by some modern writers as an example of barbarous wrangling, was in truth an anticipation of that modern dispute which still divides metaphysicians, whether the human mind can form general ideas, and whether the words which are supposed to convey such ideas, be not general terms, representing only a number of particular perceptions? questions so far from frivolous, that they deeply concern both the nature of reasoning and the structure of language." From this passage, I find that my opinion is sustained, in three points, by that of this celebrated writer; first, that this controversy remains now where it did centuries ago; secondly, as to its importance, and thirdly, as to the reasons of its importance.

differences in classes of objects, such as their size and position, relative to man, the observer.

This question arises in the conjectural history of language ; were, or were not, particular terms invented before general? Adam Smith has asserted that they were. Mr. Stewart, Professor Hedge and others have followed him, adopting his sentiments as expressed in the following quotation.

" The assignation of particular names to denote particular objects ; that is the institution of nouns substantive, would probably be one of the first steps towards the formation of language. The particular cave whose covering sheltered the savage from the weather; the particular tree whose fruit relieved his hunger; the particular fountain whose water allayed his thirst; would first be denominated by the words, cave, tree, fountain ; or by whatever other appellations he might think proper, in that primitive jargon, to mark them. Afterwards, when the more enlarged experience of this savage, had led him to observe, and his necessary occasions obliged him to make mention of other caves, and other trees, and other fountains; he would naturally bestow on each of those new subjects, the same name by which he had been accustomed to express the similar objects he was first acquainted with. And thus, those words, which were originally the proper names of individuals, would each of them insensibly become the common name of a multitude."

Remark here the examples given by Mr. Smith; a cave, a tree, a fountain. Caves and fountains are objects of unfrequent recurrence. Seldom are two of them seen together. It is doubtful whether they should be considered among natural or artificial classes. The one is a cavity from which water flows; the other (more clearly a nonentity) a fissure in the rock or an irregular subterranean chasm ; and though, from these resembling features, they are ranked under the same name, yet they have so many points of dissimilitude, that the savage inventor of language might well give names to each cave, or fountain as a particular object; and if he generalized them at all, the process would probably proceed as stated by Mr. Smith. A tree is an object usually much larger than a man, and may be conceived as standing by itself, and if so, this example would not contradict the theory. But let us state other examples. A blade of grass, a peach, an ear of corn ; all these are individuals as much as a cave, a fountain, or a tree. Let us substitute them for these examples, and see how Mr. Smith's theory will then appear.

The intellect of man is accommodated to the world around him. It is the external world which, by means of his senses, particularly the sight, comes to be transferred, as it were, within, and to have there an immaterial being; and it is, that we may read out, to our fellow men what we thus perceive, mysteriously existing within, that we have invented language. If things exist in the mind single, man invents words to express them as such; if they are perceived together as constituting a sort or kind, then he invents a word expressive of a class.

Mark on this subject the words of the inspired historian, who in nothing is more particular in the history of creation, than in the statement of the fact that God expressly intended the things which he made should be in sorts or kinds. "And God said, Let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit after his kind, whose seed is in itself upon the earth. And the earth brought forth grass, and herb yielding seed after his kind, and the tree yielding fruit whose seed was in itself, after his kind. And God created great whales, and every living creature that moveth, which the waters brought forth abundantly, after their kind, and every winged fowl after his kind. And God said, let the earth bring forth the living creature after his kind, cattle and creeping thing and beast of the earth after his kind."

Man, in his works, has imitated his Maker, and his creations no less are made each after its kind. They are inventions to supply his necessities or minister to his pleasures, and being addressed to a common nature, are ordinarily many of a sort. Such are the implements of husbandry, of navigation, and of rural economy.

The names, then, that men have invented to express the general conceptions of the mind, answering to the things which the Creator (and man in his puny works) sees good to make every one after his kind, are no less early invented than those which express particulars. This abundantly appears from the fact, that little children in the case of familiar natural* classes of objects so small that the eye takes in a number at once, learn the general before the particular appellation. Observe two children at a window, one of two years old, the other of four; you will hear the younger exclaim, as these ob-

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* Observe that the word natural, as here used, refers not to the object, but to the mind. Hence I would call chairs, tables, guns, ships, natural classes, although they are not natural objects. Nature did not make them, but nature makes every human mind recognize them as things of the same sort.

jects severally pass—man, dog, horse; while his brother of four will repeat the proper names—there is Mr. Smith, see Jowler, look at father's horse; and their progress as they go through life, will be to acquire more and more the discernment to distinguish the individuals of these natural classes; but nothing is ever added by reflection to connect more closely in one class these objects, which, before the dawn of reason, they felt and knew to be things of the same sort. In fact, do we not all feel, even in our maturity, that we know many objects as classes before we know them individually? Look at a flock of sheep; you do not know their particular marks, yet the farmer who owns them knows every one; from the grave patriarch of the flock, to the least lamb which bounds from the hillock.

In this question then, whether terms expressing individuals or generals were first invented, we think the probability clearly is, that in instances of such natural classes, as from their size and position the savage had seen together, and instantly recognized as of the same sort, he would first invent a name representing the class, and particular appellations afterwards; but, in cases of such objects as are very large, and not to be seen together, he would follow out the process described by Mr. Smith.

Finally, then, recurring to the point from which we took our departure, the doctrine which we have mainly sought to establish is, that ideas or images are commonly the subject of our thoughts, when, in the case of natural classes, we employ general terms, in that of artificial classes, rather words, claiming our attention something in the manner of algebraic characters, or arithmetical figures.

Names of artificial classes do however sometimes call up ideas or images; but when this is the case it is from a different principle of our nature than that of a felt resemblance among the objects; ordinarily, from the associating principle of contiguity in time and place. The botanist tells us that in one respect the currant and the pumpkin are to be classed together. The word by which he designates them may bring them both to my mental view, but it is only as the name of a friend's parlor recals the chairs, the pictures and the sofa. Take this sentence—"the stars of the sky and the flowers of the field are alike the subjects of God's creating power." Here the term subjects, evidently expressing an artificial classification, comprehends two natural classes, stars and flowers. The word subjects seen in another situation, might then suggest them, from my having seen it in this connexion; but the mind does not therefore recognise stars and flowers as things of the same sort, because the same word recals them ; nor is it essential that any image should be recalled to the mind by the word subjects, to make it convey truths to our understanding ; as if we say, "all the subjects of God's creating power depend on him for continued existence :"—and the figure 2 might call up mental pictures of stars and flowers, even though the eye cursorily caught it in the date of the present year, 1832. As thus—I read in a book, "Pictures of 2 sorts of things, stars and flowers." Here the uncommon use of the figure 2 might have so struck me as to remind me, the next time I saw it, of the sentence in which it was thus used, and the mental pictures of these objects thus be brought to my mind ; and if so, is it not the same process by which the word subjects might suggest them ; and when they are suggested, does not the mind, in both cases, take cognizance of them as of two sorts of things, so unlike that no common name or common relation can make us conceive of them as of one kind. Yet by means of a name expressing a common relation, we can reason and speculate about them in connexion, though we cannot conceive of them as of the same sort. If these facts are admitted, we think it must follow, that the doctrine of the nominalists is no less true with regard to terms expressing artificial classification, than is that of the conceptualists, with regard to those expressing natural classes.

Art. V.—*On the action of the second surfaces of transparent plates upon light; by* David Brewster, LL.D. F.R.S. Lond. & Edin.

Read before the Royal Society, February 25, 1830.

In a paper on the Polarization of Light by Reflexion, published in the Philosophical Transactions for 1815, I showed that the Law of the Tangents was rigorously true for the second surfaces of transparent bodies, provided that the sine of the angle of incidence was less than the reciprocal of the index of refraction. The action of the second surfaces of plates at angles of incidence different from the maximum polarizing angle, was studied by M. Arago, who conducted his experiments in the following manner.

"With respect to this phenomenon," says M. Arago, "a remarkable result of experiment may here be noticed ; that is, that *in every possible inclination* $A = A'$.*

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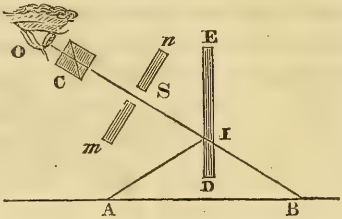
* A is the light polarized by reflexion, and A′ that polarized by refraction.

Fig. 1.



"Let us suppose that a plate of glass ED (Fig. 1.) is placed in the position that the figure represents before a medium AB of a uniform tint; for instance, a sheet of fine white paper. The eye placed at O, will receive simultaneously the ray IO reflected at I, and the ray BIO transmitted at the same point. Place at *m n* an opaque diaphragm blackened, and perforated by a small hole at S. Lastly, let the eye be furnished with a doubly refracting crystal C, which affords two images of the aperture.

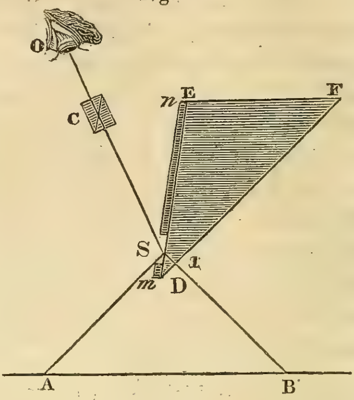
"If now, by means of a little black screen placed between B and I, we stop the ray BI which would have been transmitted, the crystal properly placed will give an ordinary image $=A+\frac{1}{2}B$, and an extraordinary image $=\frac{1}{2}B$. But if the screen were placed between A and I, and the ray AI were intercepted, we should still have two images of the hole, and their intensities would be $\frac{1}{2}B'$ and $A'+\frac{1}{2}B'$ respectively. Consequently, without any screen, if the whole of the reflected light AIO, and the transmitted BIO, are allowed to arrive at the eye, we shall have for the ordinary image $A+\frac{1}{2}B+\frac{1}{2}B'$, and for the extraordinary image $\frac{1}{2}B+A'+\frac{1}{2}B'$.

"Now it appears, from actually making the experiment, that the two images are perfectly equal, *whatever may be the angle formed by the ray* AI *with the plate of glass*, which can only be because A is always equal to A′. Consequently,

"The quantity of polarized light contained in the pencil transmitted by a transparent plate, is exactly equal to the quantity of light polarized at right angles, which is found in the pencil reflected by the same plate."

We have no doubt that M. Arago obtained these results, particularly near the polarizing angle, at which limit they are rigorously true; but at all other angles of incidence they are wholly incorrect. When we consider, indeed, the nature of the experiment which has been lauded for its elegance and ingenuity, we shall see reason to pronounce its results as nothing more than coarse estimates, in which the apparent equality of the two images is the effect either of imperfect observation or of some unrecognized compensation.

Fig. 2.

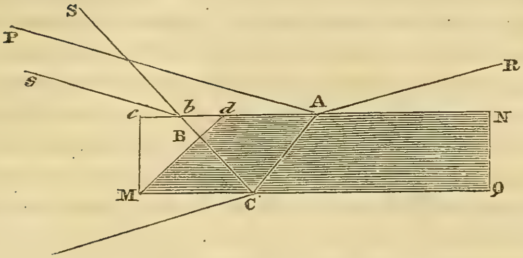


If we make the experiment in the manner shown in Fig. 2. with a colorless and well annealed prism of glass EFD, in place of a plate of glass; and make the ray BI enter the surface FD perpendicularly at I, we get rid of all sources of error, and we obtain, what is really wanted, the result for a single surface. In this case the experiment is not disturbed by the light reflected from the inner surfaces of the prism, which is all thrown off from the pencil which enters the eye.

In M. Arago's form of the experiment, part of the ray BI (Fig. 1.) undergoes reflexions within the plate, and there comes along with it to the eye, at O, a portion of light polarized in the plane of reflexion: in like manner the part of the pencil AI that enters the plate, undergoes partial reflexions, and the part reflected from the first surface carries along with it another portion of light polarized in the plane of reflexion, so that four portions of light polarized in the plane of reflexion reach the eye, while only two portions reach it polarized at right angles to the plane of reflexion, viz. those which are polarized by the refraction of each of the surfaces of the plate. Now the part of the pencil AI which suffers a first reflexion from each of the surfaces of the plate, is, as we shall presently show, defective in polarized light compared with that which has experienced two refractions, so that it requires the above additional quantities to produce a compensation with the transmitted pencil BO. If this is not the true cause of the apparent compensation, that is, if M. Arago took means to exclude the reflected pencils which seem to have produced the compensation, we must then ascribe the equality of the two images to inaccuracy of observation.

But even if we admit that M. Arago's experimental results are correct with regard to plates, it necessarily follows that they cannot be true with regard to surfaces; for it is obvious from the slightest consideration of the subject, that the phænomena of the one can never be interchangeable with those of the other.

Fig. 3.



In order to demonstrate these views by an analysis of the changes which the intromitted light experiences from the two refractions and the intermediate reflexion of a transparent plate, I took a plate of glass of the shape M N (Fig. 3.) having an oblique face M *d* cut upon one of its ends. A ray of light R A, polarized + 45° and − 45°, was made to fall upon it at A, at an angle of incidence of nearly 83°, so that the inclination of the planes of polarization of the reflected ray A P was about 36½°. Now the ray A C after reflexion in the direction C S, without any refraction at B, where it emerges perpendicularly to M *d*, would also have had the inclination of its planes of polarization equal to 36½° if there had been no intermediate refraction at A; but this refraction alone being capable of producing an inclination of 53° or a rotation of 53° − 45° = 8°, and this rotation being in an opposite direction from that produced by the second reflexion at C, the inclination of the planes of polarization for the ray C S is nearly 44½°, the reflexion at C having brought back the ray A C almost exactly into the state of natural light.

Without changing either the light or the angle, I cemented a prism M *c d* on the face M *d*, so that *c d* was parallel to *d* N, and I found that the second refraction at *b*, equal to that at A, changed the inclination of the planes of polarization to 53°; that is, the two refractive actions at A and *b* had overcome the action of reflexion at C, and the pencil *b s* actually contained light polarized perpendicular to the plane of reflexion.

In order to to put this result to another test, I took a plate M *c* N Q (Fig. 3.) of the same glass, which separated the pencil *b s* reflected at the second surface, from the parallel pencil A P reflected from the first surface, and I found that at an angle of 83° the value of the inclination I or φ for the ray was about 37½°, while the value of I for the ray *b s* was nearly 55°, an effect almost equal to the refractive action of a plate at 83° of incidence.

When the pencil R A is incident on the first surface at the polarizing angle or $56^\circ\ 45'$, the rotation produced by refraction at A is about 2°, or the inclination $I=45^\circ+2^\circ=47^\circ$; but the maximum action of the polarizing force at C is sufficient to make $I=0^\circ$ whether x is 45° or 47°. Hence C B is completely polarized in the plane of reflexion, and the refractive action at b is incapable of changing the polarization when $I=0^\circ$: the reason is therefore obvious why the two rotations at A and b, of 2° each, produce no effect at the maximum polarizing angle.

If we now call

φ =Inclination to the plane of reflexion produced by the 1st refraction at A,

φ' =Inclination produced by the reflexion at C,

φ''=Inclination produced by the 2nd refraction at b,

We shall have

$$\text{Cot}\,\varphi=\cos(i-i');\ \text{or}\ \tan\varphi=\frac{1}{\cos(i-i')}$$

$$\text{Tan}\,\varphi'=\tan x\left(\frac{\cos(i+i')}{\cos(i-i')}\right)=\frac{\cos(i+i')}{(\cos(i-i'))^2}$$

$$\text{Cot}\,\varphi''=\cot x\,(\cos(i-i'))=\frac{(\cos(i-i'))^3}{\cos(i+i')}$$

These formulæ are suited to common light where $x=45^\circ$, but when x varies they become

$$\text{Cot}\,\varphi=\cot x\,(\cos(i-i'))$$

$$\text{Tan}\,\varphi'=\tan x\left(\frac{\cos(i+i')}{(\cos(i-i'))^2}\right)$$

$$\text{Cot}\,\varphi''=(\cot x\left(\frac{(\cos(i-i'))^3}{\cos(i+i')}\right).$$

Resuming the formula for common light, viz. $\cot\varphi''=\frac{(\cos(i-i'))}{\cos(i+i')}$, it is obvious that when $(\cos(i-i'))^3=\cos(i+i')$, $\cot\varphi''=1$, and $\varphi''=45^\circ$; that is, the light is restored to common light.

In glass where $m=1.525$ this effect takes place at $78^\circ\ 7'$; a little below 78° in diamond; and a little above 80° in water.

At an angle below this, φ becomes less than 45°, and the pencil contains light polarized in the plane of reflexion; while at all greater angles φ is above 45, and the pencil contains light polarized perpendicular to the plane of reflexion. Hence we obtain the following curious law.

"A pencil of light reflected from the second surfaces of transparent plates, and reaching the eye after two refractions and an intermediate reflexion, contains at all angles of incidence from 0° to the maximum polarizing angle, a portion of light polarized in the plane of reflexion. Above the polarizing angle the part of the pencil polarized in the plane of reflexion diminishes till $\cos(i+i') = (\cos(i-i'))^3$, when it disappears, and the whole pencil has the character of common light. Above this last angle the pencil contains a quantity of light polarized perpendicularly to the plane of reflexion, which increases to a maximum and then diminishes to zero at 90°.

Let us now examine the state of the pencil C S′ that has suffered only one refraction and one reflexion. Resuming the formula $\tan \varphi' = \frac{\cos(i+i')}{(\cos(i-i'))^2}$, it is evident that when $(\cos(i-i'))^2 = \cos(i+i')$, $\varphi' = 45°$, and consequently the light is restored to common light. This takes place in glass at an angle of 82° 44′. At all angles beneath this the pencil contains light polarized in the plane of reflexion; but at all angles above it, the pencil contains light polarized perpendicular to the plane of reflexion, the quantity increasing from 82° 44′ to its maximum, and returning to its minimnm at 90°.

By comparing these deductions with the formula and table for reflected light given in my paper On the Laws of the Polarization of Light by Refraction, the following approximate law will be observed. When

$\cos(i-i')$	$=\cos(i+i')$	All the incident light is reflected.
$(\cos(i-i'))^2$	$=\cos(i+i')$	Half the incident light is reflected.
$(\cos(i-i'))^3$	$=\cos(i+i')$	A third of the incident light is reflected.
$(\cos(i-i'))^n$	$=\cos(i+i')$	An *n*th part of the incident light nearly is reflected.

This law deviates from the truth by a regular progression as n increases and always gives the value of the reflected light in defect. Thus

Angles of Incidence.	Values of n.	Differences.
82° 44′	2	0
78 34	3	12
75 38	4	21
68 56	8	38
66 4	11	43
61 22	20	50

Let us now apply the results of the preceding analysis to M. Arago's experiment shown in Fig. 1. Suppose the angle of incidence to be 78° 7′, and let the light polarized by reflexion at A (Fig. 3.) be $=m$, and that polarized by one refraction also $=m$. Then since the pencil $b\,s$ is common light, the polarized light in the whole reflected pencil A P, $b\,s$ is $=m$, whereas the light polarized by the two refractions is $=2\,m$; so that M. Arago's experiment makes two quantities appear equal when the one is double that of the other. If the angle exceeds 78° 7′, the oppositely polarized light in the pencil $b\,s$ will neutralize a portion of the polarized light in the pencil AP, and the ratio of the oppositely polarized rays which seem to be compensated in the experiment, may be that of $3\,m$ or even $4\,m$ to 1.

Having thus determined the changes which light undergoes by reflexion from plates, it is easy to obtain formulæ for computing the exact quantities of polarized light at any angle of incidence, either in the pencil C B S or $b\,s$.

The primitive ray RA being common light, AC will not be in that state, but will have its planes of polarization turned round a quantity x by the refraction at A; so that $\cot x = \cos(i-i')$. Hence we must adopt for the measure of the light reflected at C the formula of Fresnel for polarized light whose plane of incidence forms an angle x with the plane of reflexion. The intensity of AC being known from the formula for common light, we shall call it unity, then the intensity I of the two pencils polarized $-x$ and $+x$ to the plane of reflexion will be

$$\mathrm{I}=\frac{\sin^2(i-i')}{\sin^2(i+i')}\cos^2 x+\frac{\tan^2(i-i')}{\tan^2(i+i')}\sin^2 x \text{ and}$$

$$\mathrm{Q}=\mathrm{I}\left(1-2\frac{\left(\frac{\cos(i+i')}{(\cos(i-i'))^2}\right)^2}{+1\left(\frac{\cos(i+i')}{(\cos(i-i'))^2}\right)^2}\right)$$

In like manner if we call the intensity of $\mathrm{CB}=1$, we shall have

$$\operatorname{Tan} x=\frac{\cos(i+i')}{(\cos(i-i'))^2}$$

and the intensity I of the transmitted pencil $b\,s$

$$\mathrm{I}=1-\frac{\sin^2(i-i')}{\sin^2(i+i')}\cos^2 x+\frac{\tan^2(i-i')}{\tan^2(i+i')}\sin^2 x \text{ and}$$

$$\mathrm{Q}=\left(\mathrm{I}\,1-2\frac{\left(\frac{(\cos(i-i'))^3}{\cos(i+i')}\right)^2}{1+\left(\frac{(\cos(i-i'))^3}{\cos(i+i')}\right)^2}\right)$$

I shall now conclude this paper with the following table, computed from the formulæ on page 32, and showing the state of the planes of polarization of the three rays AC, GS, and *b s*.

Angle of Incidence on the first surface.	Angle of Refraction at first surface, snd angle of incidence on second surface.	Inclination of plane of polarization of A C Fig. 3.	Inclination of plane of polarization of C S Fig. 3.	Inclination of plane of polarization of *b s* Fig. 3.
° ′	° ′	° ′	° ′	° ′
0 0	0 0	45 0	45 0	45 0
32 0	20 33	45 34	32 20	32 51
40 0	25 10	45 58	24 12	24 56
45 0	27 55	46 17	17 49	18 38
56 30	33 30	47 22	0 0	0 0
67 0	37 34	48 57	18 20	20 50
70 0	38 30	49 33	23 34	27 6
75 0	39 46	50 45	32 22	37 48
78 37	40 29	51 49	38 10	44 59
79 0	40 33	51 56	38 49	45 46
80 0	40 42	52 16	40 27	47 46
83 0	41 5	53 21	44 39	53 40
86 30	41 23	54 47	50 58	60 13
90 0	41 58	56 29	56 29	66 19

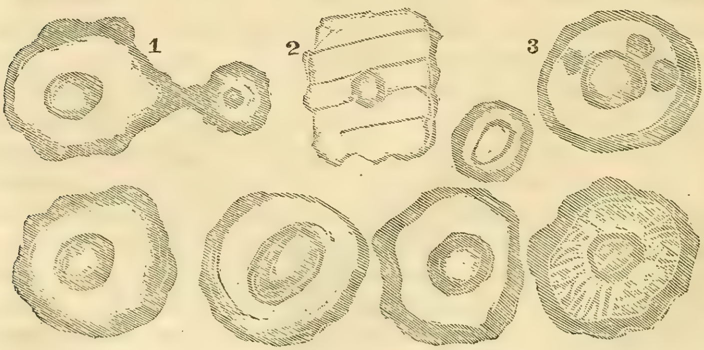
Allerly, December 31, 1829.

Art. VI.—*On Hail Storms;* by A. Jones, M. D. of Augusta, Georgia.

These storms very often occur in the Southern States during the spring, or the first months of summer. They are most frequent when the thermometer ranges between 70° and 80°. Lightning is also more frequent and terrible in the south when the thermometer occupies the above range.

In hail storms I suppose it highly probable, that at first, large drops of rain descend, till they come in contact in their passage, with a much colder current of air, when they suddenly freeze, in the act of doing which they expand, producing a hollow globular hailstone, which enlarges as it falls, by the aggregation and freezing of other drops of water, which seem to be drawn to it by some kind of attraction. They in this way enlarge, until before they reach the earth, they often attain a most astonishing size. They have been seen to fall in some places, of the size of hens' eggs, and of still larger dimensions. It no doubt has appeared to many a strange circumstance, that when falling of such large size, they have not been more fatal to animals. For if a pebble, or any other solid body of equal bulk, was to fall from the same height, we must suppose that its velocity, from its specific gravity, would be such as to render its effects terrible and destructive. We can only imagine the large hailstones that often fall, to have in some way, their specific gravity so much lessened as to render the largest of them, comparatively light and inoffensive in their fall. This is done, by their expansion in the act of freezing, by which means a hollow cavity is produced, filled with air. This air cell, with others attached as they enlarge, greatly lessens their specific gravity. It acts like the air-bladder of a fish, which enables him to rise to the surface in deep water, or the air cells in the bones of birds which lessen their specific gravity, so much as to assist their flying.

I first observed this peculiar structure of hail-stones, during a short residence in Athens, Ga. in the spring and summer of 1831. In May of this year a cloud come over from S S E. It presented the peculiar sea green appearance of hail clouds, and portions of it seemed to move in irregular directions, as if acted on by contrary currents of wind. It also was accompanied by a considerable wind and vivid flashes of lightning. After the rain had commenced falling, the wind was to a degree lulled, and large pieces of hail commenced falling, and continued to fall till the ground was covered. After the storm had passed, I walked into the yard and examined many of the stones of the largest size. I was surprised to find in the center of each a circular air cell. The annexed figures in the plate represent their most common appearance. The largest were a half, or three



fourths of an inch in diameter, and from one and a half to two inches in circumference, and from this size down to that of a small bullet. Some were united by a narrow neck, as shown by Fig. 1. Some were irregular and ragged on their edges, and crossed by irregular fractures, as is seen in Fig. 2. Others again, were dotted, with several air cells around the center one, as exhibited in Fig. 3. The center of each represents the air cells.

These hail storms are sometimes accompanied by violent winds. They make their approach from every point of the compass save directly from the east, and they come most frequently from the south-west or north west. A person who has once closely observed them, can generally foretell their approach, from the appearance of the rising cloud. It uniformly exhibits a sea green color, and often seems much agitated, and small fragments of clouds often linger beneath the main body, or seem to be suddenly formed and to fly in pursuit of it. They occur when currents of air in the heavens, retain their winter coldness, and intercept the drops of rain and convert them into hail-stones. This operation is not a little aided also, by the sudden discharges of the electric fluid of the clouds. In the south of France, they are very frequent and often destroy extensive vineyards. The people believe so fully in the idea that the discharges of electricity influence their production, that they erect lightning rods by means of poles in their fields to lessen their occurrence and effects. In this case, the discharge of the fluid is gradual, and unattended by hail, at least in proportion to what would be the case, if let off in heavy discharges.

Augusta, Geo. June 18th, 1832.

Art. VII.—*Improvement in Field Surveying.*

The general principle or method of computing the areas of irregular plane figures, as described in Art. III, No. 45 of the Journal of Science, was introduced by E. F. Johnson, Esq. into the course of instruction in the practical mathematics, in the institution of Capt. Partridge, in the year 1824, and the method is now extensively practiced by many of the young men graduates of that institution, in various parts of the country.

The same principles were likewise applied by Mr. Johnson to other branches of mensuration, and the whole, as I am informed, incorporated in a work, which is soon to be presented to the public.

The following are the general directions as given by Mr. J. for calculating areas by the algebraic process.

1st. Place in one column the courses and distances of the outlines of the field whose area is to be calculated, in the order in which they occur in traversing around it.

2d. Put the differences of latitude and the departures of each line opposite the course and distance of the same line,—the differences of latitude in one column and the departures in another.

3d. Distinguish the northings and the southings of the several differences of latitude by the signs plus and minus, and do the same with the eastings and westings of the departures; or otherwise, call the first difference of latitude, and all of the same name with it, affirmative, and all of a contrary name, negative, and do the same with the departures.

4th. Take the first departure and place it opposite, as the first quantity in a column of multipliers. For the second multiplier, add together the first multiplier, the first departure, and the second departure; and universally, to find any multiplier add together these three quantities, viz. the last preceding multiplier, the departure belonging to it, and the next succeeding departure; the number of multipliers to be the same with the outlines of the field, a multiplier to each outline.

5th. Involve each multiplier into the difference of latitude standing against it, and the half sum of the several products thus obtained, will be the area of the field in square measures of the same denomination in which its sides are measured.

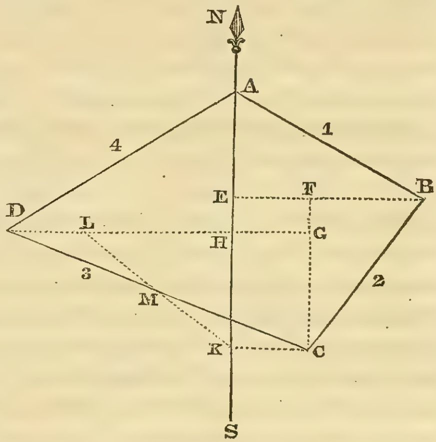
The operations of adding and multiplying, are in every case to be performed algebraically. If the additions for the multipliers are made correctly, the last multiplier will be equal to the last departure with its sign changed.

Illustration.

No.	Courses.	Dist.	Dif. lat.	Dep.	Factors or multipliers.	Products or areas.
1.	S. EAB. E.	AB	AE	EB	EB	2AEB
2.	S. FCB. W.	BC	FC	– BF	EB+KC	2BEKC
3.	N. GCD. W.	CD	– CG	– GD	– HL*	2KHL
4.	N. HAD. E.	DA	– HA	HD	– HD	2DHA
					2	2ABCKLD
						ABCKLD = ABCD

the triangles DLM and MKC being equal.*

The first meridian NS passes through the first station A. EB, DG and KC are drawn perpendicular to, and FC parallel with NS.



Calculation.

No.	Courses.	Dist. chs.	Dif. lat.	Dep.	Factors or multipls.	Products or areas.
1.	S. 60° E.	9.00	4.50	7.79	7.79	35.0550
2.	S. 35° W.	8.00	6.55	– 4.59	10.99	71.9845
3.	N. 70° W.	14.00	–4.79	–13.16	– 6.76	32.3804
4.	N. 57° 51′ E.	11.76	–6.26	9.96	– 9.96	62.3496
					2	201.7695
						10.088475 acrs.

It is stated in the article alluded to, that "in the common method of computing the area of a field, a meridian line is supposed to be drawn at some assumed distance from the commencing corner." This it is imagined is incorrect. The most "common mode," is to select for the point of commencement, the extreme East or West station of the field. Through this station, the first meridian is made to pass, and the necessity of an "assumed distance" is thereby avoid-

* DL = KC by construction.

ed. The advantage of the algebraic process, consists in its simplicity and in the universality of its application. This results from the circumstance that the meridian line not being limited in its position, may be made to pass through any station of the field, wherever it may be convenient to commence either the measurement or the calculation. If its position is such as to divide the field into equal or nearly equal parts, the multipliers or factors are lessened in quantity, and considerable labor is saved in the calculation, and the liability to error in the several computations in a corresponding degree diminished. B.

Art. VIII.—*On the Origin, Extension and Continuance of Prairies; extracted and abridged from unpublished MSS. on a theory of the Earth; by* Dr. Rush Nutt, of Rodney, State of Mississippi.

We can conceive that a prairie may proceed from the joint action of two causes. First, from the influence of a cane-brake; and secondly, from wind and fire. It has been shown that cane exerts a considerable influence on a forest of timber; that it can completely obscure the rays of the sun, as well as form by its roots an astonishing mat-work over the face of the earth, so dense that it is utterly impossible for any seed to vegetate and for the earth to bring forward a single tree. Our knowledge of the natural history of the cane, does not enable us to know the length of time it is in seeding. More than half of the cane of Mississippi and Louisiana went to seed in the year 1830. It had not seeded to such an extent, during the fifty preceding years. A few stalks or a few square yards of the cane, seed and die every year, but when stalks seed again from the same root, we do not know whether so general a seeding as that just mentioned proceeded from natural or from accidental causes; such as long feeding up, with the unusual vicissitudes of the weather of a few preceding years. The stalk and root die with the ripening of the seed, which will vegetate and come forward the following year, unless prevented by such a drowth as followed the period alluded to. However, our want of a full knowledge of the natural history of the cane, is not very important in the case before us, as we can readily conceive of a cane-brake contending with, and finally overcoming, extensive regions of forest trees. If the cane keeps possession of the same land for five hundred or a thousand years, (as we think it does,) it will of course wear out almost any family of trees. When the cane has driven out every tree and has acquired exclusive possession, it then begins to experience the consequences of exposure, without the shelter from the sun's rays which is afforded by the trees. The influence of the sun upon a cane-brake, unprotected by the trees, will in time produce the destruction of both stalk and root, by which means the land will fail to be occupied again by cane, until it has been covered anew with trees. Under favorable circumstances, the seeds of grass are always at hand, as well as those of trees; but the grass is quickest to shoot and grow, and will soon afford a dry carpet, which, if set on fire at the proper time, will readily burn and destroy any young trees that had sprung up; the grass will now continue to increase in quantity and to improve in quality as the cane-roots are decomposed and the annual fire is continued. But, on the other hand, if the firing is not carried on, the trees will, in a very few years, by their shade, exclude the grass; and should the land be adapted to the kind of trees that spontaneously appear, they may become so thickly set, as to form such a complete barrier to the sun and light, that even the cane will be kept from returning, and can regain its former residence only by taking hold at the time the trees are exchanging places; as, for instance, when one family, composed of such trees as usually accompany each other, are becoming thinned by death, and thereby making room for another to occupy the land.

There is no fact that can be better established than that prairies are formed, and are now forming, by the operation of wind and fire. Very abundant proof was exhibited to the writer, more than twenty eight years ago, when making a pedestrian journey through the distant and extensive regions of the west. He has seen the prairie in all its stages; he has seen the hurricane at work upon the forest. He has seen places where the inroad had been made only the year before; where the grass stood but thinly on the ground, and where it had become sufficiently luxuriant to burn. When the first burning took place, the timber was, in some places, partly consumed, and in other places altogether burnt off, leaving holes in the ground, made by the action of the fire upon the trees, which were burnt when standing, and thus the stump part was consumed beneath the surface of the earth.

When a hurricane makes an inroad upon a forest, the rays of the sun are then admitted to the earth, and this at once affords an opportunity for the grass to spring up; and if the land is rich and the sun freely admitted, the carpet of grass will be from six to eight feet in height. Should this grass be burnt during the fall season, or at any dry time through the winter or spring, and the practice annually continued, the ground would become more and more prepared for the production of a still more luxuriant crop of grass, when not only the dead timber would be consumed, but those trees that are alive would suffer by the fire and in a few years be killed, unless they stand on the borders of ponds of water, or on some very unproductive spots; in either case the grass is found to be short and puny, and insufficient to support a flame that would affect a tree. In extensive prairies, we often observe little clusters of trees, which, by occupying peculiar situations, are enabled to avoid the consuming flames of a burning prairie.

In a few years, all the trees which come within the reach of the fires will be killed, and thus the forest is annually dilapidated, until no signs of it remain, except those which appear in the holes in the land left by the standing trees, and in the little hillocks made by the roots throwing up the ground when they are laid prostrate by the wind. The hillock will be, in time, brought down by the action of rain; but on a very level piece of land the holes left by the burnt stumps will remain, and perhaps would never be entirely obliterated.

The prairie, which is now in its infancy, continues to make annual encroachments upon the surrounding forests. The grass of this prairie becomes closely set, and may be from ten to twelve feet in height. It pushes close up under the trees of the surrounding forest, and every fire acts injuriously upon the nearest trees; and as they are killed, the grass not only surrounds them, but passes on and *crowds* hard upon other trees, so that the prairie is constantly increasing, and would always exist and extend its borders while fire was applied.

FIRES IN THE PRAIRIES.

It is difficult to conceive of the horror excited at the sight of a burning prairie. It is an ocean of fire, whose billows roll and heave, and run together, when the mountain of pyramidal flames ascends and drives detached bodies of fire seemingly into the very clouds. The whole horizon appears to be on fire; the earth and the sky are hidden by the flames, and the eye can reach no point beyond their boundary. When the wind is brisk, the burning grass ascends and gives the appearance, as though the heavens were filled with firebrands; and such is the rapidity with which the flame moves over the face of the earth, that an attempt at escape, by the swiftest animal, would prove abortive.

In these regions of natural beauty remote from civilization, the exhausted spirits of the weary pedestrian are enlivened and fatigue is allayed, as he beholds the unrivalled charms of these vast prairies in their successive seasons of flowering. In May and June, they are robed in flowers of white and pale yellow; in July and August, in those of sky blue and red; and in September and October, in others of deep blue and brown. Flora has here her paradise of innocence and beauty, and vegetable and animal life know nothing of the tyranny of man. He destroys vegetables and animals, to produce others in their stead, and thus maintains a constant warfare with animated nature.

Domestic animals travel less than the beast of the forest, and their journeys, when performed, are not so extensive; hence they collect their food on a smaller and more contracted surface, by which means they break down and tread under foot so much of the grass within their usual bounds that the fire is either arrested on the borders of their range, or runs lightly over it without injury to the shoots that may have come forward the preceding spring. Such circumstances favor the introduction of trees, which then immediately appear, and as they obtain sufficient size to shade the land, the grass itself is driven out; the cattle are thus driven to a greater distance from the plantations in some new direction, where they soon crop the grass, and place it beyond the reach of fire. As the cattle recede, they are followed by the forest; and so soon as a farm can be enclosed by the young trees, the farmer, for the convenience of his stock, moves nearer to the prairie; otherwise, from the receding of the prairie, the cattle would seldom return to their home, and perhaps become wild by absence. In this way, the prairies of Kentucky have disappeared; and those to the west of the Ohio and Mississippi, retreat as the settlements approach them. It should be remembered that some prairies are so very level, and retain water so long at the surface, that the seeds of trees will perish, and even the roots, if the seed had sprouted, and the shoots had been burnt, or left standing.

Hence, you may observe such prairies to continue long after stock are turned upon them. So soon as the fires are restrained, trees come forth, upon all the prairies that are formed of rolling land.

A TORNADO.

We have stated that hurricanes and whirlwinds, by their inroads upon the forests, are chiefly instrumental in forming prairies.

It is believed that hurricanes are not so frequent and so violent as formerly. For the last twenty-five years particularly, they have diminished in number and energy. The signs of hurricanes, previous to the year 1805, would indicate in their case, a frequency and violence unequalled in any subsequent period.

In the year 1805 it happened to the writer to be roving on that most beautiful lawn, extending from Kaskaskia to Illinois, and which is called the American bottom. There was the most charming alternation of prairie, and woodland, and while he was musing on the causes which gave rise to forests of grass, or cane, and of stupendous oaks and cotton woods, he was roused, and his attention directed to a scene of unequalled grandeur and horror. It was a whirlwind that had crossed the Mississippi, and was making its way through the swamp, until it was near the charming prairie, which at that moment afforded rest and comfort to a solitary pedestrian. By the irresistible force of the wind, whole forests were in a moment twisted from the ground, and when thrown from the mouth of the vortex, such was the violent collision of tree against tree, that they were pounded into billets and splinters. A sound of universal distress burst forth from every quarter, and earth and sky appeared to be blended. In a twinkling the tornado scooped up a lake, with two or three feet of mud which lined its bottom. In one instant more, it tore away a house with its stone chimney. In another moment thirty or forty horned cattle, and fifteen or sixteen horses, disappeared with inconceivable quickness. The whirlwind twisted off almost every spear of a wheat field, and bore it away with the fence, cattle, horses, lake, trees, house, and whatever was in the way. For more than a mile the heavens were black, and filled with the wreck of the tempest.

In this tornado, as well as many that had before occurred in these countries on a smaller scale, there was nothing to justify a belief with Mr. Dunbar, "of a vortex with a central spot in a state of profound calm;" or of Dr. Franklin, who supposed the "vortex of a whirlwind to be a true vacuum."

From the lake to the house, was about two hundred yards, between which stood a huge cotton-wood tree of at least seven feet in diameter, and more than one hundred feet in height. It was observed, when the vortex had nearly or quite reached the tree, that the leaves and limbs began to point upwards, and at the same instant of time they were crushed, and ran together, which gave the appearance of a mock body, by which the trunk seemed to be extended; but immediately the trunk was twisted from the stump, leaving about ten feet above ground, when with a quickness, that the eye could not follow, all ran through the throat of the vortex, and was thrown out to float with others in the regions above.

There was remaining of the stone chimney, about one foot above ground, and not one of the stones removed was to be seen. Whether they were carried up in the vortex and thrown out by the circular impetus of the air, and deposited beyond the reach of observation, we were unable to determine. The water and mud of the lake were deposited on the field which contained the wheat, and from thence to the wood land beyond the prairie in the direction of the tornado, was about three miles; on which land, there were to be found only the bodies of two of the horses and five or six of the cattle. This mighty wreck was seen to pass to the north-west of St. Louis, more than twenty miles above the plantation.

Art. IX.—*Observations on depriving Flowers of their Anthers, to produce Double Flowers;* by E. T. Leitner.*

Some years ago, Dr. Messer, of Cabo, (kingdom of Wuertemberg,) published a small book, entitled "Art of raising double Gillyflowers, Neustadt at the Orla, 1828;" in which he shows how to deprive unfolded flowers of their anthers to prevent fructification, and that seeds

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* Perhaps we cannot, in any better manner, introduce a respectable young stranger to the American public, than by giving publicity to the following letter of Dr. Leitner to the Editor: its frankness and integrity are not less observable than the intelligence and zeal which it indicates.—*Ed.*

Charleston, July 14, 1832.

Dear Sir—Since your Journal has fallen into my hands, I have felt a great desire to become better acquainted with you; I therefore take the liberty to address this letter to you. I hope you will excuse my inaccuracies in writing; particularly, as I have been but a short time in this country. From early youth, I have felt a great inclination for natural history, and when, having arrived at riper age, I saw my sphere in my native land (Germany) too narrow, then a thought arose in my mind to visit and explore this interesting country, in hope that I might, perhaps, contribute, by and by, something to the knowledge and science of natural history. After visiting the College in Tubingen and enlarging my knowledge, I left my native home, to bid it perhaps the last farewell, and embarking from Havre de Grace, I from such mutilated flowers produce double flowers. Dr. Messer gave notice of it to the Horticultural Society of Berlin, (Prussia,) but with the remark, that he was less fortunate in experiments made on flowers in his garden than on those which he had in pots, perhaps because they were less distant from other flowers. The Horticultural Society encouraged him to continue his experiments, which he performed with great success. At the same time Prof. Bauer, Prof. Schuebler, Mr. C. Orthman, (inspector of the College garden,) and myself, made experiments, in Tubingen, on the same subject; and the results are now concentrated as follows. We could not find much difference between flowers in pots and the same flowers in gardens. Seeds produced by prevented fructification, always showed in one hundred plants sixty or seventy with double flowers, while one hundred plants, when in the same ground, in a natural way, produce no more than twenty or thirty. Even the seeds of the former produced flowers larger and more full, than in the natural way. In some of the flowers, the number of the petals was multiplied from fifty to fifty five, when in single flowers there were no more than

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arrived in New York, last year. Having little knowledge of the language, I at first encountered a great many obstacles, which prevented me from visiting the circles of the learned and scientific. I came to South Carolina, after I had wandered through a great part of New York and Pennsylvania. I cannot sufficiently praise the hospitality of the people of Charleston; I am treated with the greatest kindness and benevolence, and they do every thing in their power to extend my views. I shall finish, in Charleston, my studies of medicine, being with Dr. J. Edwards Holbrook, Professor of Anatomy in the Medical College; at the same time, I am delivering lectures on botany in that institution. I was indeed surprised and delighted, to find more spirit here for natural history, than in any part of the United States which I have visited. About seventeen ladies and fifteen gentlemen attend my lectures; a considerable number in the summer season.

I have in view an expedition to Florida next March, the time at which the lectures terminate. I shall visit first the Florida Reefs, (perhaps accompanied by Mr. Audubon,) and penetrate from thence into the heart of the territory, to explore its great treasures, and to lift the veil which now covers that part of the United States. I expect to stay there until the sickly season begins, and then return to Charleston, if God prospers my undertaking, to distribute the collections among the subscribers. The subscription is only $10 for each member, and the money is returned in shells, minerals, plants, insects, reptiles, and some stuffed birds, and seeds. I hope to procure about thirty subscribers in this city. If I succeed next year in my expedition to Florida, and finish my studies in medicine, I shall very probably undertake an expedition, on a larger scale, to the western states. I hope the gentlemen at the North will not overlook such an occasion to enlarge their museums and herbariums.

I now take the liberty, Sir, to offer a few observations only, for the pages of your Journal. Very respectfully yours, E. T. Leitner.

four. No stamen, or rudiment of the germ, was discovered in the centre of the flower. The following are the most interesting remarks on the subject.

1. To succeed in these experiments, you must cut out the anthers from the closed flower, when they are almost formed, but have not yet spread out the pollen. The Gillyflower (Cheiranthus annuus) succeeded in the best manner, just when the petals were about $3\frac{1}{2}$–$4'''$ (lineæ Parisienses) long, already a little colored, but still closed and folded; the petals must very cautiously be opened with a pincette, and the anthers taken out.

2. If you cut off the anthers when the pollen is already spread out in some measure, then large and perfect pods are produced, but the single flowers are mingled with double ones.

3. If you take them before the anthers are formed, and the petals still colorless, or only whitish green, and about 1–$1\frac{1}{2}'''$ (Paris measure) in length, standing out of the calyx, then no seed at all is produced, and the germ after some time drops off sterile. This observation proves that the fructification must be according to the former method certain, though imperfect.

4. If you observe the further growth of the pods of such deprived flowers, you will remark, that they grow less regular than natural ones; they thicken and swell up, sometimes on the upper more than on the under part; they are generally shorter than usual, and vary very much in size on the same plant.

5. In the state of maturity, you find less seeds in pods of mutilated flowers than in those not so. We find the seeds sometimes only attached to one side, the other side of the dissepiment being empty; single pods contained from five to seven seeds, when natural ones had from forty six to fifty.

6. The single seeds are sometimes smaller, sometimes more or less curved, and imperfect: the weight of one thousand ordinary seeds of the Gillyflower, in a dry state, attached for ten months to the dissepiment, was in the month of July 26 grains. One seed had a weight of about .026 gr. or near to $\frac{1}{38}$ gr. The same number of seeds from double flowers was 22 to 24 grains; single seed, $\frac{1}{41}$ to $\frac{1}{45}$ gr.

7. We observed sometimes, in natural pods of the Cheiranthus annuus, curved and imperfect seeds, which produced double flowers also.

8. Simple Gillyflowers, from seeds of artificial, deprived flowers, displayed sometimes an irregular shaped corolla; instead of four, only three petals; and instead of six stamens, only three on one side of the corolla.

9. The color remained, as well in single as in double ones.

10. The odor seems to be augmented in double flowers.

11. Manure has some effect on the multiplying of flowers; however, not so many flowers are then produced, in the Cheiranthus annuus; the whole plant rather becomes more strong and luxuriant. Often the manure of pigeons, and powdered bones, has the effect of imparting white spots to colored flowers.

12. On Cheiranthus incanus, (Stockflower,) it has the same effect, and in that plant the seeds seem to differ too in proportion, so that the weight of one thousand ordinary seeds amounted to 33 grains, and one seed about .033, or near $\frac{1}{30}$ gr.; the same number of seeds of double flowers 30 to 33 grains, or single seeds $\frac{1}{30}$ to $\frac{1}{33}$ gr.

These experiments show, that this formation of double flowers, produced by depriving the flowers of their anthers, agrees well with the theory of sexuality. The usual fructification is only disturbed, but not immediately destroyed; the imperfect seed is still formed; the plants raised from them display, instead of the organs of sexuality, a multitude of petals, where the ability of production is manifested.

The experiment I made with Nicotiana Langsdorfii and N. paniculata, can be connected with it. I deprived the former of the stamens, and fixed the pollen with a quill on the stigma of the latter, which produced, by sowing the seed the next year, quite a different plant—a medium between both. Dr. Gaertner made an experiment of this kind with Nicotiana glutinosa and N. suaveolens, which produced a variety with a multitude of beautiful red blossoms. It is to be wished, that similar experiments may be made in this country, with different plants and in different places.

Art. X.—*Miscellaneous Geological Topics relating to the lower part of the vale of the Mississippi; alluvion by rain; up filling and extension of valleys; subsidence of the sea; original vale of the river with its wings and present channel.—From unpublished MSS. on the Theory of the Earth;* by Dr. Rush Nutt, of Rodney, Mississippi.

That the ocean once rolled its waves over the present Delta of the Mississippi does not admit of a doubt. We will first consider the tract of country, from Vicksburgh to Baton Rouge, whose width is between ten and fifteen miles from the present boundary of the bluff.

SKETCH OF THE COUNTRY.

The unevenness of the face of this district will at once strike the traveller with surprise. It is a country cut to pieces by broad ravines; and notwithstanding the narrowness of the ridges, they are much disfigured by excavations, running into their sides. The general direction of the principal ridges is westerly, intersecting the Mississippi at right angles, and they are gradually depressed, as they run from the limits of the district now under consideration, until they are cut off by the vale.

Most of the bluffs are from one to two hundred feet in height. By observing their descent, which is often gradual, when receding from the bluff to the limit of the territory we are now describing, it would appear that, did the ridges run upon a declivity similar to that which they formerly had, they would extend at least ten or fifteen miles farther than they now do, in a similar course. We shall then suppose, that prior to the existence of the present river, these bluffs were continued and terminated by a gentle declivity; being met by a slight subsidence on the other side, which was an extensive ravine, that was afterwards to become the present vale; thus they gradually encroached upon the basin, and finally succeeded in driving out the waters of the gulf, which we shall consider as the Natches basin.

COMPOSITION OF THE STRATA.

In proof of the correctness of our position, we shall appeal to the fact, of the presence of molluscous testacea, which are found to be very regularly and generally dispersed from within five feet of the present surface down to the sand, which formed the downs and beach of the ocean itself. The first foot of soil we shall call vegetable mould; beneath that we find a stratum of deep red clay, very hard and tenaceous, of about four feet in depth, and abounding in alumina, iron and lime. The next, or substratum is that which extends to the sand; it is of a pale yellow color, contains less alumina and a very little iron, and abounds in comminuted arenaceous quartz. By attrition in water it has been rendered as fine as the sand of Arabia, which is now extending the limits of Cobi, in Asia, and similar causes are enlarging the desert of Sahara, in Africa; where floods of sand are carried upon the wings of the wind, until countries and cities are overwhelmed and lost beneath its accumulating mountains.

In this stratum, the snail shells are regularly distributed throughout this region, and are found in every foot untill you reach the sand. Upon examination of the bluffs made by the inroads of the Mississippi, we uniformly find the shells thus deposited. Now as these snails must have been buried by the gentle alluvion of the higher land and as the present bluffs formerly receded by a gentle declivity for ten miles into the rear, until they ended in a plain,—where would they find a limit? Is it not evident that they did once extend by a gradual depression, until they were lost or gently died away? There is but one species of snail found buried here, and they exist at this time very extensively; and can be found under the bark and in the cavities of rotten wood. There is another species of snail, whose shell we have never been able to detect beneath the surface of the earth; they are rarely to be found, for they delight in perpetual shade. They must have appeared in this country at a late period: they are already extinct, unless where the forest has continued in an uninterrupted state.

We have already remarked, that neither species of the snail is to be found in the first stratum of clay, nor are they to be seen in the vegetable mould. It is in the range of these strata, the mould and first clay stratum, making a depth generally of five feet, that the air has exerted its influence in decomposing the shells, converting them into lime, and the vegetable roots which occupy this region have contributed to their farther and more speedy destruction.

INFLUENCE OF CANE BRAKES, &c.

If we are asked why the shells are decomposed in this and not in the substratum, we answer that we are about to enter upon another epoch in our local history:—The visitation of cane (Arundo Mississippi.) As soon as this vegetable got possession and became matted over the face of the country, the washing down of the land ceased at the surface, and the helpless snail escaped a premature interment. It was then that the abrasions and excavations took place beneath the surface. It was then that the rains bore off the earth and deposited it in the great north and south ravines, and these were destined to become, at a future day, the bed of a mighty river, which was to be employed in transporting the earth to assist in expelling the sea, and forming what we shall call the Orleans' basin. It was then that the present dark and deep vegetable mould began to be deposited. The cane roots formed a perfect mat and net-work over the face of the earth, while their stalks held the leaves and decayed wood so firmly that all remained and nothing was removed by rain. From century to century the leaves, limbs and trunks of trees were tied down to the very spot which they first occupied, and the rains could only sink the decomposed mineral vegetable and animal matter, imparting by an increase of iron, lime and alumina, firmness of texture to the stratum below.

From the depth of the stratum of vegetable earth, we may estimate the time the cane has been on the surface. We have taken the deposit of one year in leaves and dead wood on a given piece of ground, and reduced it to ashes; calculations on the result, allowing for the destruction by fire, and the action of rain and air on this stratum, will bring us to the probable conclusion, that the cane was set, and the formation of this black mould actually began, twelve hundred years previous to the time when it began to be disturbed by man. As doubtful as this calculation may be, it affords us more information than that derived from the trees. The forest, which witnessed the arrival of the cane, has perished in days that have long gone by, and probably several generations of trees besides. We find no trees of this country, whose life exceeds the term of three hundred years. The present forest, like the aged hemlock, is dead at the top, and we might add, in the center too; as the trees are of the kind, which first decay in the heart of the trunk. In short, we can safely assert, that had not the white man appeared to molest this full grown garden of nature, the present race of trees would have disappeared in forty years more, and the country have been a prairie.

PECULIARITY OF STRUCTURE.

A remarkable circumstance in this district is the absence of the superincumbent stratum of clay. In the neighborhood of Natchez the vegetable soil rests upon the stratum which abounds in arenaceous quartz; and that which is rendered tenaceous by alumina and iron is wanting. The trees which cover this land, do not exceed fifty or sixty years of age. This land has, in most places, a deep vegetable mould, but why it should be without the iron and alumina can be accounted for only upon the supposition, that for the greater part of the period of its present position, it remained a prairie. From this it would appear, that grass does not much contribute to the generation of a sub-stratum, so desirable to the farmer,—without which he is but poorly compensated for his toil in collecting and spreading his manure upon a soil which is unable to retain, and appropriate it to use. We therefore conclude, that this section of our district was a prairie for, at least, six hundred years before the cane got possession of it.

It may be supposed, that the superincumbent stratum of clay was the last washed down, and brought with it the properties it now exhibits. To show that such a conjecture was unfounded, we state, that all the sides of hills, as well as the tops of the ridges and the plains, are furnished with this stratum; but whenever we approach a grove of aged magnolia trees, which most usually occupies the point of a ridge, whether the grove is on the summit or on the side of the ridge, if the rain can remove the leaves, this stratum will be wanting. It must be remarked, that the magnolia groves so completely obscure the rays of the sun, as to prevent entirely the growth of the cane, or permit, at most, only a scattered and small growth. It has been already stated, that this clay is found on the sides of the hills, where the cane enjoyed freedom of light, and occasional access to the rays of the sun. This fact, with the actual appearance of the furrowed ridges, scooped out on both sides every ten or twenty steps, will suffice to show that the clay was not brought from a distance and deposited there; but that it was deposited from the operation of an earlier cause, and that it remained notwithstanding the disadvantages such a situation would be attended with in consequence of frequent waste from rain.

While upon the subject of this sub-stratum, we shall mention the invariable occurrence of a blue stratum of tough clay, generally found immediately above the sand, or within a few feet of it. When wells are sunk and water obtained in this clay, like that in the London clay, it is never fit for use; its smell and taste are very offensive being not unlike that of the mud of a salt marsh. In this stratum the snail shells are very abundant. Should we not attribute this stratum to the washing down of the land, the pushing out the sea, and the forming, in this manner, of marshes and pools of stagnant water, which series of events was followed by a luxuriant vegetable growth; It is evidently the vegetable and animal matter of this marginal stratum which gives to it so unpleasant a smell.

If we are correct in the conclusion, that this is the marginal stratum, which girded the sea in this quarter, the question may be asked, has the sea subsided?—We have made no calculations of the height of this stratum above the sea, but incline to the opinion that it is more than one hundred feet above the gulf stream. Much attention has been given by the writer to the appearance of bluffs, and many inquiries have been made of persons employed in the sinking of wells for water, to ascertain if there were any reasons to admit a heaving of the land. But it appeared, upon inquiry, that nothing of the kind has occurred, and that the land of the above named district has been gradually formed by the slow and uniform action of the rains, in bringing down the earth from higher places, and thus raising and extending the vallies.

SOURCES OF FRESH WATER.

It is worthy of remark, that, in some instances, wells have been sunk and the sand reached without observing the blue clay; but water was not obtained until they descended to the sand containing pebbles, whose depth is sometimes ten or twelve feet. This sand must be composed of such beds as are usually observed to be of unequal height, such as form the downs of the sea shore, being thrown up by the wind, and consequently they lie higher than the water level. In proof, it may be stated that no water can be obtained in these beds; they are also without the pebbles which invariably occur on the face of sand as the water runs over it, whether from the base of the bluffs, or across the bottom of wells. It should be remembered that the appearance of sand, near the surface, on hills, or other situations, should not be confounded with the downs above alluded to. This occasional and rare occurrence of sand, would seem to have been caused by earthquakes. Such deposits of sand are generally narrow and short. It is also worthy of remark, that the blue clay, or marginal stratum referred to above, should not be confounded with the occasional appearance of blue clay, from five to thirty feet in depth, and formed by the gradual interpolation of land upon ponds, which have existed at various depths between the surface of the earth and the sand below.

FERTILITY OF THE CANE DISTRICT; INFLUENCE ON WATER.

Notwithstanding the unevenness of this district of country, as before observed, it is the most fertile of all the regions of the South, and for this it is indebted chiefly to the cane. Previous to the appearance of this vegetable, the soil which was very fine and easily acted upon by rain, continued to descend, carrying leaves, wood and the molluscous testacea in its course, which, in process of time, produced this stratum of clay, so remarkable for its fineness and looseness. Thus it was that every facility was afforded to the solution of this stratum in water, so as to afford on its arrival a speedy and luxuriant growth to the cane. It was then that the surface of the earth was for the first time, in this region, enabled to enjoy repose. It was then, that the deposit of wood and leaves, was confined to the very spot which first received them. And it was then, on account of the fallen leaves and timber, that the rain water was caused to experience insurmountable difficulties in obtaining a passage on the surface of the earth. It was, therefore, driven below; here it met with less difficulty, readily pursuing the course of the cane roots, which had already penetrated the earth in every possible direction. It was here that the water, assisted by the roots of trees, which enabled it to descend lower, found a ready outlet. Thus a way of escape was provided: but it was done at the expense of the stratum of clay; as the water passed on, it carried with it much of the earth, which lay immediately beneath and about the roots of the cane and trees. This removal of the earth produced a corresponding subsidence of the superincumbent trees and cane, and of the earth, which filled up the interstices of the net work. When the roots again seized upon the earth below, they obtained a temporary and uncertain hold; but the water, again accumulating on a declivity, has, in some instances, burst forth, carrying downwards, for a considerable extent, both the cane and the soil; the breach is, however, soon repaired; the surrounding cane roots run in and quickly penetrate the earth in every possible manner, and render the fortification doubly strong. Thus the land was imperceptibly sinking and forming frightful hollows and mangled ridges, with their sides fluted and grooved to such a degree that the cultivation, in many places, is rendered almost impracticable. Yes, this secret and unsuspected removal of the earth was going on for, perhaps, twelve hundred years; carrying the earth by secret paths to a great distance, where it was either appropriated in forming what is now called second bottoms or bluff-flats; or deposited at a point where it was, at some distant day, to be again removed by a river that did not then exist, and it was destined to assist in laying the foundation of the Mississippi Delta, or what we have called the Orleans basin, with its upper or northern boundary beginning at Baton Rouge and not at Natchez, as supposed by Mr. Dunbar.

SUBTERRANEAN CAVITIES AND CHANNELS.

Our first stratum of clay, beneath the vegetable soil, contains a multitude of irregular cavities, traversed by the same clay, and disposed like the reticular texture of bones. These cavities are produced and perpetuated by rain water, which, as fast as it is compressed by superincumbent weight, passes readily through the soil and vegetable matter, and through this clay, into the next stratum, or it forms small channels between the two. These cavities are lined with a very thin coat of lime or chalk, derived from the rain water, bringing from the surface the spoils of the snail shells which time creates, destroys and decomposes. In very dry seasons, the lime, iron and alumina, give to this stratum of clay, a hardness and adhesiveness almost equal to that of lead. It dries so hastily in the sun, that it cannot be used by the brick-maker. The second stratum, which contains a superabundance of sand, requires more alumina and iron, to produce the weight and tenacity which are so very important in bricks. It may be doubted whether the levigated marl, mentioned by Mr. Dunbar, which "assumes a compactness and solidity resembling pitch," is very well "adapted to the use of the potter." This earth of the Mississippi bottom is alumina, with a considerable quantity of vegetable and animal matter. We have noticed the effects of heat upon this earth, when united with sand and made into brick. While burning, it is extremely difficult to raise and continue the white heat, without producing fusion; the bricks are very light, friable, and remarkably brittle.

To show the readiness with which land covered by cane received and absorbed the rain water, we will cite as instances two tracts thickly set with a natural growth of cane; both of these tracts received the heaviest falls of rain, without showing the least sign of draining on the surface. The first field contains about eighty acres, and was well known to the writer before the cane was removed, or the land much trodden by cattle. The whole of this piece of land was so situated, as to be drained by one outlet or valley. We frequently observed, that the heaviest falls of rain upon this land, previous to clearing and cultivation, did not exhibit the least sign of water on the surface of the vale. But after a part was put into cultivation, it was seen that a canal would be necessary to secure the crop from occasional inundation. So soon as all the land was turned to use, the canal was enlarged from year to year, until it was ten feet wide and six feet deep, before it was of sufficient dimensions to retain the water on its passage, and prevent an overflow, during a heavy fall of rain.

INSTANCES OF THE INCREASE OF SURFACE WATER.

The next case is not a part of a plantation, but of a tract lying on each side of a well known water course of this country, called Coles' Creek;—we shall suppose this tract to extend fifteen miles in one direction; but as the creek has branches, we will confine our remarks to its northern stream, in which it may be supposed to contain eight or ten square miles. Sixty years ago, this tract, as well as that in the vicinity, was a gloomy region of perpetual shade. Our informant, Mr. Daniels, reports his frequent visits about this time, for the purpose of hunting here the bear and the deer: for many years in succession, and often, several times in the same year, he crossed this then dry ravine, without either a channel or water. After a term of years, when settlements were made round about, and the cattle of the plantations extended their range, treading the land and breaking the texture of the roots of the cane brake, holes appeared in the ravine where now is Cole's Creek: they were occasioned by the land and cane sinking into the subterranean passages, which had been made by the water. In wet seasons water was found in these openings; but in dry weather there was none. At length a ditch of five or six feet wide, and eight or ten feet deep, was formed by the rains. For some years after, Mr. D. could step across it in some places, and in others he could jump over it. Twenty six years since, when we first observed this creek, the usual crossing places did not exceed ten or twelve steps in width and eight or ten in depth. But as the country was cleared, the creek continued to enlarge its dimensions until the present time, when it is between two and four hundred feet wide, and at least twenty five or thirty feet deep. The inundations are more frequent now than twenty five years ago, and the creek must of course discharge, in a given time, an infinitely greater quantity of water.

What more need we say, in support of our position of subterraneous water courses, by the infiltration of water through the earth. A new or uncultivated country, whether clothed with grass alone, or with trees and cane, will imbibe all the water that falls upon it, unless where the country is based upon strata of rock, or the soil is very sterile; and indeed many of the rocky districts, particularly those of limestone, are apt to contain more subterranean than superficial streams. It is worthy of remark, that in settling all the country west of the Alleghany mountains, there was a very general want of water; whether it was in the limestone regions of Tennessee, Kentucky and Ohio, or in the extensive prairies of Indiana, Illinois and Missouri, or in the great cane-brakes of our district; the scarcity of water was every where observed, and water was truly a desideratum. But as the settlements extended, with the introduction of cattle, the earth became more compact, and spontaneous vegetation less flourishing, which, by the increased firmness of the ground, caused the water to remain upon or rise to the surface;—hence it was found, that streams of water multiplied with the increase and extension of cultivation.

The water of our district is strongly impregnated with lime, which it receives from the snail shells, in passing through the upper and lower strata of clay and vegetable earth. Deposition of lime from the water takes place in all the cavities, whether occasioned by the decay of former deposits of wood, or of the roots of trees: this deposition of lime crystallizes, and is found, also, amorphous in the earth.

THE MISSISSIPPI.

We are again brought to the spot where the magnificent Mississippi now rolls. When did this river appear, and what is its age? Owing to causes unknown to us, this singular river was not confined, but driven out from the land, by the operation of the numerous lakes and grand reservoirs of water, and by the extensive regions of cane, which alternated with prairies, and began to show themselves and spread very generally over the continent. When the Indians arrived, (an unknown period,) they must have found no small difficulty in penetrating the cane-brakes. To make their journeys the more readily, they doubtless adopted the plan of burning the cane every autumn, which, under favorable circumstances of dry weather, would sometimes destroy, for the moment, the vegetation of immense regions, burning every tree to the top and leaving none alive. This mode of removing the cane must have been continued and extended with the increase of Indian population, by which means the water, under the given circumstances, escaped more readily. No matter how extensive a country of cane and wood was destroyed by fire; the cane during the following year would spring forth again, and in two or three months, stand as thick and as luxuriant as before. Having the exclusive possession of the land, it precluded the possibility of the coming forth of trees, but being unable long to withstand the action of the sun's rays, it would ere long die, and leave the land free for grass and trees to take possession and contend for the mastery.

It was now that the waters of the lakes found the fractured points in the hills and the mountains, and began to press hard upon them; hurricanes, assisted by fire began to form the prairies, and continued to extend their bounds. And now during the spring season, on the surface of the ravines, the water began to show itself, and make its way slowly, through the thick cane-brake, until taking advantage of the paths, made along the ravine by the beasts of the forest, it at length excavated a distinct channel. This channel probably existed in a very inconsiderable degree, at the time when the white man appeared. Under his subduing hand, forests and cane-brakes disappeared, and even prairies lost their names and became forests and fields.

ABORIGINAL BURNING.

I suppose that during the second century, of the Christian Era, the Indians passed out of Asia into America, and that about the fifth and sixth century, they had considerably increased and spread over North and South America, where they continued to kindle their autumnal fires. About this time, the waters of the lakes had probably made a considerable breach through the ridges and mountains, which formed natural dams, running across the ravines, and then the water began to show itself on the surface of the vale, when inroads were soon made upon the cane and trees, and thus a channel was formed. In 1750, the French settlements began on the banks of the river, above New Orleans; for the term of twenty years they cultivated the land and "rarely" says Mr. Dunbar, "had they ever seen the Mississippi surmount the level of its banks, and the embankment, called by the French name of levee, was rarely required and only in very low places. Since that period, from year to year, the river has continued to rise higher and higher, which has obliged the inhabitants of Lower Louisiana to prolong and reinforce their levees," &c.

The Mississippi now is evidently enlarging, as progress is made in clearing and cultivating the lands, whose waters run into this river. Within the last twenty-five years, its general width has sensibly increased, and its overflows are more frequent. There is no good reasons for the belief that it is becoming more shallow; but that the contrary is true, is we think demonstrated by the fact that there is an evident diminution in the number of what are denominated snags, and sawyers or planted trees.* It may be observed also, that the current is less furious at particular points, as near the termination of a bend, where the water always presses hardest. We think these changes indicative of an increased depth of water in the river, rather than of a tendency to become more shallow as many have supposed. The natural outlets through the Delta, that forms the mouths of the river cannot increase, but must diminish in number as the depositions from the water accumulate; consequently although the impediments at the mouth may not diminish, they cannot increase, before the Delta is pushed upon Cuba. We should also recollect, the weight of this stream, which surpasses, perhaps, any other in the world, and when assisted by the Gulf stream, it will always keep its mouths and bar of at least the same depth as at present.

PROSPECTIVE VIEW.

When the surface of the great country, whose waters pour into the Mississippi, shall be compacted by time, with the aid of a more scant spontaneous vegetation, and of a more extended cultivation, the quantity of water which will then be borne through the channel of the river, will be incomparably greater than at present. Heavy and repeated rains, which might now bring the water, only within five feet of the level of the banks, will then produce such an overflow, as will inundate the vales and destroy the crops.

In the year 1805, the writer stood upon the banks of the Missouri, and with astonishment beheld its diminutive stream. And even inconsiderable as it was, it appeared to be half filled with sand bars.

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* Local names given to trees that have fallen into the river, and become so fixed that the currents do not remove them.—*Ed.*

The current of this river is very rapid, and the sand bars are (like the billows of the ocean) forever rolling in the current, and shifting from place to place, and when with the progress of the current they leave the river, others will follow close behind. This river drains a country whose extent is more than three times greater than that watered by any other river of the United States, including the Mississippi, above its junction with the Missouri. It is not as large as the Ohio or Tennessee rivers, and its freshets make very little impression on the Mississippi, as far down as the Natchez basin. It is the Ohio, that compels the Mississippi to call to her assistance, her thousand reservoirs, and her extensive vale, to retain the waters unbosomed by this most beautiful river, her magnificent tributary.

When the prairies of that immense region lying on both sides of the Missouri, and extending quite to the Rocky Mountains, shall have vanished, what will be the appearance, and size of this river? The same question will apply to the Arkansas and Red River? It should be remarked, that the country bordering on these rivers, is more level, than that on the Ohio. Hence their waters will not be extricated so readily; but nevertheless their bounds must be extended to an incredible degree. When all the water that falls on this great country, and which now serves to replenish those mighty rivers, that roll through dark and gloomy forests, and through interminable deserts, shall be turned in their courses, and caused to keep as much above ground as the waters of the Ohio; the Missouri will then indeed become vast, and her freshets will be truly terrific. Judging from the observations of more than twenty five years, we will venture to say, that the Missouri must, by and by, discharge in a given period, twenty times as much water as now.

OPINIONS OF MR. DUNBAR.

In the 6th vol. of the American Philosophical Transactions of Philad. may be seen "A description of the Mississippi and its delta," by Mr. Dunbar, in which, when speaking of the formation of the delta, he remarks. "When we survey this immense work, formed by the hand of nature, we cannot accord with the opinions of certain visionary philosophers, who have been pleased to amuse themselves with the pretended infantile state of our continent, compared to their trans-atlantic world; but on the contrary, we must grant to it an incalculable antiquity." If Mr. Dunbar had been apprised of the existence and extent of the Natchez basin, that he sat and wrote within its bounds, and that it was formed by a process, incalculably slower than that which formed the Delta, what would he have said? After a fire-side geological survey of the globe, Dr. Hutton concluded: "We find no vestige of a beginning, no prospect of an end." It is due to the memory of Mr. Dunbar, thus publicly to assert, that his remarks upon the Mississippi and its delta, are of the highest excellence and authority.

Respecting the delta, Mr. Dunbar farther remarks that "upon all lands long subject to culture, and defended from the inundation though near the margin, the appearance is almost lost." This is a mistake, as there can be no sensible diminution of sand; the increased firmness and adhesiveness of all soils upon long culture, is in consequence of the farther decomposition and consequent loss of vegetable matter.

The second clay stratum of Natchez basin, has long since lost all appearances of vegetable matter; it has been resolved, and all the volatile and fertilizing properties carried off by the passage of water through it, leaving nothing behind, but a part of the iron and alumina yielded by decomposition.

Not to mention absurdities of a higher cast, it is an idle fancy to talk of the effects of the water of the Mississippi "banishing disorders common to other countries." This delusion is found in all civilized countries. Mineral waters have often been supposed to effect that which is due to change of situations producing a new train of associations, by the novelty of the scene, and the change of air, and thus often a very powerful influence is exerted upon chronic diseases. More benefit is derived from these causes than from the waters, as it rarely occurs that their qualities are suited to the particular nature and state of the disease.

The Mississippi may be regarded as a river almost without barriers; it cannot be controlled by its own banks or by the feeble ramparts erected by man; occasionally, it rolls through a breadth of thirty miles; roves with restless activity from side to side; subverts entire forests, and at its pleasure obliterates the soils which it had deposited in former ages.

LAKES ALONG THE MISSISSIPPI.

This river has no lakes at its mouth, but it is abundantly supplied with them on each side, throughout its whole extent. These numerous lakes are formed by bends of the river, presenting not unfrequently the figure of a half moon, or of a horse-shoe. Each cut off, before the mouths are closed, serves as grand reservoirs for floating wood, which accumulates in the bogs to an enormous extent. When the two ends of the bend are filled with wood and mud, leaving a canal to accumulate with the lake, the river rolls off to the east or west, when, ere long, another great bend is scooped out, and another cut off takes place, which are scattered throughout the whole of the vale, of this most astonishing river.

The mud which causes the turbidness of the water of this river, is brought principally from the Missouri. Most of the floating timber, in the time taken to make the journey of five or six hundred miles, sinks by the accumulation of mud. This journey is accompanied by frequent delays, as the planted timber often arrests that which is floating, and detains one and another tree, until many hundreds are locked and interwoven together, when a considerable mass of logs will be formed and perhaps detained; both very high and very low water occasionally extricates the mass, when the trees again separate and take the direction of the current. Few or none of the logs from the Missouri, unless perhaps the cotton-wood, reach Natchez. We have never heard of pines arriving at that place, although cedar has been occasionally seen and supposed to have left the Tennessee river.

SUBMERGED AND INHUMED WOOD.

That an immense forest of timber lies concealed beneath the depths of this river, in all its roads across the vale, was evinced by the earthquakes which occurred in 1812, and which were so severely felt at New Madrid. These convulsions brought to the surface of the river an incredible quantity of timber. The first shock was at night; the boat-men imagined it to be the approach of a storm: hearing a mighty noise like wind, and feeling considerable agitation of the boats, they went above to see whether all their fastenings to the shore were sufficient; and to their astonishment no shore could be seen; the distant lights of the town were sometimes seen to the right and sometimes to the left. They imagined themselves to be neither in the river, nor on the land; but flying with rapidity through the air, accompanied by a moving forest. It appeared, that for five or six minutes, the boats were impelled up the stream with great rapidity, and in the same space of time they were returned, which accounts for the shifting appearance of the lights and the rising of the wood gave the appearance of a moving forest. This extraordinnry motion of the water, so wedged together the logs, that a complete bridge was formed across, and along the river as far as the eye could reach.

In the above case, the backward current, alternating with the downward stream, produced by the repetition of the *Heavings*, which took place in the river, each *Throw* brought upon its back, from a vast depth, sand, fossil coal, and the river, and carried all to a considerable height before the confined air escaped, and the convulsion ceased. While this mountain of sand, coal and water was going up, and during its stay, the river was running down the sides, alike, to the north, and to the south; the boats and the timbers, on the south side experienced occasional vollies which continued to drive them with irregular velocity in the same direction; but it was otherwise on the northern or upper side; here the current, when it had descended, united with the accumulated waters above, and with inconceivable violence returned back, upon the yielding of the *heave*. These billows of convulsive nature, repeatedly oc-occurred in the course of thirty or forty minutes; when the boats, trees, coal, and sand that were at, or near the summit of this mountain wave, retreated and pitched headlong into the yawning abyss beneath, where they now sleep in silence and darkness. Had a thick stratum of rock above the confined air formed the bed of this river, a mountain would have been made; and a rampart formed which would have driven the Mississippi out of its bed, and caused it to have sought a channel beyond the limits of this mighty bulwark.

Will this river ever lose its primitive character? Should the vale and adjacent country, be raised by future upheavings of earthquakes, so as to give the Mississippi its second and final heave, and should it thus become, like the other rivers of America, fixed within impassible shores, the principal mountain may be formed in the fork of the Ohio, and Mississippi, throwing these rivers out of their present channels, extending the throw along the vale, obliterating the Mexican Gulf, and Carribean sea, and receiving into her bosom the great Antilles. The coal beds then exhibited here, would probably equal those of Pittsburg in quality; and for quantity would more than equal all the beds of the United States.

But waving hypothetical considerations as to what may be; and considering what now exists, or soon will be; we shall suppose the day not distant, when this river will be perfectly subdued, and its vale brought within the control of man; that parallel and cross canals will be run, intersecting each other at right angles, for every two or four miles; that all the lakes will be filled up, with the accumulation of earthy matter, by conducting the water upon them in canals, and that all the immense region of cypress forest, the most valuable timber in the world, will be reclaimed and brought within the reach of commerce and the arts of life.

PECULIARITIES OF THE MISSISSIPPI.

The Mississippi, like the Caspian Sea, has its bluffs on the eastern side, with its principal vale and lakes to the west. When the river is full to the top, all the land and the trees seem to float upon the surface. The water of the river penetrates the soil with astonishing facility. This will be seen by observing its level, which is preserved throughout the vale. A hasty rise in the Mississippi, in consequence of the want of time, often leaves the water lower in the swamps than in the river, by which means, the level is lost; but when the flood remains stationary for a short period, the level is, under favorable circumstances, recovered. To illustrate the facility with which water passes through the earth; we might produce the instance of a sand bar across the Arkansaw, mentioned by Major Pike: When the river is low, all the water escapes by infiltration through the sand. What is improperly called the *raft* in Red river is another example, in which nearly all the water which descends that river, when low, escapes through the mud and sand, and along the roots of trees. There is a sand-bar across the Mississippi, below the Ohio river, which, in low water, contains not more than three feet. When we consider that there are a thousand rivers discharging themselves into the Mississippi, and that some of them are at least as wide as it,—shall we say that the Mississippi is deep and carries off all the water that pours into it; or shall we conclude that, like the Caspian Sea, it is lost by evaporation? this solution of the difficulty appears to us very absurd. The size of the Caspian Sea, presenting such an immense sheet of water to the sun, would of course cause an escape of considerable water by such a process;—but will it account for the waste of the waters of all the rivers which run into it?—We shall not believe that either the bed of the Caspian Sea, or that of the Mississippi is sheeted over with a flooring, impervious as a solid plate of iron.

Subterranean passages, made by incessant infiltration, producing small holes or excavations which communicate with the interior of the earth, where they meet with subterranean rivers unquestionably exist. As a proof of this fact, we find occasionally that their inhabitants leave those dreary regions, and by pursuing the streams, find their way to the surface of the earth. In what other way can we account for the appearance of fish in ponds, whose waters are clear, and whose depth is sufficient to keep cool through summer, and of a regular temperature during winter. Fish find their way into ponds in the course of one or two years; where they continue to improve in size.

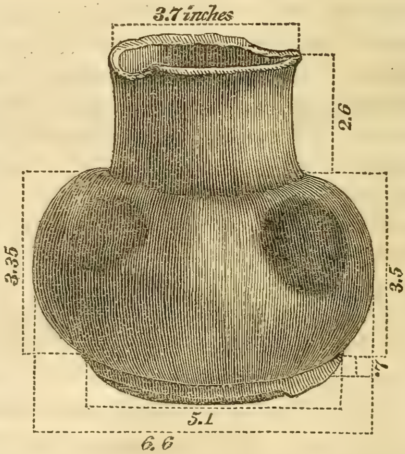
We witnessed a very remarkable fact of this kind, in the case of a fish which visited the surface, a few years ago. The passage which enabled him to reach the light of the sun, was connected with a hole at the bottom of a ditch, of about three feet in diameter, and two feet deep. This canal was made to drain a small valley, of rain water; during the winter and spring seasons, the water rose quite as high as the bottom of the canal; but did not during summer approach nearer the surface than twelve or fifteen feet. This fish was about eight inches in length, and perhaps of equal circumference. The hole occupied was filled with water, and there was not a sufficient quantity in the canal to enable him to pass up or down the valley. He was remarkably shy: many attempts were made to approach the spot so near as to enable one to thrust a pole into the crevice; into this he would retreat, when alarmed; but all efforts to approach him proved unsuccessful. He would sometimes be absent for two or three days in succeession. After a stay of about three weeks, and not being able to find a large stream, or a fit habitation on the earth,—he disappeared.

Art. XI.—*Notice of an Ancient American Utensil; by* Prof. Walter R. Johnson.

Philadelphia, August 9, 1832.

TO PROFESSOR SILLIMAN.

Dear Sir—The early state of the arts among the aborigines of this country, is a subject of much interest to the American antiquary. Under this impression, I take the liberty of forwarding to you the following description, and the accompanying sketch, of an article of American manufacture, of a date probably anterior to the time of any European discoveries on the North American continent—perhaps anterior even to the age of mounds and mummies. For the donation of this interesting relic of antiquity, I am indebted to the kindness of Mr. Isaac Rawlings, of Memphis, in Tennessee. He informs me that it was found near his residence, some eight or ten years ago, after one of those extensive falls of the river bank, which are known to be frequent along the line of the Mississippi. It had been buried several feet beneath the surface, and was brought to light by the *avalanche*. The materials of this piece of Indian pottery are blue clay and white particles of a soft, friable substance, resembling calcined and pulverized shells. The exterior has neither glazing nor coating of any kind, but only such a degree of smoothness as would be likely to result from long use and much handling. It does not appear to have been formed upon a potter's wheel, nor indeed to have received the effects of any machinery in its manufacture, but the hand which *moulded* it, must have been not a little skilled in the production of such articles, as the figure will sufficiently indicate. Time appears to have produced but little effect upon the materials. The figure will show two slight fractures of the rim, and the scaling off of the whole exterior part of the base, except on one side.



At four points, on the upper portion of the body, and equidistant respectively from each other, are four flattened spots, each about 1.5 inch in diameter, and, with one exception, marked by a darker color than the rest of the vessel. Two of these spots are seen in the figure. The depressions were obviously made in the moist state, and, together with the color, may have resulted from the arrangement used in burning or *baking* the ware; by which means these four points were more pressed than others, while soft, and less exposed to the fire, when hot, than other parts of the vessel. Hence the carbonaceous or other coloring matter, may not have been so completely expelled from these parts of the surface.

Articles of this description must, at a very remote period, have been common in that part of the country whence this was taken.

In the Philadelphia Museum are two jugs or bottles, composed of similar materials, found in Tennessee, at the depth of fifteen or twenty feet below the surface of the ground. Several specimens of the same ware, are also contained in the collection of the Philosophical Society, in this city. Some of the latter, and one of those in the Museum, bear a near resemblance in form to an egg, with one end opened and extended a little, to constitute a neck and mouth. The most rude and apparently the most ancient specimens have generally this form; which may *possibly* have been suggested to the mind of the savage, together with the very idea of earthen ware itself, by the previous use of egg shells for some domestic purposes. None of the specimens of pottery above referred to, appear to have received any glazing—a remark which, as far as my observation has extended, is likewise applicable to the Mexican and South American pottery. The latter occasionally exhibit a species of varnish very durable in its nature, but entirely distinct from a true glazing. This observation is in conformity with the opinion of Mr. Abraham Miller of this city, whose practical acquaintance with this branch of art has led him to a careful examination of many specimens of the ancient manufacture.

The dotted lines and figures in the cut indicate the several dimensions. That the vessel was not formed by revolving machinery is shown by the difference in the depth of the body on two opposite sides. The contents of the vase are three and a half pints. From its peculiar composition and manufacture, it sends forth when moistened a fresh earthy odor, exactly like that which is perceived at the commencement of a sudden shower, at the close of a hot summer's day. As a drinking vessel, this circumstance may have enhanced its value in the eyes of the Indian, who thus regaled his sense of smell exactly as when he quaffed from the pure native spring.

I have been thus particular in the above description, from a belief, that when collected, figured and described, objects of this kind may aid in forming an estimate of the state of the arts and civilization among the nations which possessed this continent at periods of very remote antiquity, and may perhaps furnish an *index* to mark the relationship of the American Indians, either with each other, or with distant nations of the globe.

ART. XII.—*Remarks on the Strength of Cylindrical Steam Boilers; by* WALTER R. JOHNSON, Professor of Mechanics and Natural Philosophy in the Franklin Institute, Philadelphia.*

[Read before the Institute, at the stated monthly meeting, July 26, 1832.]

IT has been generally supposed that the rolling of *boiler-plate* iron, gives to the sheets a greater tenacity in the direction of the length, than in that of the breadth. Supposing this to be correct, it has frequently been asked, how the sheets ought to be disposed in a cylindrical boiler of the common form, in order to oppose the greatest strength to the greatest strain. It has also been asked, whether the same arrangement will be required for *all diameters*, or whether a magnitude will not be eventually attained, which may require the direction of the sheets to be reversed?

To determine these questions in a general manner, recourse must be had to mathematical formulas, assuming such symbols for each of the elements as may apply to any given case of which the separate data are determined either by experiment or by the conditions of the case. The *principles* of the calculation require our first notice.

1. To know the force which tends to burst a cylindrical vessel in the longitudinal direction,—or, in other words, to separate the *head* from the curved *sides*, we have only to consider the actual area of the head, and to multiply the number of units of *surface* by the number of units of *force* applied to each superficial unit. This will give the total *divellent* force in that direction.

To counteract this, we have, or may be conceived to have, the tenacity of as many longitudinal bars as there are linear units in the circumference of the cylinder. The united strength of these bars constitutes the total retaining or *quiescent* force, and at the moment when rupture is about to take place, the *divellent* and the *quiescent* forces must obviously be equal.

2. To ascertain the amount of force which tends to rupture the cylinder along the curved side, or rather along two opposite sides, we may regard the pressure as applied through the whole *breadth* of the cylinder upon each linear unit of the diameter. Hence the total amount of force which would tend to divide the cylinder in halves by

* From the Journal of the Franklin Institute.

separating it along two lines, on opposite sides, would be represented by multiplying the diameter by the force exerted on each unit of surface, and this product by the length of the cylinder. But even without regarding the *length*, we may consider the force requisite to rupture a *single band*, in the direction now supposed, and of one linear unit in breadth; since it obviously makes no difference whether the cylinder be long or short in respect to the ease or difficulty of separating the sides. The *divellent* force, in this direction, is therefore truly represented by the diameter multiplied by the pressure *per unit of surface*. The retaining or *quiescent* force in the same direction, is only the strength or tenacity of the two opposite sides of the supposed band. Here also, at the moment when a rupture is about to occur, the *divellent* must exactly equal the *quiescent* force.

3. In order to estimate the augmentation of *divellent* force, consequent upon an increase of diameter, we have only to consider that as the diameter is increased, the product *of the diameter and the force per unit of surface*, is increased in the same ratio. But unless the thickness of the metal be increased, the *quiescent* force must remain unaltered. The *quiescent* forces, therefore, continue the same; the *divellent* increase with the diameter.

4. Again, as the diameter of the cylinder is increased, the area of its end is increased in the ratio of the *square* of the diameter. The *divellent* force is therefore augmented in this ratio. But the retaining force does not, as in the other direction, remain the same, since the *circumference* of a circle increases in the same ratio as the diameter. The *quiescent* force will consequently be augmented in the simple ratio of the diameter, without any additional thickness of metal, so that on the whole the total tendency to rupture in this direction will increase only in the *simple* ratio of the diameter.

5. Since we have seen that the tendency to rupture, in both directions, increases in the simple direct ratio of the increase of diameter, it is obvious that any position of the sheets which is right for one diameter, must be right for all. Hence, there can never be a condition, in regard to mere magnitude, which will require the sheets to be reversed.

6. The foregoing considerations being once admitted, we may proceed to ascertain what is the true direction of the greatest tenacity in the sheet, if any difference exist, and to what that difference *might* amount, consistently with equal safety of the boiler in both directions.

7. Let $x=$ the diameter of the cylinder; $f=$ the force or pressure per unit of surface, (pounds per square inch, for example;) $T=$ the tenacity of metal, which with the diameter x and the force f will be required in the linear unit of the circumference, in order to hold on the head. Then, the whole *quiescent* force will be $3.1416x\text{T}$, while the *divellent* will be $.7854x^2f$; consequently $.7854x^2f=3.1416x\text{T}$, as above stated. Dividing by $.7854x$, we have $xf=4\text{T}$; and we derive immediately $x=\frac{4\text{T}}{f}$, $f=\frac{4\text{T}}{x}$, $\text{T}=\frac{xf}{4}$. That is, the tenacity of the *longitudinal bar of the assumed unit in width, will be one fourth of the product of the diameter into the pressure,* measuring the tenacity by the same standard as the pressure, whether in pounds or kilogrammes.

8. Now assuming the tenacity required in the *circular band* of the same width to be t, we shall, agreeably to what has already been said, have the *divellent* force expressed by xf and the *quiescent* by $2t$, so that $xf=2t$ and $t=\frac{xf}{2}$; also $f=\frac{2t}{x}$, and $x=\frac{2t}{f}$. Having thus obtained two expressions for each of the quantities x and f, we may by comparing them, readily discover the relative values of T and t; thus, $x=\frac{4\text{T}}{f}$ and $x=\frac{2t}{f}$, hence $\frac{4\text{T}}{f}=\frac{2t}{f}$, and $4\text{T}=2t$ or $t=2\text{T}$. From which it follows, that, *under a known diameter, and with a given force or pressure, the tenacity of metal in a cylindrical boiler of uniform thickness, ought to be twice as great in the direction of the curve as in that of the length of the cylinder, and that if this could be the case the boiler would still have equal safety in both directions.* In whichever direction, therefore, the rolling of the metal gives the greatest tenacity, in the same direction must the sheet always be bent in forming the convexity of the cylinder. It follows that if we suppose the tenacity precisely *equal* in both directions, the liability to rupture, by a mere internal pressure, *ought to be twice as great along the longitudinal direction as at the juncture of the head.* This supposes the strain regular and the riveting not to weaken the sheet.

9. To know how large we may safely make a cylindrical boiler, having the absolute tenacity of the metal, in the *strongest direction,* and with a known thickness, we have only to revert to the formula $x=\frac{2t}{f}$. That is, *the diameter will be found by dividing twice the*

tenacity by the greatest force per unit of surface, which the boiler is ever to sustain.

10. When, knowing the absolute tenacity of a metal or other material reckoned in weight, to the bar of a given area, in its cross section, we would determine the *thickness* of that metal which ought to be employed in a boiler of given diameter and to sustain a certain force, we may use the formula $t=\frac{xf}{2}$, and, dividing the latter member of this equation by the *strength* of the square bar, which we may call s, we obtain the thickness demanded in the direction of the curve, which we may denominate p, so that $p=\frac{xf}{2s}$; this will give the thickness of the boiler plate, either in whole numbers or decimals. Thus, suppose the diameter of a cylindrical boiler is to be 36 inches,—that it is to be formed of iron which will bear 55000 lbs. to the square inch, and is to sustain 750 lbs. to the square inch;—what ought to be the thickness of the metal? Here $x=36$, $f=750$, $2s=110{,}000$; consequently, $p=\frac{36\times750}{110000}=.2454$, or a little less than one quarter of an inch.

11. It must, however, be evident that the *minimum* tenacity, of any particular description of metal, is that on which all the calculations ought to be made, when there is any probability that the actual pressure will, in practice, ever reach the limit assigned as the value of f, in the calculation.

If we had plates of different metals, or of different known degrees of tenacity in the same kind of metal, and were desirous of ascertaining how strong a kind we must employ under a limited *thickness*, *diameter* and *pressure*, we should decide the point by transforming the formula $p=\frac{xf}{2s}$ into $ps=\frac{xf}{2}$, and then into $s=\frac{xf}{2p}$. In other terms, in order to know the strength of the metal required, or the direct strain which an inch square bar of the same ought to be capable of sustaining, we must *multiply the diameter of the boiler in inches by the pressure per square inch in pounds, and divide the product by twice the intended thickness in parts of an inch.* Thus, how strong a metal ought to be employed to sustain a pressure of 1000 lbs. to the square inch, in a boiler 30 inches in diameter and one quarter of an inch thick? Here $s = \frac{30 \times 1000}{2 \times .25} = 60{,}000$. Hence we see that the metal must be capable of sustaining *sixty thousand pounds* to the inch bar, or in that proportion, for any other size. This formula enables us to determine whether among the metals of known tenacity *any* one can be found to fulfil the conditions under the thickness assigned.

12. On the basis of the foregoing formulas, the following table of diameters, thicknesses of iron, and strains to the inch of metal, in both directions, has been formed. It is obvious that the *actual* tenacity of the metal employed in a given case must be of the greatest importance to the result. The extensive series of experiments recently undertaken by the Institute to determine this question, in reference to different kinds and varieties of boiler plate, and with regard to the various circumstances of its manufacture and application, will hereafter furnish us with important data to aid in applying the formulas to each separate case. I shall for the present assume the tenacity of an inch square bar of rolled iron at 55000 lbs. in the direction of the length of the sheet. Supposing the pressure generally employed in cylindrical high pressure boilers to be 150 lbs. to the square inch, agreeably to the practice in this city, the table is calculated upon the principle that the boiler ought to have five times as great a strength as it is ordinarily required to exert. The calculation is upon a continuous sheet of metal, without seams in any direction. The thicknesses are given in *ten-thousandths* of an inch; but in practice the last figure may be omitted without material error.

Diameter of the boiler in inches.	Thickness of plate iron which will bear 55,000 lbs. to the square inch required to resist the strain in the direction of the curve under a pressure of 750 lbs. to the square inch, calculated by the formula $p=\frac{xf}{2s}$.	Corresponding tenacity of each inch wide ring or band required to support a pressure of 750 lbs. to the square inch, calculated on the formula $t=\frac{xf}{2}$.	Tenacity required in each longitudinal bar of one inch wide, to sustain the pressure tending to burst out the head, calcalated on the formula $T=\frac{xf}{4}$.
Inches.	Inch.	Pounds.	Pounds.
1	.0068	375	187.5
2	.0136	750	375
3	.0204	1125	562.5
4	.0272	1500	750
5	.0341	1875	937.5
6	.0409	2250	1125
7	.0476	2625	1312.5
8	.0545	3000	1500
9	.0613	3375	1687.5
10	.0681	3750	1875
11	.0745	4125	2062.5
12	.0818	4500	2250
14	.0954	5250	2625
16	.1090	6000	3000
18	.1227	6750	3375
20	.1363	7500	3750
22	.1490	8250	4125
24	.1636	9000	4500
26	.1773	9750	4875
28	.1909	10500	5250
30	.2045	11250	5625
32	.2182	12000	6000
34	.2318	12750	6375
36	.2455	13500	6750
38	.2591	14250	7125
40	.2727	15000	7500
42	.2860	15750	7875
44	.2980	16500	8250
46	.3116	17250	8625
48	.3252	18000	9000
50	.3388	18750	9375

13. I am not aware that this subject has been previously treated in a general manner, at least as it regards several of the points above presented. Mr. Oliver Evans made some particular calculations of the strength requisite to sustain the pressure in a boiler of known dimensions, under a tension of 1500 lbs. to the square inch. In the

table at p. 27 of his "Young Steam Engineer's Guide," he has given calculations for seventeen different diameters of boilers, with the power which, at each diameter, the steam would exert "to break every ring of one inch wide in any one place," and "the thickness of the sheets of *good iron* necessary to hold the power." His table is formed on the supposition that sheet iron will bear 64,000 lbs. to the square inch, and would consequently lead to considerable *excesses* if strictly applied in practice. To six of the diameters he has annexed the "power exerted on the heads to burst them out, in pounds weight." These he has calculated in the usual manner, by multiplying the area by the pressure per inch. Opposite to *three* of the numbers just mentioned, he has added "the strength of the boiler to hold the head on, in pounds weight." These he has calculated on the supposition that the metal had equal tenacity in all directions. On this supposition, and on the principles above developed, each of those three numbers should have been exactly double of that against which it stands in the preceding column. Neither of the three is so, precisely; but the first and third come as near it as could be expected, considering that the thickness is expressed only in hundredths of an inch, while the second is too small by more than a million of pounds. These errors would not, I apprehend, have occurred had the author adverted to the general principle above developed, in regard to strength required of the metal in the two directions.

The following extract from the table just alluded to, will illustrate the preceding remarks: a column of corrected results has been added.

Diameter of the boiler in inches.	Power to break each ring of 1 inch, pressure being 1500 lbs.	Thickness of the plate of iron sustaining 64,000 lbs. to the square inch.	Power exerted on the heads.	Strength to hold on the heads.	Corrected numbers to be substituted for those of col. 5, agreeably to the foregoing remarks.
42	31,000	48	2,077,500	4,052,400	4,155,000
36	27,000	42	1,525,500	2,037,440	3,051,000
20	15,000	23	471,000	918,777	942,000

The very general use, in this country, of strong cast iron *heads*, fastened to the wrought iron *cylinders* by broad flanches extending some inches within the latter, there riveted and subsequently further secured by a strong wrought iron hoop, driven on when hot and *shrunk* by cooling,—appears to obviate the necessity of examining the question in regard to the best form and necessary thickness of wrought iron heads. I have lately seen, at the Philadelphia Water Works, the range of boilers, constructed several years ago, on the above principle, by Oliver Evans himself, removed, on account of their use having been superseded by water power. Although these boilers had been for several years employed under a pressure of 100 and 150 lbs. per square inch, yet the heads did not appear to have suffered in the least degree from exposure to this force. Hence the French instructions, forbidding the use of plain cast iron heads for pressures above 1½ atmospheres, do not seem to be founded on sufficient experience of their actual value.

Art. XIII.—*A simplification of Dr. Wollaston's Reflective Goniometer; by* R. Graves, Jr., Civil Engineer.

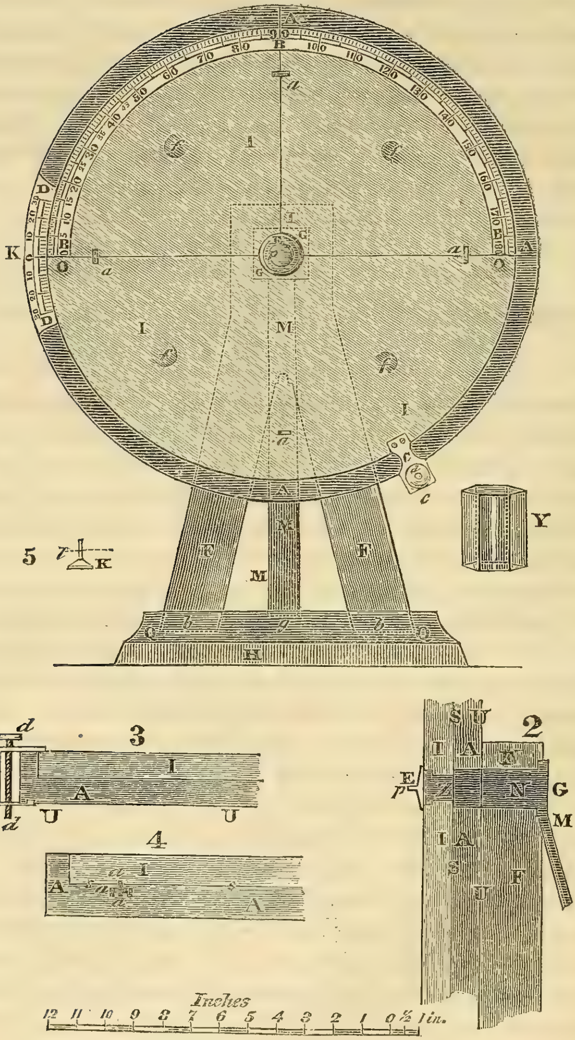
Having found much difficulty attendant upon the use of Dr. Wollaston's goniometer, I was led to the construction of the one, a description of which follows.

I am aware that it has been said, "that the value of a reflected angle *cannot* be found by *mere inspection*," yet it will readily be granted that, let a person assume *any* degree of intenseness of reflection upon one plane of the angle sought, and let him detect the *same degree* of vividness upon the remaining plane, he will have inspected the angle formed by the meeting of these two planes, the which, if done upon any graduated surface whose revolving can be determined, will give the value of the angle sought. Now the only difficulty lies in detecting *equal* degrees of intenseness. This I have tested both by the amount of a double right angle, and by affixing an angled plate upon the revolving plane. It can be done by simply *catching the darkenings on the edges, as they approach the axis of the planes* the value of whose angles is sought. There are two kinds that have been used. One made of brass with bands and braces instead of being solid, is an expensive though light and pretty instrument. The other is made of *well seasoned* wood; it is less neat in appearance, but is simple, cheap and can be made by almost any person, (I made the one I use myself.) It is the latter instrument that I shall describe.

Elevation view.—The dark concentric ring AA, bounding II, is made of mahogany one half or three fourths of an inch in breadth upon the anterior surface, two inches deep till it meets II, it is then

REFLECTIVE GONIOMETER.

Fig. 1.



Scale of one foot.

continued beneath II, posteriorly one inch deep to the center square bolt N. A vernier or nonius DD, of silvered brass is attached to AA, half way up anteriorly, graduated in minutes corresponding to the degrees upon BB; and for the better concentration of the visual rays a small knee K, is made to fit upon the line of O on the vernier at the angle of vision K.

The plane II (of maple or any light colored wood) is made to fit the *inner* part of A, both surfaces I and A being in the same plane anteriorly, one inch in depth and seventeen inches in diameter. It revolves upon the iron axis Z, and has a small brass head piece E, attached to *it* (and revolving with it) from the center, *p*, of which is a pin projecting three fourths of inch from its surface, upon which the crystalline form that we wish to inspect is adjusted and fastened. A semi-circular band of brass BB, three fourths of an inch wide is fastened to the upper edge of II, graduated in degrees corresponding to the minutes upon the vernier D. The small rollers *a*, *a*, are of iron one fourth of an inch in diameter, secured in the inner plane *s*, *s*, of A, for the more easy and true moving of II. And to hold the revolving plane II, immovably upon its arbor Z; and thereby to prevent BB, from slipping from its place, (after adjusting it by observation,) *before we read the angle off;* we have a brass clamp C, screwed fast upon the edge of I, and pressing upon a groove in the plane II of A posteriorly by a screw *d*. (This on the brass instrument works by a tangent screw.) The semi-circular groovings *f*, *f*, are to fit the end of one's fingers in moving the rotary plane I. The whole stands upon a firm support F, M, Q. The legs F, F, (of mahogany two inches square by twelve inches in elevation, i. e. from the top of the stand Q, to the horizontal diameter of AA,) are immovably secured in the mahogany stand or footing Q, which for the better *steadying* of the instrument has a leaden bottom H, one half of an inch in thickness by twelve inches square, attached to the stand Q, inferiorly, and still further to attain firmness, an iron brace M, one inch by one fourth of an inch, may be fastened to G, with its bent end screwed in the surface of Q.

To secure the different parts against shrinking, I would not have the given proportions (however clumsy they may appear) lessened.

Example.—We first place the instrument upon the table, so that its anterior plane receives the rays as vertically and strongly as may be (reflected through any uninterrupted space, for instance a window); then adjust it so that O upon the vernier and O upon the graduated semi-circle may stand immediately opposite to each other, i. e. K, *p*, A being in the same horizontal line. Screw the clamp C, fast. And with a bit of wax secure your crystal upon the projection *p*, turning it till you see (through the point of view K) the *brightest* light fall upon the center of the chosen side, as shown on Y. It being now adjusted, unscrew the clamp, and revolve H gently from you, (inferiorly) till you catch *the same* intenseness of light as you started with, resting upon its remaining side (the faint shadowing playing upon either edge of the side viewed, leaving a line of strong light passing through its center). Screw the clamp fast again and read the angle off,—the degrees upon BB, and the minutes upon DD.

By this simple and *expeditious* process, the angles of any crystal (reflecting light from its sides and above the size of a pin's head, till so large that we can measure it by the simple goniometer) may be found with the surest accuracy.

Art. XIV.—*List of the Plants of Chile; translated from the "Mercurio Chileno," by* W. S. W. Ruschenberger, M. D. U. S. Navy.

(Continued from Vol. XX. p. 260.)

Faba vulgaris. Mœnch. *Haba.* A plant cultivated in fields and olitories. Its seeds are eaten when tender and serve to thicken broth which the French call *purée.* Beans make a good diet for horses, and it woud be well to extend their cultivation with this view, and particularly in winter when there is a scarcity of grass and straw and barley is advanced in price.

Fabiana imbricata. Ruiz and Pavon. A small tree in sandy places near the torrents of Taguatagua and San Fernando. It is called *Pichi;* its singular appearance, the disposition of its small leaves and the great number of its whitish flowers, recommend it as an ornamental plant. Country people make spoons of its wood. There is I think another plant bearing the same vulgar name which it is said serves as a dye. I have not seen it and therefore cannot speak of it.

Fagus obliqua. Mirb. *Roble*—oak—a tree common in the high mountains. Its trunk sometimes acquires the thickness of three or four yards and a very considerable height. The wood is much used in carpentry; it is used in the construction of houses, ships, cart-wheels, &c. Its bark is good for tanning hides and gives them a red color. In the spring is formed on the branches of this tree a great number of whitish tubercles, the parenchyma of which is spongy, though sufficiently consistent at first. I thought it a *galla* or excrescence produced by the wound of some insect as is seen on some other trees of Europe, and I gave the matter but little attention, but two days afterwards they became unglued from the branch and I observed with surprise that the skin was broken and the whole surface covered with pentagonal tubes precisely similar to the alveoli of a honey-comb, at first full of a gelatinous substance, of the color of milk, which disappeared with the maturation, afterwards throwing out from these cavities with some force an impalpable powder when it was touched, exactly as is observed in the *Peziza vesiculosa.* At the end of two days these bodies softened, lost their expulsive property and rotted. These circumstances incline me to think that these tubercles are mosses, and perhaps a new genus approximating to the *Sphœria*, if the color and consistence are not deceptive. Its vulgar name is *Dignénes.* Some persons eat them, but their insipid and styptic taste is disagreeable. I will study this singular production, the first opportunity that presents itself.

Fedia Samolifolia. Bertero. A very common species in the fresh pastures of the hills and mountains; it is also met with in the plain near torrents. It is of no use, although its leaves (somewhat fatty,) have the same taste as those of the *F. olitoria*, Vahl. which is eaten as salad in Europe.

Festuca. L. I have met with many species of this genus; the most common is that which is called *posto blanco*, *paja teatina* which is the *F. muralis*, H. B. and K. It grows in arid spots on the plain and on walls. The *coiron* is also a *Festuca* which is found in the pastures of the high mountains near the snows. Its leaves are very useful for covering huts and houses. Large quantities of it are annually used for this purpose. The *F. Brizoides*, Spreng., which authors say comes from Montevideo, is very common in arid and stony situations in the mountains and along the Cachapual.

Ficus Carica. L. *Higuera.* The first fruit is called *brevas* and the other *higos*, figs. There are many varieties. This tree flourishes in Chile: I have seen some of them of an immense size. The fruit is delicious, sweet and very abundant. It is dried in large quantities for the winter and also for exportation. Turners should make use of its wood as they do in Europe and particularly in Geneva.

Flaveria Contrayerva. Pers. It is found in fields and olitories near drains and cultivated places. This plant is called here *dan-da;*

it is generally used in yellow tincture, prepared by decoction. The *Eupatorium Chilense*, Molina, which Steudel has preserved in his *Nomenclator*, is only a synonym of this species.

Fragaria Chilensis. Ehrh. A pretty species which is cultivated almost every where. Strawberries vary much in their form and color. They are excellent though they want that pleasant odor possessed by those of Europe. They should be cultivated in the neighborhood of the capital.

Frœlichia violacea. Spr. This tree is found in the garden of the Chilean Lyceum. There is but one root which it is said was planted by the Jesuits. The Indians call it *uthin*; it is the *Itia* of Molina according to Sprengel, who designates it under the name of *Lonicera corymbosa.* L. Although I have only been able to examine the fruit in its different states, I am of opinion that the plant does not belong to this genus and not even to the family of *Rubiaceæ* to which this genus belongs. It will perhaps form a new one which will be included with the *Caprifoliaceæ*, which I will determine when I see the flower. The fruit is of the size and color of the orange and of the form of the pear; it has but one stone, rarely two. If this tree were cultivated it might serve as an ornament to gardens and even be made useful in tanning and dyeing. Gallic acid and tannin abound in every part of the plant.

Fuchsia macrostemma. Ruiz and Pavon. A shrub which is seen in shady and humid woods, near the rivulets, on mountains, and which for the elegance of its flowers, is cultivated under the name of *Tilco*, or *jasmin del papa;* it resembles a variety of the *F. coccinea.* Ait. Its beauty makes it worthy of propagation. I have seen another species of this genus on the heights of Valparaiso, which resembles the *F. lycioides*, Andr.

Fumago. Pers. The black dust which is often observed on the leaves of orange trees, pear trees, and *litres*, constitutes, according to Persoon, a genus to which he has given this name, because the leaves appear to have been exposed to the action of smoke. It forms many species according to the plant on which it is found. There is some doubt as to the nature of this production; and modern botanists do not name it.

Fumaria spicata. L. It grows near roads, and in the vicinity of Valparaiso, Santiago, and Corcolen. Although very common, and particularly in the last place, it is very probable originally from Europe.

Fumaria hygrometrica. Hedw. Common on walls, in pastures and on the margins of drains, and in humid situations. It is a moss, like many others, called *pastito.* I have found another species which appears to me to be different; it approaches to the *F. calvescens,* Schwagr.

Galinsogea parviflora. W. A weed which grows in all gardens and is called *tomatillo,* a name which bears no relation to the plant. It is useless.

Galium Aparine. L. *Lengua de gato,* very common in enclosures and thickets in the pastures of the plain, and in other places. There are three other species: the first resembles the *G. rotundifolia,* L., and the other two appear to be new. One of them has the stalks ligneous at the base, and the fruit bristly; it is found in the woods, on the highlands, and on the banks of the Cachapual.

Galvezia spicata. Bertero. A beautiful shrub which mounts on trees, adhering by their roots like the *yedra* (ivy), which name has been given to it. Its fruit is very red and of the size of a pea: it is called *coralillos.* Probably this species is the same as the *Myrtus parasitica Marifolia.* Feuill. As to its generic character it approaches the *Galvezia,* but the species is very different from the *G. punctata,* Ruiz and Pavon, which I have not even met with.

Gardinia purpurascens. Bertero. A bulbous plant resembling the *Allium* and the *Ornithogalum,* L., which I have seen only once in the inclosures along the road leading to Quinta, not far from the houses of Zamorano. It is called *mapolita azul,* and merits cultivation in gardens on account of the elegant color of its flowers. In testimony of my veneration and gratitude to him who gave me the first ideas of botany, I have dedicated this pretty plant to the memory of the celebrated professor of physics, the late Doctor Francisco Josè Gardini, a worthy scholar of Beccaria, and to whom Galvani owes, in a great part, the honor of his valuable discovery. Among his works crowned by the academies of Europe, I will only cite the following:—*De influxu electricitatis atmosphæricæ in vegetantia. Taurini,* 1782. 8vo.

Gardoquia obovata. Ruiz and Pavon. *Oreganillo.* A small shrub frequent in elevated situations and among the thickets on the highlands. Its leaves are aromatic and might be employed in certain painful affections.

Geastrum hygrometricum. Pers. It is found in winter on walls near drains. It resembles the *G. rufescens*, Pers., but I think it differs from both.

Geranium Pusillum. L. Very frequently in pastures, along roads and in cultivated lands. It is called *core-core*, and is employed as a remedy in various complaints, particularly in pains of the teeth, gums and throat. It is also used in decoction as a wash for old ulcers. The *G. Robertianum*, L., is common in woods, and among the rocks on the highlands. A third species is found in elevated pastures, at the entrance of woods and thickets; this resembles the *G. tuberosum*, L., from which however it differs in its *napiform* root. Its flowers vary in size and in the intensity of their color; its stalk is sometimes recumbent and sometimes upright.

Geum coccineum. Sibth. and Smith. Vulgarly, *flor del clavo.* Modern authors, as Sprengel and De Candolle, give this plant as originally from Asia Minor, and particularly from Mount Olympus, in Bithynia, no doubt from the description and plate of it, published by Sibthorp and Smith in the *Flora Græca.* Nevertheless De Candolle in his *Prodromus* says that he had received a specimen of this species from Balbis, under the name of *G. Chiloense.* This observation leads me to think that it is cultivated in the island of Chiloe, but I have learned with much satisfaction that the *flor del clavo* is very common in humid pastures at the foot of the mountains opposite to Cachapual, at a short distance from *Rio-claro.* Consequently, we must say that Chile is also its native country, and compare the Asiatic species with that of America, and decide upon their identity. Amateurs should in the mean time propagate this plant in their gardens. The inhabitants use its roots in certain complaints; it has the odor of the pink, like those of the *G. Urbanum*, L.

Gilia laciniata. Ruiz and Pavon. Common in sterile and stony places, along rivers and torrents, and is not wanting on the highlands. There is another plant of the family of the *Polemoniaceæ*, frequent in the humid pastures on the plain, and near torrents. In its leaves it resembles the *G. coronopifolia*, Pers.; but the generic characters are altogether different. I think it will form a genus which I will describe hereafter.

Gnaphalium Viravira. Molina. Vulgarly *Viravira;* common in sterile and stony situations on the plain and highlands. I only find it mentioned by Steudel, and I do not see that it is considered as a synonym. This plant occupies a middle place between the *G. lu-*

teoalbum, L., and the *G. candicans*, Kunth. Perhaps it belongs to the last, which Gaudichaud has also collected in the Falkland islands and which he has called *G. consanguineum*. The comparative examination of the specimens will decide the question. This plant is much used and has vulnerary as well as febrifuge and sudorific properties attributed to it. The *G. Chilense*, Spr., is a very beautiful plant which prefers the mountain rocks; it is sometimes as white as snow; its stalk is woody and is known by the same vulgar name. I have also met with the *G. Cheiranthifolium*, Lamk., in stony situations, on the hills around Valparaiso and Santiago. It is a beautiful species resembling the *G. Montevidense*, Spr. Many others have been collected in dry pastures, along drains, and in the sand near torrents, both in high and low situations. Two of them appear to me new; the first approaches the *G. Pennsylvanicum*, W.; the other, which is viscous in all its parts, grows in Leona; finally four approxmate the *G. Germanicum*, *minimum*, Smith, *pyramidatum* and *arvense*, W.

Gonolobus. Michx. A plant is cultivated in gardens which appears to belong to this species. Its fruit or rather follicles, open when ripe and give exit to numberless grains armed with very long villi, similar to cotton, hence the name of *vicuña* by which some distinguish it; but this shrub is more generally known by the name of *jazmin del Tucuman*. Not having seen the flower, I can say nothing at present. Nevertheless the peculiar form of its smooth leaves with small glands in their insertion with the petiole, the point of which is oblique, are particulars with which I have not met united in any published species. Two other plants of this family are indigenous. The first is called *vogni*, a name common to other vegetables. It is found on the arid hills near the Cachapual on the road to *Cauquenes*. Its flowers were not open. The second, called *voquicillo*, frequent on the hills, in the highlands and even in enclosures on the plains, appears to be related to the *Cynanchum lanceolatum*, Kunth, although it differs essentially from it.

Gossypium herbaceum and *arboreum*. L. *Algodon*, cotton. They are sown almost every year in some gardens, but rarely ripen in consequence of the frost, which begins early. If it were desirable to try the cultivation of the first of these plants on a large scale, it would be necessary to select the warmest position, and perhaps if sown early something might be obtained though never very considerable. Would it not be more profitable to give preference to the *cañamo?* (*Cannabis sativa.* L.) I have been assured that it is successfully cultivated in Conception; a good reason for introducing it into the province of Santiago, and though not with a commercial view, every proprietor should sow a small quantity on his lands as is the practice in Europe. The small quantity collected would serve for making cords, which are so necessary, and by which a great number of hides would be saved, and employed for other purposes. The stripped and dried stalks, with a small quantity of sulphur on the two ends, form matches which would cost nothing, the use of which is unknown in this country, though so useful in domestic life. The great inconvenience of obtaining a light in urgent cases, and particularly in the country, at the expense of the lungs and of patience, when a single moment lost might be important, is continually experienced. Pardon this digression to objects which may appear too humble—to those who think so I will say, there is no subject trifling when the general good of society is linked with it.

Gratiola Peruviana. L. A small plant which grows in gardens and cultivated places; it delights in the shade and in humidity. It is rare.

Grindelia glutinosa. Dun. A pretty species with large flowers, which grows in the fissures of rocks, and on the hills of Valparaiso, Leona and Taguatagua. Although the description may answer to it, I am inclined to believe that the Chilian plant differs essentially from that of Mexico. In the stony and arid pastures, in the vicinity of the Cachapual, is found the *G. Pulchella*, Dun., which merits cultivation. I have found two varieties; the first in dry places on the banks of the Maypu; it is smaller, its leaves are entire very sharp pointed, and even acerate and prickly; the other, at the foot of Mount San Cristoval, near the Capital, with tomentose and whitish leaves. They may possibly be distinct species. In this case I will call them *G. acerosa* and *G. canescens.* This approaches to the *G. angustifolia,* Kunth, but the stalk is fructicose.

Gunnera scabra. W. Vulgarly *pangue;* a very useful plant which is met with in marshy places, near water courses and torrents in the mountains. Its virtues and uses are so generally known that it is useless to enumerate them. Molina speaks of it in detail, and I will refer to his work. I will only add that it should be largely cultivated for tanning, and yielding an excellent black dye. The decoction of its root is administered in certain abdominal affections. The juice of the petiole and stalk (scapus) is acidulous but styptic; ices are made with it and are generally liked.

Gymnostyles Chilensis. Spr. A small plant very common, in the spring, in pastures, on the highlands, and along roads on the plain.

Hedyotis Virginica. Spr. In the sandy pastures along the edges of torrents in Taguatagua. A pretty plant with dull blue flowers. They are very small and do not claim attention.

Helianthus annuus. L. A plant from Peru and Mexico, cultivated in gardens and which many call *flor del sol.* Various authors state that the whole plant offers important advantages, particularly the seed; they yield oil in abundance. On this account it ought to be cultivated largely. It would also be well to introduce into the country the *H. tuberosus*, L., native of Brazil; its tubercles, known in France under the names of *alcachofes de Jerusalem* or *topinambours*, are alimentary. Hogs are fond of them and fatten on their use.

Heliotropium Chilense. Bertero. I have seen this beautiful plant on the sides of the roads, in sandy places surrounding the lake of Aculéo. It approaches the *H. filiforme*, Humb., though it differs from it considerably. It is strange that the *H. Peruvianum*, L., is almost unknown in this country. The sweet smell of its flowers which is so much like that of the *Vainilla*, secures for it a conspicuous place in gardens, where it might be easily cultivated in beds, without any necessity for flower pots.

Hemimeris Urticifolia. W. Found in woods, and principally on heights and in exposed situations. I do not know whether it has any vulgar name. It should be cultivated—its flesh-colored and numerous flowers recommend it.

Heracleum tuberosum. Molina. The species described by this author is in my opinion doubtful; at least, it does not in any particular resemble that which I have met and which is very common in the pastures of Leona and the Punta de Cortes. The plant of Molina is similar (according to Willdenow) to the *H. Sphondylium*, L., while mine closely resembles the *Sium Bulbocastanum*, Spr., with the difference that the fruit is alate, the tubercles almost round, of the size of a nut, blackish outside and white in the interior, and of an agreeable taste. They are much sought by the *guanque* or cururu, a small animal similar to the *Mus cyaneus*, Molina, which fills the subterraneous cavities which it makes, with these tubercles and lives on them during the winter.

Himantia. Pers. A small moss which grows on rotten wood. It resembles the *H. plumosa*, Schumacher.

Hoffmanseggia Falcaria. Cav. Frequent in cultivated places near Chimba and the Magazin. It appears a little different, and perhaps is that which Miers has called *H. Chilensis.*

Hoitzia linearis. Spr. This plant is common in the pastures of the highlands and at the entrance of woods near the Cachapual. It differs in its leaves being smooth, and its flowers not viscous.

Holcus. L. It is met with in the inundated meadows near the lake of Taguatagua, and resembles the *H. Halepensis,* L. but differs from it considerably, and even appears to be another genus.

Hordeum vulgare. L. Cebada;—barley, cultivated in fields. Its grain, mixed with straw, forms excellent food for horses, and particularly in winter; it is also used for refreshing ptysans. The beer which is made in the country, and the use of which is daily augmenting, consumes a large quantity of this grain; therefore, its cultivation should be extended. Brewers ought also to endeavor to introduce the hop, (*Humulus Lupulus,* L.) which would be very advantageous for them. The *H. murinum,* L. (*cola de raton,*) is frequently met with on the sides of roads and at the foot of walls, near inhabited places. I have found a variety of this last species in barren situations, on the banks of the Cachapual. It is very small and has the sheath of the leaves swollen. I think it might be separated and called *H. utriculatum,* as its character is the same as that of the *Alopecurus,* to which that name is given.

Hyacinthus Orientalis. L. *Jacinto;*—hyacinth, cultivated in gardens. Its varieties are numerous, but the most beautiful are not sufficiently propagated in the country, and some are unknown. They should be taken care of, that they may not degenerate. Its bulbs, placed in water, in vessels adapted to the purpose, and placed in a moderate temperature, flourish in winter and form a pretty ornament for saloons. The same may be done with the Narcissus and other plants of the same family.

Hydrocotyle Asiatica, and *Ranunculoides.* L. Vulgarly, *tembladerilla.* These two species are common in drains, in stagnant waters, in villages and neighboring cultivated grounds. Some attribute medicinal virtues to them. The acrid principle common to many aquatic plants, and to some species of this genus, makes its quality suspicious.

Hymenopappus glaucus. Spr. *Manzanilla del campo.* Very common in sterile and sandy places, both on the plains and highlands. Its aromatic and penetrating odor, resembling the chamomile, has given it this vulgar name. Its infusion is administered in the same complaints as the Spanish chamomile; but the principal use of the plant is for making brooms, which are of an inferior quality. It forms also a dye, which is now but little used. The *Santolina tinctoria*, Molina, adopted by Persoon and Steudel, is a synonym of this species, as has been observed by Sprengel.

Hypnum. L. Many species are met with on the barks of trees, on rocks, in the woods, and on the margins of drains. These plants, like others of the family of mosses which grow in this country, are not of sufficient interest to merit enumeration; besides, this labor requires much time, and the means of comparison, which are not always possessed by a travelling naturalist.

Hypochœris. L. The name of *escorzonera* is given indifferently to two plants, which, at first sight, appear to belong to two different species, since one has a simple stalk, a single flower, and grows among the rocks of the highlands, and the other is ramose, with smaller flowers, and prefers sandy spots, near rivers, in the plain. Notwithstanding this, the intermediate characteristics which I have observed do not allow me to separate them: I will only say that the first should be referred to the *H. Sonchoides*, Kunth. The root of the *escorzonera* is much used in the country; its decoction, considered as refreshing, is employed in a multitude of cases, as in catarrhal affections, &c. Those who are recently delivered commonly make use of it.

Jasminum officinale. L. Jasmine; cultivated for the whiteness and sweetness of its flowers. The *diamelo*, (*J. Sambac*, L.) is also met with in many gardens; the variety with double flowers is much esteemed, but the cultivation is more difficult.

Impatiens Balsamina. L. Vulgarly, *miramelindre;* common in all gardens. This flower, purely ornamental and inodorous, varies much in its color. The double variety is little known.

Iris Germanica, L. and *pallida*, Lamk. *Liris.* They are met with in gardens. The foliage and form of their flowers are quite singular: there is a variety with white flowers. The *chatre capuchino*, (*I. Sisyrinchium*, L.) is less frequent. These plants are not much esteemed, on account of their short duration and the rapidity with which their corollas wither.

Isaria crassa, and *mucida.* Pers. Two small mosses; the first grows in the dead chrysalides of insects, and the second on rotten wood, in winter.

Isatis tinctoria. L. Common in drains, near Rancagua, and in cultivated situations. It is probable that some persons may have been desirous of trying its cultivation, to extract the blue which might be used as a substitute for the indigo of commerce. This is what is called in French *Indigo-pastel.* It might be well to cultivate it extensively.

Juglans regia. L. An European tree, known by the name of *nogal.* Every body knows the nut and the different uses to which it can be applied; it is, therefore, useless to enter into details. Although the walnut is common in this country, it might be usefully multiplied, with a view both to the increase of its fruit and the abundance of an excellent wood.

Juncus. L. Three species, which approach the *J. acutiflorus,* Ehrh. *Bufonius* and *bulbosus,* L. They grow in drains and humid meadows, in the plain.

Jungermannia. L. Plants of the hepatic family, which delight in shady and humid places. The *J. Tamarisci,* L. grows on the mountain rocks; the *Magellanica,* Lamk. on the trunks of trees: it is scarce. There is another species, which I believe new, and which grows in elevated fields, on the highlands.

Jussieua. L. A species of this genus is very frequent in marshy situations and in drains. It approaches the *J. repens,* L. and differs from it in being velvety, which however is not constant. The *J. Montevidensis,* Spr. is not very different from our plant, as I have often seen the peduncles armed with two bracts. I also think that the *Onosuris Chamissonis,* D C. *prodr.* belongs to this species, which should not be separated from the genus *Jussieua.*

Kageneckia oblonga. Ruiz and Pavon. A very beautiful tree, called *bollen.* It grows in the woods, on the highlands, and on the heights near Cachapual. Its bark is used as a dye; it is also thought to be purgative, but is not at present employed. I have observed that the young branches and leaves are glutinous, which induces me to think that this species is only a variety of the *K. glutinosa,* Kunth.

Kœleria villosa. D C. A very common grass in the dry pastures of the highlands, and along the sides of roads in the plain.

Krigia. Schreb. A small plant of the tribe of the *Chicoraceæ,* frequent in high meadows, and in the plain. The generic character answers to it, with some little difference, but among the species described I do not find one with pinnate leaves. I shall call it *K. Chilensis.*

Lactuca sativa. L. A vegetable very generally cultivated and used. There are some varieties much esteemed. This plant is said to be refreshing, and as such enters into the composition of ptysans. The extract or juice obtained from it either by incisions into the stalks, or slightly bruising it, inspissated by a moderate heat, is a sedative remedy, similar to opium but without its irritating property. This extract is called *Lactucarium* or *Thridace.* The *L. virosa,* L. which some cultivate, in particular, yields an extract more active and in some cases preferable.

Lardizabala biternata. Ruiz and Pavon. A shrub with viny stalks and branches, common in the woods of *Taguatagua* and *Cauquenes.* The name *voqui,* common to other plants very different in their nature, is given to this. Its stalk acquires the size of the arm at the base and diminishes insensibly as it lengthens; its neighboring branches interlace and form beautiful natural arbors. It is one of the most esteemed ligatures or withes (lianas?): twisting it when scorched and warm, the bark peels, and keeping it in water for twenty four hours, it becomes very flexible. It serves to secure the rafters of roofs, for lathing (envarillar?) and thatching houses: cords are also made of it which are very durable. Its fruit, which is called *coguil,* is sweet and of a delicate flavor when ripe. The inhabitants of the country consume great quantities of it and carry it to the village markets. Cultivated in gardens this plant would have a fine effect on account of its foliage and its long branches loaded with flowers. This great mass of choice green would be very useful in a garden to hide whatever might be offensive to the view.

Lathyrus odoratus. L. *Clarin.* Its flowers display their colors and yield their fragrance in every garden. With a little attention and sowing the seed at different periods, this plant might be kept flourishing throughout the year. Two other species are indigenous and grow amongst the weeds and rocks about the hills. It approaches the *L. subulatus,* and *nervosus,* Lamk. It is commonly called *alberjilla.*

Laurelia. Juss. The tree which grows in the woods of Taguatagua called *laurel,* is by no means the *L. aromatica, Poir*: the latter has the leaves entire, while that which I have seen has them serrate. It might perhaps form a new species which I would call *L. serrata.* Its roots run deep; the trunk is usually twenty yards high and a half a one in circumference. The wood is white, easily worked, but brittle; incorruptible in the air, but rots in water. In the center are seen some black bands, the undulating veins of which produce a beautiful effect. The leaves, the flowers and the bark are aromatic. It is employed as a remedy for headache proceeding from cold. From the inside of the bark are made some very efficacious sternutatory powders. A decoction of its leaves employed as a warm lotion or in drink is reputed to be antisiphylitic. Administered in the form of baths it strengthens the nerves and is thus employed in paralytic affections. Fumigations from this plant are used in convulsions and spasmodic diseases.

Laurus Peumo. Miers. The *peumo* does not belong to the genus *Peumus* of Persoon, as we shall see. Molina has confounded in his *Peumus,* trees which are entirely different, the *bolda* and *peumo*: the first is the *P. fragrans*, Pers., but the *P. rubra*, *alba* and *mammosa*, Molina, are only varieties of the species of which we speak. This tree, frequent in the plains and on the hills, and of an elegant foliage, reaches the height of from sixteen to twenty yards, and two in thickness. The wood is very durable in water: its bark is much used in tanning and gives to the skins an orange tint. The people of the country are very fond of its fruit and consume large quantities of it. Its taste, ungrateful and terebinthinous at first, becomes agreeable by infusion in warm water. Anti-hydropic virtues are attributed to it. The nut yields an oil which should be extracted, as it would be advantageously used. Another species of *Laurus* is that which is called *lingue*, *line* or *litchi.* Molina has called it *L. caustica.* Sprengel places it in the genus *Persea*, Gaertin; Miers names it *L. Linguy.* We are of the opinion of the last, and we are persuaded that the *L. caustica* differs from our species. This tree grows in the woods on the mountains; its trunk is usually from twenty four to thirty yards high, and two in in circumference. The wood is solid and spotted. It is employed in house-building and for axletrees, basins, troughs, and even for the masts of small vessels. It is worked with facility and rots in water. Its bark is excellent for currying and tinges red, leather and drumsticks or ramrods (baquetas?) The fruit, of the size of a *vetch,* and of a blackish color, is grateful to birds, but the flesh of those that eat it acquires a bitter taste. It is injurious to *small cattle* and horses. Some persons are fond of its infusion. It is strange that no one has attempted to introduce into the gardens of Chile, the sacred tree of poets, the laurel of Europe. (*L. nobilis.* L.) Beside its merit as a sightly tree, it would serve to awaken the Muses of the Andes, to whom it would yield its branches to weave civic crowns!

Lebidea. Ach. Many species are met with on the bark of trees and more upon rocks. The *L. atrovirens*, *Parasema*, *Lapicida*, *Caesia*, *atroalba*, Ach., are quite common. There are many others which have not been determined. Not one of these plants of the family of the Lichens attracts the attention of the inhabitants nor serves for any purpose.

Lemna minor and *gibba.* L. Frequent on the surface of stagnant water, in marshes and in drains. Some call it *lentejuelas*, but its most common name is *luchicillo*.

Lepidium bipinnatifidum. Desv. It grows in abundance along the sides of roads and on walls. This plant varies much: sometimes, it presents itself without a stalk, but more frequently however with a creeping one. I have seen a variety with a high straight stalk, which might form a distinct species. The *L. Bonariense*, L., is found in the woods of Cachapual. There is another one common about the hills of Valparaiso, which resembles the *L. spicatum*, Desv. The *L. sativum*, L., is cultivated in a few gardens. All these plants, on account of the acrid and piquant principle which they contain, are ranked among the antiscorbutics.

Leptostroma vulgare. Fries. Found on dead herbs in winter.

Leskea involvens. Hedw. A small moss, which grows in fresh and humid places. It is found also on old trunks, in the woods. Two other species grow on the bark of trees. It resembles the *L. Sevicea*, Hedw. and the *L. Bonplandii*, Spr.

Libertia Ixioides. Spr. A pretty plant, of the family of the Irideæ. It grows in shady situations, about the hills. It has no vulgar name, but merits cultivation.

Ligusticum. L. The herb called *panul* appears to belong to this genus, but at present I cannot assign its species. The Umbelliferæ, generally speaking, are difficult to determine, and particularly when the fruit has not arrived at perfection. The *panul* is employed as a medicine; its root is administered in decoction and its bruised leaves are applied externally. The whole of the plant is slightly aromatic. It is probable, however, that the virtues ascribed to it are exaggerated.

Lilæa subulata. Humb. I have only seen this plant once, at the foot of the hill of San Cristoval, coming out from the Chimba. It is to be observed, that it has never been met with before the present time, except in the neighborhood of Zipaquira, a village of New Granada, at the height of 1410 toises above the level of the sea. If it was at all interesting, we might suppose that it had been transported, which would be difficult, on account of the absolute want of communication between the two countries.

Lilium candidum. L. Vulgarly, *azucena*—white lily. A common plant in gardens. Its large flowers, emblems of candor, give it that appreciation which it enjoys. The *Azucena colorada*, which is also seen in some houses, is *Hemerocallis fulva*, L. Finally, there is another species of *Lilium* to which this common name is given, and which appears to be a variety of the *L. bulbiferum*, L. This last is still more rare.

Limosella aquatica. A small plant which grows in the drains and marshy situations near Santiago, Corcolen and Taguatagua. Its flowers are either white or blue. I have seen them with two stamina and sustained by a peduncle larger than their leaves. If these characters were constant, we might include this species under the denomination of *L. australis*, R. Br.

Linaria Pelisseriana. D C. I have not been able to find any difference between the species which grows in France and Italy, and that which I have seen in the pastures of the hills, and among the rocks, near the Punta de Cortes and the Taguatagua. It is probable, nevertheless, that it has been introduced.

Linum Aquilinum. Molina. It is frequent in arid and dry situations, about the hills and mountains. Its thick tufts and large yellow flowers might render it interesting if cultivated. The whole plant is used in medicine. Its infusion is given in abdominal affections, and particularly in indigestion. Its fumigations are prescribed under a variety of circumstances. Without wishing to falsify those who pretend to support the favorable results drawn from daily experience, we will remark that a large portion of its virtues are derived from prejudice in its favor, and from the slight character of the diseases to which this and other remedies are applied. What cannot be denied is, that faith exercises, in certain cases, a much more powerful action than the medicament itself. It is said that in former times the cultivation of the *L. usitatissimum* (flax) was introduced and succeeded well, and even at present, in certain parts of the province of Conception, very excellent crops are gathered. Why is a branch of agriculture, so essential, and one which has enriched so many individuals in Europe, neglected? Can we say that the climate, the soil and the want of irrigation, prevent? Certainly not. There are reasons, perhaps, which we are not permitted to perceive. Still the nation continues shamefully to pay high tributes to foreign countries, while it declaims against the favor which their products find in our markets. Apropos of the filamentous plants, we will point to the facility of introducing the cultivation of the *Phormium tenax*, Forst. generally called in Europe *New Zealand flax*, because the inhabitants of that island employ this vegetable production in the manufacture of cloths and cordage. This plant is very common in the stoves and green-houses of Europe, and in the southern provinces of France and England, it begins to be cultivated in the open air. Consequently, we should think that the climate of Chile is favorable for it, and that in a few years rich harvests might be gathered. The experiments which have been made on the strength of its filaments have afforded the most satisfactory results. The mode of preparing it is very simple, so that every thing tends to recommend this new branch of industry.

Lippia Citriodora. Kunth. There is scarcely a garden in which we do not meet with the *citron*, and in fact it merits the appreciation of florists, on account of the beauty of its foliage and the pleasant odor which it exhales. Cultivated with care, it might be made a beautiful plant of embellishment. The infusion of its leaves is employed in hemicraneal pains, and in all the class of nervous and hysterical affections. The *L. nodiflora*, Rich. grows in fields and olitories. There is a variety entirely joined to the earth and smaller than the others in all its parts. It is common in sandy and arid spots, on the plain, and near torrents, where it forms a beautiful sod.

Lithospermum Apulum. L. This species appears to be indigenous, since it is met with in the fields and in cultivated places, and in pastures distant from the hills. It would be necessary to compare it with that of Europe, to know the difference, if any exists. It has neither vulgar name nor known use.

Litrea venenosa. Miers. Every body knows or has heard of the *litre*, a tree very common in the highlands and plains. I have seen some six yards high, but the diameter is small. The wood is solid and hard. It serves for the knees of vessels, for wheels and axles of carts, and for the points of ploughs. It is substituted for iron in many cases. Its root, sawn into boards, is beautifully mottled, and is used for inlaid work. It is said that the shade of this tree is dangerous; that those who lie in it, swell in a most extraordinary manner, and the contact of its leaves produces pimples and flea-bite efflorescence. It is generally believed, also, that refrigerants and anodynes are the remedies in these cases. The family of the *Terebin-*

thinæ, to which this species belongs, includes many which possess the above qualities in a high degree. But I believe they exaggerate those of the *litre,* at least judging from my own experience. The Indians employ its fruit to prepare honey, sweetmeats, and *a chicha,* (a species of drink,) which they assure us is quite pleasant. Admitting, for the present, the name which Miers gives it, I am of opinion that the *litre* is the *Mauria simplicifolia,* H. B. and Kunth, whose native place even is not well known, according to the most recent authors. The generic characters agree entirely and appear common to the *Cambessedea,* Kunth, although this is originally from the East Indies. I agree with Sprengel, who views the *Cambessedea* as synonymous with the *Mauria.*

Loasa, Adans. Many species are natives of Chile. Almost all of them grow in the woods on the high lands among brambles and stones, and some in the neighborhood of the plains. The *L. Blacei,* Lindl., (*L. acanthifolia,* Bot.; *Reg.*) is the most common. It is called *ortiga brava* or *cardito.* The *L. Triloba,* Juss. *ortiga, ortiguilla.* I have met with a well marked variety in the woods near Cachapual, and I have called it *L. heterophylla,* believing that it constitutes a distinct species. The *L. volubilis,* Juss., known under the name of *monjita.* Finally another called ortiga, but with white flowers. It does not differ from the *L. palmata,* Spreng., to which should probably belong the *Blumenbachia insignis,* Schrad., a genus admitted by De Candolle, (Prodr. part iii, p. 340.) The *L. albida,* Miers, is perhaps the same species.

Lobelia, L. The name *tupa* is given indefinitely to three species of this genus, whose stalk is fructicose. One of them is the *L. Tupa,* L.; the other appears to be the *L. decurrens,* Cav., and the third in my opinion is new. These shrubs are elegant, and particularly their flowers. They grow on the borders of woods and near torrents. I have found the last in Valparaiso. The poisonous property of these plants is the only reason against cultivating them in gardens where they would appear well. It is said that formerly this plant was used to give strength to wine. I believe the Indians only are capable of such proceeding.

Lolium temulentum, L. The whole world is acquainted with the *Vallico,* (bearded darnel?) unfortunately too common in fields where wheat is grown. This baneful plant ought to call the attention of agriculturalists, who must know that they cannot succeed in destroying it entirely, until they give more attention to the selection of the seed which they sow, and weed carefully the plant, and afterwards the ears. This last operation would be facilitated by making parallel furrows about two yards apart, as in this way one could enter easily into the sown part without injury to the field. The *Vallico*, in place of being cut, should be torn up by the roots, and its sheaves should be burned out of the reach of any cultivated place. Its grain is very injurious: bread which contains it intoxicates, causes vertigo, nausea and a torpor of the limbs. It has been the cause of many epidemics. Negligence is in a great measure the cause of so many evils. There is an opinion prevalent here, that wheat sown in a wet season and in humid soil, will degenerate and become *Vallico*. I knew several proprietors and agriculturists, who were desirous of persuading me that in certain parts the wheat disappeared altogether. All supported their assertions by experiments performed under their own eyes. This prejudice is so gross as not to merit refutation. My reply was to ask whether cabbages changed to radishes, and whether beans (*porotos*) ever became lentils (*lentejas*). When we come to speak of tillage, of manure, and of different seed-times, we will endeavor to prove that this pretended anomaly, with many others, cannot be satisfactorily explained without the aid of a precise or definite knowledge of cultivation, and of philosophical principles on which are founded those of vegetation.

Lorantus, L. The three species which I have met are known without distinction by the vulgar term *quintral*. The most common of all is the *L. Tetrandrus*, R. and Pav. It grows on almost every tree : its flowers are of a magnificent red color. It is not mentioned in the *Species Plantarum* of Sprengel. Perhaps it is a synonym of the *L. Lucarquensis*, H. B. and Kunth, although Stendel admits them as two distinct species. The *quintral de quisco* grows exclusively on the stalks of the *Cactus Peruvianus*, L., where it is very common. Its flowers are the same, but always small, contracted, and absolutely without leaves. It is without doubt the *L. aphyllus*, Miers. A third, which I believe to be new, is a parasite on the branches of the thorn in the woods of Taguatagua. The form of its leaves distinguishes it at once from the first; its berries are of a different color. Not having seen the flower, I do not know whether it belongs to the same division. Nevertheless I will call it *L. linearifolius*. The *quintral* yields a beautiful black dye which is frequently used by the people of the country. From the first is prepared a bird-lime which is used for catching birds. The same use is made of that which is extracted from the *Chilca*.

Lotus subpinnatus, Lag. Although De Candolle has lately placed this plant in the genus *Anthyllis*, giving it the name of *A. Chilensis*, it appears to me impossible to separate it from the *Lotus*. Its size, and above all its legumes four times larger than its calyces, which are not swollen, are the facts I give at present in support of my opinion. The globulous tubercles which De Candolle says are found on its roots, are also met with in a species of Trifolium, as we shall hereafter see. This plant is common in sandy pasturages along rivers, and on hills.

Lucuma obovata, Kunth. *Lucuma de Coquimbo.* This tree is cultivated in some gardens. The climate here (Santiago) is not favorable to it. The fruit which is eaten comes from Coquimbo. Though generally esteemed, its taste is not very superior, and cannot be compared with that of the *Achras Sapota*, L., a tree of the same family.

Lupinus microcarpus, Sims. Common in the sandy plains near Cachapual, and in mountain pastures. This interesting species, on account of its size and the color of its flowers, merits cultivation. Its vulgar name is *Alberjilla*. The *Artamuz* of the gardens does not differ perhaps from the *L. multiflorus*, Desrouss. The stalk is fruticose; it flourishes nearly throughout the year; it is appreciated for the beautiful color of its many flowers.

Luzula. D C. The species which I have met in the pastures of the mountains near Leona, is doubtless the *L. interrupta*, Desv.

Luzuriaga cordata, Bertero. It grows among the stones in arid places in the plains. It is herbaceous; its root is terminated by a tubercle; the stalk is prostrate and the leaves cordiform. All these characters distinguish it from known species.

Lychnis Chalcedonica. L. *Escarapela*, cultivated in gardens for the beauty of its flowers, which are disposed in clusters, and whose color is either bright red, or rose, or white. The variety with double flowers is most esteemed, but is not so common. The *L. grandiflora*, Jacq., should be introduced, as it is much more beautiful.

Lycium Chilense. Miers. A very branchy shrub which grows in bramble fields, on the banks of the Maipu, in Leona, and in the neighborhood of Santiago. It does not differ from *L. obovatum*, R. and P., except in the smallness and form of its leaves, and may be perhaps only a variety.

(To be continued.)

Art. XV.—*Notice of a Fountain of Petroleum, called the Oil Spring.*—Editor.

The Oil Spring, as it is called, is situated in the western part of the county of Allegany, in the state of New York. This county is the third from Lake Erie, on the south line of the state—the counties of Cataraugus and Chatauque lying west and forming the south western termination of the state of New York: the spring is very near the line which divides Allegany and Cataraugus.

Being in the county of Allegany, I was indebted to the kindness of a friend, who, on the 6th of September, took me from Angelica to the spring. After crossing the Genesee River, our ride was to the town of Friendship, six miles; then to Cuba, eight miles; and thence, into the township of Hinsdale, three and a half miles; making seventeen and a half miles from Belvidere, the seat of Philip Church, Esq. and twenty one miles from Angelica village. The place will be found, without difficulty, by taking a guide at Hick's tavern, which is on the corner of the road from Cuba, where it is intersected by the road to Warsaw, two miles west of Cuba. The last half mile is in the forest; a road is cut, for the greater part of the way, through the woods, but the path becomes, finally, an obscure foot track, in which a stranger, without a guide, might easily lose his way, or at least fail of finding the object of his search.

The country is rather mountainous, but the road running between the ridges is very good, and leads through a cultivated region, rich in soil and picturesque in its scenery. Its geological character is the same with that which is known to prevail in this western region; a siliceous sandstone, with shale and in some places limestone, is the immediate basis of the country; the sandstone and shale, (the limestone I did not see,) lie in nearly horizontal strata; the sandstone is usually of a light gray color, and both it and the shale abound with entrocites, encrinites, corallines, terebratulæ, and other reliquiæ characteristic of the ancient secondary or transition formation.

The oil spring or fountain rises in the midst of a marshy ground; it is a muddy and dirty pool, of about eighteen feet in diameter, and it is nearly circular in form. There is no outlet above ground—no stream flowing from it, and it is of course a stagnant water, with no other circulation than that which springs from changes of temperature, and from the gas and petroleum which are constantly rising through the pool.

We were told that the odor of petroleum is perceived, at a distance, in approaching the spring; this may, not improbably, be true, in particular states of the wind, but we did not distinguish any peculiar smell until we arrived on the edge of the fountain. Here, its peculiar character becomes very obvious. The water is covered with a thin layer of the petroleum or mineral oil, giving it a foul appearance, as if coated with dirty molasses, having a yellowish brown color. Every part of the water was covered by this film, but it had no where the iridescence which I recollect to have observed at St. Catharine's well, a petroleum fountain near Edinburgh, in Scotland; there the water was pellucid, and the hues, produced by the oil, were brilliant, giving the whole a beautiful appearance: the difference is, however, easily accounted for; St. Catharine's well is a lively, flowing fountain, and the quantity of petroleum is only sufficient to cover it partially, while there is nothing to soil the stream; in the present instance, the stagnation of the water, the comparative abundance of the petroleum, and the mixture of leaves and sticks, and other productions of a dense forest, preclude any beautiful features. There are, however, upon this water, here and there, spots of what seems to be a purer petroleum, probably recently risen, which is free from mixture, and which has a bright brownish yellow appearance,—lively and sparkling: were the fountain covered, entirely, with this purer production, it would be beautiful.

We were informed, that when the fountain is frozen, there are always some air-holes left open, and that in these the petroleum collects in unusual abundance and purity, having, distinctly, the beautiful appearance which has just been mentioned as now occurring, here and there, upon the water. The cause of this is easily understood; the petroleum being then protected, by the ice, from the impurities which, at other times, fall into it, thus escapes contamination, and being directed to the air-holes, both by its levity and by the gas which mixes with it, it there collects in greater quantity and purity. All the sticks and leaves, and the ground itself around the fountain, are now rendered, more or less, adhesive, by the petroleum; and the rods and paddles which are used in the water, cannot be touched, without covering the hands with a tar-like coating.

They collect the petroleum by skimming it, like cream from a milk pan; for this purpose, they use a broad flat board, made thin at one edge, like a knife; it is moved flat upon, and just under the surface of the water, and is soon covered by a coating of the petroleum, which is so thick and adhesive that it does not fall off, but is removed by scraping the instrument upon the lip of a cup. It has then a very foul appearance, like very dirty tar or molasses, but it is purified by heating it and straining it, while hot, through flannel or other woolen stuff. It is used, by the people of the vicinity, for sprains and rheumatism, and for sores on their horses, it being, in both cases, rubbed upon the part. It is not monopolized by any one, but is carried away freely, by all who care to collect it, and for this purpose the spring is frequently visited. I could not ascertain how much is annually obtained; the quantity must be considerable. It is said to rise more abundantly in hot weather than in cold. Gas is constantly escaping through the water, and appears in bubbles upon its surface; it becomes much more abundant and rises in large volume whenever the mud at the bottom is stirred by a pole. We had no means of collecting or of firing it, but there can be no doubt that it is the carburetted hydrogen,—probably the lighter kind, but rendered heavier and more odorous by holding a portion of the petroleum in solution; whenever it is examined we should of course expect to find carbonic acid gas mingled with it and not improbably azote or nitrogen. We could not learn that any one had attempted to fire the gas, as it rises, or to kindle the film of petroleum upon the water: it might form a striking night experiment.

We were told that an intoxicated Indian had fallen into the pool and been drowned, many years ago, and that his body had never been recovered; others doubted the truth of the story. Were it true, it would be a curious enquiry, whether the antiseptic properties of petroleum, (so well exemplified in the Egyptian mummies,) may not have preserved this body from putrefaction.

The history of this spring is not distinctly known: the Indians were well acquainted with it, and a square mile around it is still reserved for the Senecas. As to the geological origin of the spring, it can scarcely admit of a doubt, that it rises from beds of bituminous coal, below; at what depth we know not, but probably far down; the formation is doubtless connected with the bituminous coal of the neighboring counties of Pennsylvania and of the West, rather than with the anthracite beds of the central parts of Pennsylvania.

A branch of the Oil Creek, which flows into the Allegany River, a principal tributary of the Ohio, passes near this spring, and we crossed the rivulet in going to it; thus we had the pleasure of seeing water that was on its way to New Orleans and the Gulf of Mexico; we had just passed the Genesee, which flows into Lake Ontario, and is thus seeking the Atlantic through the St. Lawrence; and a little east, rise waters which flow to the Susquehannah and the Chesapeake Bay, and thus this elevated land, (said to be one thousand five hundred feet above the ocean level,) is a grand rain shed, for the supply of rivers, seeking their exit through very remote and opposite parts of the continent.

I cannot learn that any considerable part of the large quantities of petroleum used in the eastern states, under the name of Seneca oil, comes from the spring now described. I am assured that its source is about one hundred miles from Pittsburgh, on the Oil Creek, which empties into the Allegany River in the township and county of Venango. It exists there in great abundance, and rises in purity to the surface of the water; by dams, enclosing certain parts of the river or creek, it is prevented from flowing away, and it is absorbed by blankets, from which it is wrung. Although I have this statement from an eye witness,* still it would be an interesting service, claiming a grateful acknowledgment, if some gentleman in the vicinity of the petroleum, or at Pittsburgh, would furnish an account of it for this or some similar Journal; and as there are numerous springs of this mineral oil in various regions of the west and south west, connected especially with the saline and bituminous coal formations, it would promote the cause of science, if notices of any of them were forwarded for publication.

The petroleum, sold in the eastern states, under the name of Seneca oil, is of a dark brown color, between that of tar and molasses, and its degree of consistence is not dissimilar, according to the temperature; its odor is strong and too well known to need description.

I have frequently distilled it in a glass retort, and the naptha which collects in the receiver is of a light straw color, and much lighter, more odorous and inflammable than the petroleum; in the first distillation, a little water usually rests in the receiver, at the bottom of the naptha; from this, it is easily decanted, and a second distillation prepares it perfectly for preserving potassium and sodium, the object which has led me to distil it, and these metals I have kept under it (as others have done) for years; eventually they acquire some oxy-

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* Mr. Ovid Hard, stage proprietor, of Rochester, N. Y. who mentioned Mr. J. L. Chase, residing on the Oil Creek, Venango County, Penn. as a gentleman from whom exact information may be obtained.

gen, from or through the naptha, and the exterior portion of the metal returns, slowly, to the condition of alkali—more rapidly, if the stopper is not tight.

The petroleum remaining from the distillation, is thick like pitch; if the distillation has been pushed far, the residuum will flow only languidly in the retort, and in cold weather it becomes a soft solid, resembling much the maltha or mineral pitch.

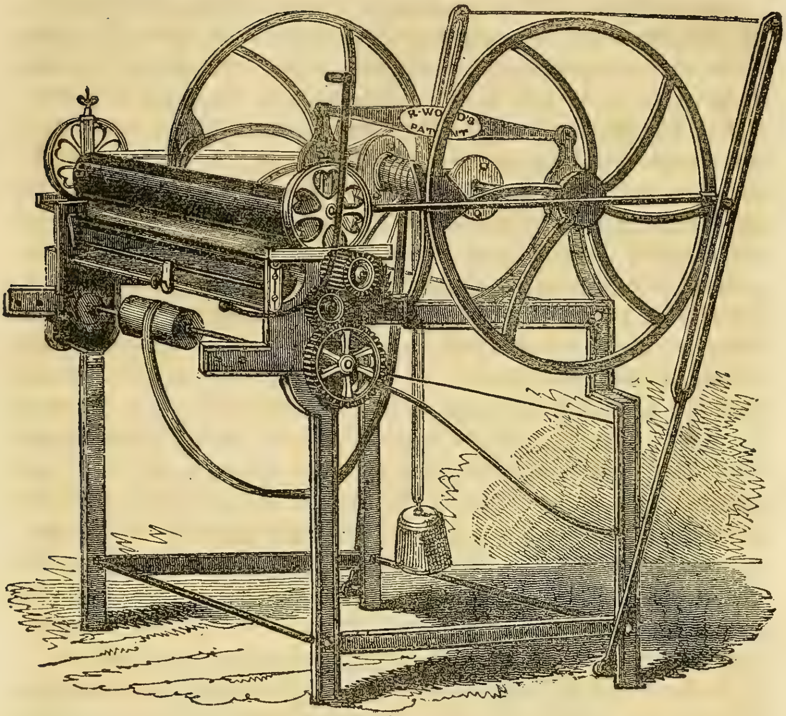
The famous lake of maltha and petroleum, in the island of Trinidad, is well known: I have specimens from that place, in all the conditions between fluid petroleum and firm pitch. It is unnecessary to repeat, that the English use it on their ships of war, as a substitute for tar and pitch, and that the bituminous mass in the natural lake, (which covers several square miles,) is sufficiently tenacious to support a man, during the colder part of the year, but at the opposite season is too soft to sustain any considerable weight.

In alluding to the probable connexion, with bituminous coal, of the oil spring named at the head of this notice, I did not mean to imply that petroleum and other bituminous substances *necessarily prove*, that there is coal beneath; for it has been ascertained that bitumen exists, in a limited degree, in many minerals, as appears from some of the phenomena of volcanos, and was proved experimentally by the late Hon. George Knox, in an extensive series of researches, published in the Philosophical Transactions of London. As regards the probability of finding coal, the opinion should be thus modified; if the country on whose waters, or in whose rocks, petroleum or other varieties of bitumen appear, is such an one as, in its geological structure, is consistent with the usual associations of coal, then the existence of bitumen, especially if it be abundant, and more especially if the rocks themselves are impregnated with it, affords a strong presumption in favor of the existence of coal beneath. Such is the fact in this part of the state of New York. The shale at Geneseo is highly bituminous and burns readily, with abundant flame. I cannot answer for the rocks in the immediate vicinity of the Oil Spring, as they are not in view. The people have dug a few feet for coal at the distance of a few yards from the spring; the excavation is too shallow to decide any thing, except that the petroleum rose in this place also, as at the spring, thus proving, that the bituminous impregnation is not peculiar to that spot.

If these remarks should excite any interest in the minds of landed proprietors in that vicinity, I would venture to suggest to them, that it would not be wise, without more evidence, to proceed to sink shafts; for they would be very expensive and might be fruitless. It would be much wiser, *to bore;* which would enable them, at a comparatively moderate expense, to ascertain the existence, depth and thickness of the coal, should it exist; but, even this should not be done without a previous diligent examination of water courses, banks, precipices, excavations for wells, cellars, roads, &c. which might perhaps materially aid the enquiry. The well known existence of bituminous coal beds at the distance of a few miles in Pennsylvania, renders it highly probable that they may pass under this region, but perhaps at too great a depth to admit of profitable extraction; for the abundance of coal in other parts of Pennsylvania and the west;—the magnitude and easy accessibleness of the beds, and the excellence of the coal, will long render it impossible that thin beds, in other parts of the country, especially if lying deep in the ground, should be wrought without ruinous expenditure.

It is worthy of remark, that the cattle drink, freely, of the waters of the oil springs, a fact which we should hardly expect, since they are so foul, and since there is abundance of pure water near; and also because we should expect that the petroleum would render the water very disgusting to animals; perhaps they may find in this fountain, something of the reputed virtues of tar water; I could not learn that birds ever light upon or near the spring; the mephitic gases might, perhaps, make it *a real Avernus,* to them.

The present depth of the petroleum spring is but a few feet. It is scarcely necessary to add, that, in accordance with the usual state of popular impression in similar cases, it is confidently asserted here, that the oil spring, was, when first known, *literally a bottomless pit;* we may however, safely conclude that it was then much deeper than at present. When I asked a plain man, in the vicinity, how he imagined it was first formed, he replied, that he believed the *gas-air,* (as he called it,) blew up the ground, at the time when the fountain first rose, and that the flow of the water and gas had preserved it ever since, although it had been greatly filled and clogged by earth and other substances, falling or thrown into the cavity. I shall not attempt to substitute any theory of my own, for this indigenous hypothesis, of an uninstructed man, who certainly reasoned ingeniously, if not conclusively. I presume he had never heard either of Pluto or Neptune, and therefore drew his conclusions from his own mind and not from any geological theory.



Art. XVI.—*Notice of Wood's Inking Machine.**

Of all the inventions produced by the ingenuity of man, none has had so extensive and beneficial an influence as the Press; and any improvement in a machine so widely affecting the interests of society, cannot be considered unimportant. Accordingly, the history of printing, from the rudely carved block and simple press of the inventor of the art, to the movable types and complicated machinery of the present day, would be found at once curious and interesting. But, though a general view of the progress of this chief of arts, could not be unacceptable, it is proposed, at present, merely to invite public attention to a machine which will perhaps be considered not one of the least important of its improvements.

* This Journal is printed on a press, to which one of the above named machines is attached.—*Ed.*

It is well known that the increased demands made upon the press, by the eager thirst for knowledge, and the general spirit of competition, that characterize the times, have caused the power of steam to be called to its aid, to obtain dispatch and cheapness of production. The Steam Press, however, though a proud trophy of modern art, from its great size and enormous cost, could be used only in the greatest establishments, and by men of large capital; while, at the same time the general inferiority of its work, which almost necessarily resulted from its great despatch, limited its use chiefly to the printing of newspapers. A machine was still wanting, that should be available to the common printer, that would enable him to work at less cost, and to compete with his more opulent neighbor. This desideratum was attempted to be supplied by some contrivance that might be applied to the common hand-wrought printing press, in such a way as to cause it, by its own action, to ink the form of type by means of a roller, when worked by one man. Several attempts had been made for this purpose, both in this country and in Europe, but hitherto without success: the different machines being either too deficient in the proper distribution of the ink necessary to good work—occasioning too great an obstruction to the action of the press, to allow of its being worked by a single person—or requiring too great an alteration of its construction, to admit of general use.

In this machine, these objections have been overcome; and it is thought that it will be found to be well adapted to the purpose for which it is intended. It is applicable to any of the hand-wrought presses in common use; requires no additional motion on the part of the workman; and but a slight increase of muscular power.

The machine being placed on the side of the press, opposite to that on which the workman stands, the axis of the handle of the press (called the rounce), is lengthened a few inches on that side, and a bevel-toothed wheel placed upon it, for the purpose of giving motion to the machine. This is the only alteration necessary to be made in the press; and, except a couple of fastenings attached to its frame, to hold the machine firmly in apposition with it, is the only connexion between them.

On the front side of the machine is a shaft, having at one end a bevel-toothed wheel, which is worked upon by that on the end of the rounce; in the middle, a barrel to which is attached a strap, which winds up a weight that propels the inking roller; and at the other end a spur-wheel, which gives the motion to the rollers, necessary for distributing the ink thereon.

Above this shaft, on a level with the form of type, is the distributing roller; upon the surface of which the ink is spread, and from which it is taken by the inking roller, which rests upon it.

The inking roller is supported by wheels at each end, upon which it travels; and is suspended in such a manner, that its pressure upon the type may be regulated with the greatest nicety. A large or small roller, or two small rollers may be used, if desired.

Behind the distributing roller, is placed the ink fount or trough; in which is an accurately-ground iron roller, revolving in the ink, which is allowed to flow upon its surface more or less freely, by means of an adjusting scraper.

Resting against the fount roller, is a small supply roller, which, during the action of the machine, is raised against the distributing roller, and communicates ink to it, which by the assistance of another small roller on the opposite side, and of the inking roller on the top, is spread thereon of a perfectly even and uniform thickness; the distributing roller having a lateral or end motion, as well as a revolving motion, to make the distribution more complete. In this manner a much more perfect distribution is obtained, than in machines in which the ink is directly communicated to the roller that passes over the type.

At the back part, on a horizontal axis, (having in the middle a moveable barrel, to which is suspended a weight, and to which is also fastened one end of the strap before mentioned, attached to the barrel on the shaft in front,) are two fly-wheels, of diameters corresponding with the width of the table of the press; having on the outer side of each, a pivot, that runs in a slot or groove in a perpendicular lever that works on a joint at the bottom of the machine, and on the inner side, a small projection, by which a catch holds the wheel in its proper position.

To these levers, at the height of the inking roller, are attached, by joints, horizontal arms that extend to it; and which, by the vibratory motion given to the levers by the action of the fly-wheels, move it forward and backward over the form; and by properly proportioning the barrel on the axis of the fly-wheels, and that on the shaft in front, the roller may be made to traverse the form, once, twice, or oftener, as desired.

This description will give a tolerably good idea of the general construction of the machine, the operation of which is as follows:—

The workman, in running in the table of the press, winds up the weight that propels the inking roller; and in running it out, gives the motion to the several rollers, by which the ink is communicated to, and distributed upon them.

The frame of the press on which the sheet of paper is placed, (called the tympan,) when raised, strikes a lever which releases the catches that hold the fly-wheels, which are immediately set in motion by the weight on their axis, and, by their revolution, carry the inking roller forward and backward over the form.

A strap or string attached to the same barrel to which the weight is suspended, but in an opposite direction, is wound up by its descent, and, at the proper time, raises a lever which throws the catches into their places, and arrests the motion of the wheels.

This machine, which has also been adopted in England, is thus noticed by the editor of the Repertory of Patent Inventions, published at London.

"Persons who have seen the grand rolling cylindrical presses, moving by the aid of a steam-engine, and at the Atlas newspaper office in particular, must have been struck by the peculiar method of distributing the ink." After describing this method, he says—"now the objects gained by this series of rollers—saving of manual labor, expedition, and regular supply of ink, are gained also by the invention under notice. The grand difference is in the *primum mobile.* In the case we have described, the mover power is steam; the space occupied is very large, and the expense exceedingly great; and we have found this invention applied only in the largest establishments, and to those immense rolling presses, that steam alone can work.

"Here it is that Mr. Wood's merit begins. He has applied a system of rollers, as like as possible to those we have just described, to hand-wrought printing presses. The action of a part of the press is made to produce the rotation of a fly-wheel, which sets in motion the inking process, and its effect is exactly the same as this important part of the steam press, without its expense."

We understand, that in practice, the machine of Mr. Wood, is found truly valuable; its operation in inking, being uniform and expeditious, and attended by little inconvenience.—*Ed.*

Art. XVII.—*Observations on Inclined Planes; by* J. Thomson, Engineer, and late Professor of Mathematics in the University of Nashville, Tenn.

TO THE EDITOR.

Sir—In the formation of rail roads, the proper location of inclined planes forms an important subject of inquiry. The following equations have been made out in order to facilitate calculations in reference to the ascent and descent of cars on inclined planes, where friction forms a considerable part of the resistance to be overcome. These equations are given with the expectation that they may be found easy of application, in cases where general results, approximating to the truth, and not strict accuracy, are required. Indeed, it is impossible to give equations that will meet all the causes of irregularity of motion on inclined planes, and be found accurate in practice.

We will suppose in the first place, that the resistance of friction that retards the motion of a car, descending an inclined plane by its own gravity, is required.

Let a=weight of the descending carriage.
g=accelerating force of gravity.
g'=accelerating force in direction of the plane.
n=length of the plane divided by the height.
s=space passed over in time t.
x=force of friction of the wheels, compared with g.
f=friction expressed in pounds.

When a body descends a plane without friction, we always have, by the laws of descending bodies, $t^2=\frac{2s}{g'}$, but when g' is diminished by friction, $t^2=\frac{2s}{g'-x}$, whence $x=g'-\frac{2s}{t^2}$, and since $g'=\frac{g}{n}$, $x=\frac{g}{n}-\frac{2s}{t^2}$ . . . . . A; we have also the proportion $g : x :: a : \frac{ax}{g}=f$, and by substitution

$$f=\frac{a}{n}-\frac{2as}{gt^2} \quad . \; . \; . \; . \; . \; \text{B.}$$

The friction f in this equation includes both the friction of attrition and of rolling, and also the resistance occasioned by the inertia of the wheels in rolling. Mr. Wood, in his "Treatise on Rail roads," makes allowance for this latter resistance, so as to obtain the resistance of attrition and rolling unaffected by inertia. To do this, he introduces into his equations the weight of the wheels separately from the weight of the load, the wheels being increased in the ratio of SG to SO, SG being the radius of the wheel, or the distance of the center of gravity of the wheel from the circumference, and SO being the distance of the center of oscillation from the same. This latter point was found by causing the wheel to vibrate from a point in the circumference, and calculating from the times of vibration. Although this was necessary in Mr. Wood's experiments, in order to obtain separately the amount of rubbing and rolling friction, yet it will readily be seen that many cases will occur in practice, where it will be inconvenient and sometimes impossible to ascertain the value of $\frac{SO}{SG}$. In the equations here given, the inertia is included in the general estimate of friction, for the sake of convenient application. Examples will be given hereafter.

Let V=velocity, and F=accelerating force, we always have, by the laws of descent, $t^2=\frac{V^2}{F^2}$, hence the equation above, $t^2=\frac{2s}{g'-x}$ becomes $\frac{v^2}{(g'-x)^2}=\frac{2s}{g'-x}$, from which $x=g'-\frac{v^2}{2s}$, and substituting for g' its value,

$$n=\frac{2sg}{v^2+2sx} \quad \ldots\ldots \text{C.}$$

This equation may be used when the height of a plane of a given length is required, such that a car, descending by its own gravity, may acquire a given velocity at the foot of the plane; or when the height is given, the length s may be found. The value of x is found from equation A by experiment. According to the experiments of Mr. Wood, $x=.15$, where the friction is equal to about the 220th part of the weight. When the friction is taken as the 300th part of the weight, as is sometimes done, $x=.107$. In general, if the friction is equal to the mth part of the weight, we always have $x=\frac{g}{m}$.

The friction f of the wheels being found, it is to be used as a given quantity in the case where a train of cars, descending an inclined plane, draws up another train at the same time, the trains being connected by a rope passing over a wheel at the top of the plane, and supported by small wheels or sheaves along the rail track. In this case it is necessary to find the friction of the rope, sheaves, and wheel at the head of the plane.

Put w and w' = the absolute weights of the descending and ascending trains respectively, v and v' = their weights in the direction of the plane, g'' = the accelerating force by which the united trains move, x = the friction of all the moving parts, compared with g, F$=x$ expressed in pounds, F = the friction of rope, sheaves, and rope-roll in pounds. Then $v=\frac{w}{n}$, $v'=\frac{w'}{n}$, $g'=\frac{g}{n}$, we have also the proportion $v+v' : v-v' :: g' : g''$, and hence $g''=\frac{g'(v-v')}{v+v'}=\frac{g(w-w')}{n(w+w')}$. Again, when friction is removed, we always have $t^2=\frac{2s}{g''}$, but since g'' is diminished by friction, we have $t^2=\frac{2s}{g''-x}$, and hence $x= g''-\frac{2s}{t^2}$, and by substitution $x=\frac{g(w-w')}{n(w+w')}-\frac{2s}{t^2}$. x being found, we have $g : x :: w+w' : F'=\frac{x(w+w')}{g}$ = the whole resistance in pounds, and since F$=$F$'-f$, F$=\frac{x(w+w')}{g}-f$. Now putting a and d = the sum and difference of the weights, and substituting for x its value, we have

$$F=\frac{d}{n}-\frac{2as}{gt^2}-f \; . \; . \; . \; . \; . \; D.$$

In this value of F, the resistance arising from the inertia of the sheaves and rope-roll, is included; and in the application of the formula, half the weight of the rope is to be considered as constituting a part of the weight of each train; or a, the sum of the weights, is equal to the whole weight of the rope added to the weights of the ascending and descending trains. Mr. Wood obtains the friction without the inertia, by introducing into his equations the inertia as equal to one half the weight of the sheaves and rope-roll. The accuracy is doubtful, as the inertia depends much on the form of the wheels. Where it is proposed to ascertain the exact amount of rubbing friction, it would certainly be necessary to obtain as nearly as possible the true amount of inertia. But in ordinary practice, the error would not, perhaps, be important, if the resistance of inertia and friction were estimated together.

Resuming equation D, it will be seen that if the ascending weight on the plane becomes indefinitely small, d becomes equal to a, and the equation becomes

$$F=\frac{a}{n}-\frac{2as}{gt^2}-f \ldots\ldots E.$$

This formula may be applied where cars are used to draw out the rope from a fixed engine by the force of gravity alone. In estimating the value of a in this equation, half the weight of the rope is to be considered a part of the weight of the descending train.

The values of F in equations D and E being found from the data given in the experiments of Mr. Wood, we find an approximate value of F, that may be used in any case in practice. Let k=weight of the rope, m=weight of the sheaves, p=weight of the rope-roll, and r=weight of the ascending train, we have

$$F=\tfrac{1}{50}\left(k+m+p+\frac{2r+k}{n}\right) \ldots\ldots K.$$

This value of F may be used, when a fixed engine draws up a train of cars, while another train descending, draws out the rope from the engine. When the engine is not assisted by a descending train, we find from the experiments mentioned above,

$$F=\tfrac{1}{40}(k+m+p) \ldots\ldots L.$$

The values of F and f being known, we may ascertain the amount of resistance overcome by a fixed engine, in drawing a train of cars up an inclined plane. Putting a= weight of the train, it is evident that the resistance to motion will be $\frac{a}{n}+F+f$, since F and f include the resistance of friction and inertia of all the moving parts. Hence, making t= time in minutes, we have for the resistance R, moved one foot in one minute,

$$R=\frac{s}{t}\left(\frac{a}{n}+F+f\right) \ldots\ldots M.$$

And the horse power necessary to overcome this resistance will be, supposing p= number of pounds expressing the power of one horse,

$$P=\frac{s}{pt}\left(\frac{a}{n}+F+f\right) \ldots\ldots N.$$

If the engine be assisted by a descending train, we have, making d= difference of the weights of the ascending and descending trains,

$$R=\frac{s}{t}\left(\frac{d}{n}+F+f\right) \ldots\ldots O.$$

$$P=\frac{s}{pt}\left(\frac{d}{n}+F+f\right) \ldots\ldots S.$$

In order to give examples of the application of the above formulæ, we may quote some of the experiments given by Mr. Wood.

"*Experiment* 2d, *on friction.*—Length of plane 1164 feet; perfectly straight, with a uniform and regular descent of 1 yard in 104.24; edge rail of Losh and Stevenson's patent, $2\frac{1}{2}$ inches broad at top. The carriages were allowed to descend freely by their gravitating force, and the space they passed over ascertained by a stop watch. Four loaded carriages, each weighing 9408 lbs. descended the plane in 120 seconds." The value of x in equation A, from these data, is .15, and $f=42.79$ lbs. for the resistance of friction of each carriage, being nearly the 220th part of the weight. By Mr. Wood's formula, we have, in this case, $f=39.35$ lbs. The difference in results may be caused by the resistance of inertia not being included in the latter value of f.

"*Experiment* 19th.—Upon the Killingworth rail road: self-acting plane, with a rope-roll, round which the rope winds, one end of which is attached to the descending, the other to the ascending carriages; length of plane 715 yards, descent $57\frac{1}{2}$ feet. Six loaded carriages, each weighing 8764 lbs. descended by their gravitating force, and drew up seven empty carriages, each weighing 2800 lbs. on a mean of several times, in 180 seconds; weight of the rope 3884 lbs.; weight of the sheaves 3297 lbs.; weight of the rope-roll 4636 lbs. The descent of this plane is not regular, being greater at the top than at the bottom, the line of the road perfectly straight." Taking, in this case, $f=$ the 200th part of the weight, we find F, from equation D, equal to 212 lbs. Mr. Wood gives, in this instance, $F=204$ lbs.

"*Example.*—Suppose a descending plane, the length of which is 1800 yards, down which it is intended to pass 9 loaded carriages at a time, each weighing 4 tons, which drag up 9 empty carriages, each weighing 24 cwt.; required the height of the plane, or inclination, that will cause the descent in 400 seconds. Weight of rope 5562 lbs.; weight of the sheaves 5400 lbs.; rope-roll 454 lbs." In this case, taking $f=$ the 200th part of the weight of the carriages, and $F=\frac{1}{50}\left(k+m+p+\frac{2r+k}{n}\right)=228+\frac{1099}{n}$, we have, by substitution in equation D, $228+\frac{1099}{n}=\frac{d}{n}-\frac{2as}{gt^2}-f$, which gives $n=51\frac{3}{4}$; that is, the plane rises 1 in $51\frac{3}{4}$. The formula of Mr. Wood gives 1 in 50, for the elevation of the plane. It should be observed, that t has been taken equal to $\frac{7}{8}$ of 400, a correction adopted by Mr. Wood, in order to cause the descent within the required time, in all states of the weather.

"*Experiment* 27th.—Boulton and Watt's low pressure condensing engine, with two thirty inch cylinders, steam $4\frac{1}{2}$ lbs. per square inch above the pressure of the atmosphere, weight of rope 6967 lbs., sheaves 10278 lbs., rope-roll 8960 lbs., length of plane 2646 feet, height $154\frac{1}{2}$ feet. Time of drawing up seven loaded carriages, each weighing 9408 lbs., six hundred and twenty seconds, the engine making three hundred and seventy four single strokes, five feet each." Here we have $f=294$, and $F=\frac{1}{40}(k+m+p)=655$, or more accurately, by a previous experiment on a plane precisely similar, we have $F=686$ lbs. Hence by (M) the resistance overcome by the engine is $R=1288960$ lbs., the power of the engine is 4988738 lbs. whence we have the effective power of the engine upon the load, compared with the pressure of the steam upon the piston, equal to 25.8 per cent., nearly the same as obtained by the author.

"*Example.*—Suppose an inclined plane, one thousand yards in length, height sixty feet, up which a train of eight loaded carriages, each weighing 9408 lbs., is required to be drawn by an engine on the summit, in three hundred seconds, with a rope weighing 4065 lbs., sheaves 6000 lbs., rope-roll 4500 lbs., while at the same time the same number of empty carriages, each weighing 3472 lbs. are descending; required the power of the engine." Here we have $f=515$, and by (K) $F=315$ lbs., hence by (S) we have $P=32\frac{1}{2}$ horses' power. Mr. Wood gives in this case $P=33\frac{1}{3}$ for the power of the engine, the two results differing by $\frac{5}{6}$ of a horse power.

It will be seen from the above examples, that the results of the equations given, do not differ greatly from those derived from the equations of Mr. Wood; and the facility of using them is much greater. Strict accuracy is unattainable in questions of the above kind. The friction of the moveable parts of the apparatus on an inclined plane, and other circumstances may so vary, that it would be impossible to give equations that would meet with accuracy every case that may be presented in practice.

The reduction of friction is of the greatest importance in rail road improvements. We have had no accurate experiments for ascertaining the amount of friction on curved rail ways. In order to reduce this kind of friction, various plans have been proposed and tried. The exterior wheel has been enlarged by causing it to run on its flange while passing a curve; sometimes the conical wheel has been adopted to answer the same purpose; and it has been proposed, in order to avoid the inconvenience of the conical wheel, to suffer one of a pair of wheels to turn freely on its axle. That the first method cannot be used to advantage, will be seen, if we ascertain the depth of flange necessary on a curved rail way. Put r = radius of the interior wheel, $r+x$ = radius of the exterior wheel including the flange, R = radius of interior rail, $R+d$ = radius of the exterior, d = distance between the rails, then $R : R+d :: r : r+x$, hence $x=\frac{dr}{R}$ = depth of the flange. Let $R=500$ feet, $d=4.5$, $r=1.5$, then $x=\frac{1}{6}$ of an inch nearly. If $R=1000$ feet, $x=\frac{1}{12}$ of an inch for the depth of the flange. From these examples it will be seen that the flange must be too small for the ordinary purpose of keeping the car on the rails on a straight road. There is also a disadvantage in the use of the conical wheel. On a straight road there must necessarily be a small allowance of breadth between the rails, in order to give play to the wheels; hence a car will constantly change its position in the small space allowed it, in passing from one side to the other, and thus alternately raise and depress the sides of the car. This will perhaps produce more friction on a straight road, than the wheels will obviate on a curve.

When the conical wheel is used, the play given to the wheels on a curve should strictly correspond to the slope of the rim in such a manner as to produce the intended effect.

Let R = radius of the exterior rail.
r = inner or greater radius of the wheel.
r' = outer or less radius of the wheel.
d = distance between the flanges inclusive.
b = breadth of rim of the wheel.
p = play allowed the wheels while passing a curve. Then to find p when the other quantities are given, we have

$$p=\frac{bdr}{R(r-r')-br}.$$

And to know the form of the wheels when the necessary play is allowed, we have from the last equation

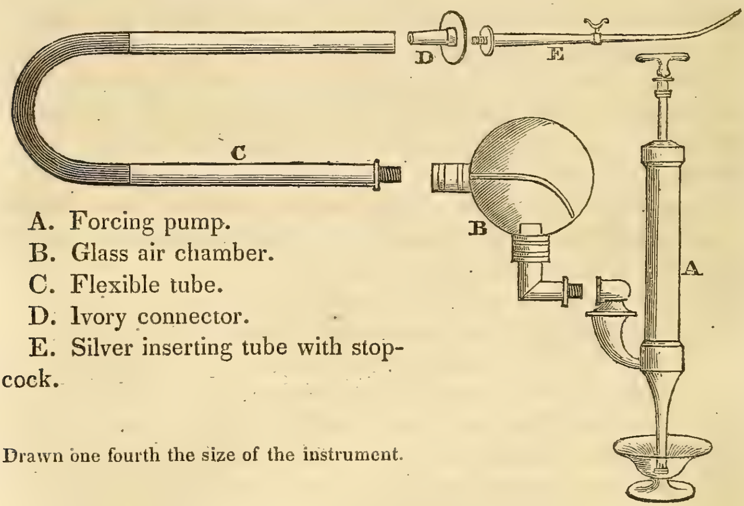
$$r'=r-\frac{(d+p)br}{pR}.$$

In this equation, the inner radius r of the wheel, and the breadth b, are supposed to be known, whence r' is found, and hence the proper conical shape may be given to the wheels. But after all, the conical wheel does not remove altogether the friction, unless the axles are made to take a position perpendicular to the rails. The method of effecting this to advantage is yet a desideratum.

Art. XVIII.—*Notice of an improved instrument for Venous Injection, with a figure—communicated for this Journal by* Dr. J. Mauran, in a letter to the editor, dated Providence, Sept. 14, 1832.

Remark by the Editor.—The annexed notice was accompanied by an interesting printed report on the Cholera, as it appeared in New York, up to the middle of July, signed by J. Mauran, Thomas H. Webb and Samuel Boyd Tobey.

The present communication, grew out of the observations of these medical gentlemen, during a visit which they made to New York, for the purpose of observing the malignant Cholera.



A. Forcing pump.
B. Glass air chamber.
C. Flexible tube.
D. Ivory connector.
E. Silver inserting tube with stop-cock.

Drawn one fourth the size of the instrument.

TO THE EDITOR.

Sir—We were early persuaded that a part of the failure from the "Venous Injections," which have been resorted to for the promotion of reaction in aggravated cases of asphyxiated cholera, has arisen (under the circumstances) not so much from the *nature* of the operation, as from the manner of its performance, through the imperfections of the apparatus employed. This opinion has been subsequently fortified by the observations of Dr. Francis, of New York, in a very interesting communication to Dr. Read, of Savannah, on the absorbing topic, wherein he states that "in the few autopsic examinations of subjects after venous injections had been employed, great cerebral congestion has been found, and *air* within the heart, mesentery, and large bloodvessels," and also by his further allusion to the horrors of a death after the injections, which he remarks, "are too terrific for delineation even by a Fuseli." Are not the results above quoted mainly the consequence of the presence of air in the bloodvessels? From a perusal of the interesting communication of Dr. J. C. Warren, illustrative of the appalling effects of such an accident on the system, as fully reported in the August number of the American Journal of the Medical Sciences, and the Boston Medical Magazine for 1832, we are still more of the opinion that our first impressions were correct.

Air in the heart and bloodvessels, and sufficient in quantity to be perceived and noted in post obit examinations!—It certainly did not exist in a free state in the blood, nor could it have been absorbed by the liquor and afterwards disengaged and thus rendered free; the temperature 113° of Fahrenheit, at which it was ejected, precludes the possibility of such a phenomenon. Whence came it then but through the imperfections of the instruments employed? I allude not to the more recent very ingenious arrangement (the barometer tube, &c.) of Dr. Depeyre, of New York, and adopted by him to avoid the very terrific effects above described,—an instrument admirably calculated to avoid the introduction of air, and not otherwise objectionable than from the manifest inconvenience of its use, the want of portableness. Air being inadmissible to the bloodvessels (though in ever so small quantities) without imminent danger to life in a healthy state of the functions, how necessary must it be to exclude it altogether in an operation intended for the relief of that state where the vital and physical powers (extremely prostrated and reacting tardily) are but feebly calculated to resist even present disease, much less that superinduced artificially by the very means put in requisition for effecting relief.

My object in addressing you is to communicate, for insertion in your useful and widely extended Journal, the plan of an instrument for venous injections which is deemed to be eminently arranged for general use, being *safe*, convenient, and portable; and if its publication should in any degree subserve the purposes for which it was intended, the ends of the writer will have been fully attained.

From the experiments which have been instituted by Latta, Craigie and Mackintosh abroad, and those more recently performed in this country, we cannot longer doubt the recuperative effects of proper and judicious venous injections in aggravated cases of asphyxiated cholera; nor will this application be limited, it is conceived, exclusively to this disease, but may become eventually a beneficial adjuvant in other diseases, which (resisting the ordinary methods of treatment) would otherwise be abandoned to the powers of the fell destroyer.

Annexed is a plan of the apparatus proposed, which consists simply in the addition of a silver inserting tube and a *glass air chamber* to the "Improved domestic instrument of Maw," (with which every practitioner and private family is or ought to be supplied) or to the more complicated stomach and injecting pumps of Read and others.

Method of use.—Adapt the whole as illustrated on the plate, then (the pump being placed in the liquor to be employed, the stopcock freely opened, and the tube inclined upwards) by a few strokes of the piston, the expulsion of all the air is thoroughly effected, as will be evinced to the operator by the uninterrupted, silent jet. Having now the air-chamber nearly, and the remainder of the apparatus completely filled with the liquid, close the stopcock so as to allow but a 'guttatim' emission, and insert with care the extremity of the tube into the vein previously prepared for its reception.

The contained fluid being under compression and constantly flowing from the point of the instrument during its introduction, all admission of air into the vessels is thereby effectually excluded. Another advantage arising from the stopcock, which should be noticed, is the perfect regulation of the current during the process of injecting.

TO THE EDITOR.

POSTSCRIPT. Providence, September 17, 1832.

Sir—In a communication made to you for insertion in your Journal on the 14th inst., I forgot to state, that I have occasionally tipped the points of the inserting tube with a *bulb* (say half a line in diameter) which, from its exciting less irritation in the vein, I prefer to the oblique point as presented on the plate. I would also state that I have purposely omitted the metallic slide or guard to prevent the reflux of the liquor and flow of blood from the orifice, preferring rather the application of the finger of the operator for that purpose.

ART. XIX.—*François Huber.—Notice of his Life and Writings;* by A. P. DE CANDOLLE.

Translated for this Journal by PROF. GRISCOM.

EVERY thing which brings into view the surmounting of a great difficulty, is gratifying to the human mind. Those who are the least adventurous or inventive, are pleased with the exhibition of examples by which the bodily or mental strength of their fellow creatures has been enabled to conquer obstacles which appeared to be insuperable; and it is in a feeling of this nature, that all the wonderful tales of ancient times have had their origin. Those who are more accustomed to reflection, love to follow such examples into their details, and to study the process by which men of genius have succeeded in overcoming trials, or turning them to a good account. If such efforts are of short duration, they are admired as facts of fleeting occurrence; but if the obstacle is permanent, and the efforts continue unrelaxed, the admiration which is excited by a momentary burst of genius or energy is increased by the more profound sentiment which results from the contemplation of that sustained force, that voluntary and immovable patience which is the gift of so small a portion of our race. Such examples ought to be preserved for the honor of humanity, and for the encouragement of those who are inclined to turn aside at the prospect of difficulty. It is right to demonstrate, from time to time, to young people, that, if patience and resolution, are not, as some have asserted, the only elements of genius, they are at least its firmest auxiliaries, its most powerful instruments, and that they are faculties so important as to lead, not unfrequently, in the search of truth, to the same results as genius itself. These reflections, though they may perhaps appear at the first glance, to be somewhat pretending, will receive support from the history of the individual to whose memory this notice is devoted.

FRANCIS HUBER was born at Geneva, on the 2d of July, 1750, of an honorable family, in which vivacity of mind and imagination seemed hereditary. His father, John Huber, had the reputation of being one of the most witty men of his day, a trait which was frequently noticed by Voltaire who valued him for the originality of his conversation. He was an agreeable musician, and made verses which were boasted of even in the saloon at Ferney. He was distinguished for lively and piquant repartee; he painted with much facility and talent;* he excelled so much in the cutting out of landscapes, that he seemed to have been the creator of this art; his sculpture was better than that which those who are simply amateurs are able to execute,† and to this diversity of talent he joined the taste and the art of observing the manners of the animal creation. His work on the flight of birds of prey‡ is still consulted with interest by naturalists. John Huber transmitted almost all his tastes to his son. The latter attended from his childhood the public lectures at the college, and under the guidance of good masters he acquired a predilection for literature which the conversation of his father served to develope. He owed to the same paternal inspiration his taste for natural history, and he derived his fondness for science from the lessons of De Saussure, and from manipulations in the laboratory of one of his relatives who ruined himself in searching for the philosopher's stone. His precocity of talent was manifest in his attention to nature at an age when others are scarcely aware of its existence, and in the evidence of deep feeling at an age when others hardly betray emotions. It seemed that, destined to a submission to the most cruel of privations, he made, as it were instinctively, a provision of recollections and feelings, for the remainder of his days. At the age of fifteen, his general health and his sight began to be impaired. The ardor with which he pursued his labors and his pleasures, the earnestness with which he devoted his days to study, and his nights to the reading of romances by the feeble light of a lamp, and for which, when deprived of its use, he sometimes substituted the light of the moon, were, it is said, the causes which threatened at once, the loss of health and of sight. His father took him to Paris to consult Tronchin on account of his health, and Venzel on the condition of his eyes.

With a view to his general health, Tronchin sent him to a village (Stain) in the neighborhood of Paris, in order that he might be free from all disturbing occupations. There he practised the life of a simple peasant, followed the plough and diverted himself with all the

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* Several pictures of game, a kind in which he excelled, and his own portrait, are deposited in the Museum of fine arts, given by his family.

† A trait of his talent is preserved, which is indicative of his character. He is presenting a piece of bread to his dog, in such a way as to make him bite it off on all sides, and there issues from it a very striking bust of Voltaire.

‡ Observations sur le vol des oiseaux de proie; par M. Jean Huber. Geneve, in 4to, 1774.

rural concerns. This regimen was completely successful, and Huber retained, from this country residence, not only confirmed health, but a tender recollection and a decided taste for a rural life. He loved to narrate the hospitality of these good peasants, their mother wit, their kindness towards him, and the tears which flowed on his taking leave of them, not only from his own eyes, but from those of his male, and also, as it is said, his female acquaintance among the villagers.

The oculist Venzel considered the state of his eyes as incurable, and he did not think it justifiable to hazard an operation for cataract, then less understood than at present, and announced to young Huber the probability of an approaching and entire blindness.

His eyes, however, notwithstanding their weakness, had, before his departure and after his return, met those of Maria-Aimée Lullin, a daughter of one of the syndics of the Swiss Republic. They had been companions at the lessons of the dancing master, and such a mutual love was cherished as the age of seventeen is apt to produce. It had become almost a part of their existence, and neither of them thought it possible that any thing could separate them. The constantly increasing probability, however, of the blindness of Huber, decided M. Lullin to refuse his consent to the union; but as the misfortune of her friend and chosen companion became more certain, the more did Maria regard herself as pledged never to abandon him. She had become attached to him at first through love, then through generosity and a sort of heroism, and she resolved to wait until she had attained the lawful age to decide for herself, (the age of twenty five,) and then to unite herself with Huber. The latter perceiving the risk which his infirmity would probably occasion to his hopes, endeavored to dissimulate. As long as he could discern some light, he acted and spoke as if he could see, and often beguiled his own misfortune by such a confidence. The seven years thus spent made such an impression on him that during the rest of his life, even when his blindness had been overcome with such surprising ability as to furnish one of his claims to celebrity, he was still fond of dissembling; he would boast of the beauty of a landscape, which he knew of only by hearsay, or by simple recollection—the elegance of a dress—or the fair complexion of a female whose voice pleased him; and in his conversation, in his letters, and even in his books, he would say, *I have seen, I have seen with my own eyes.* These expressions, which deceived neither himself nor any one else, were like so many recollections of that fatal period of his life when he was daily sensible of the thickening of the veil which was constantly spread between him and the material world, and increased his fear not only of becoming entirely blind, but of being deserted by the object of his love! But it was not so: Miss Lullin resisted every persuasion, every persecution even, by which her father endeavored to divert her from her resolution, and as soon as she had attained her majority, she presented herself at the altar, conducted by her maternal uncle, M. Rilliet-Fatio, and leading, if we may so term it, herself, the spouse who in his happy and brilliant days had been her choice, and to whose saddened fate she was now determined to devote her life! A friend, a relation, an intimate confidant, was at her side;—that friend was my mother, and the story of this wedding of love and devotion, often related to me by her in my youth, is connected in my heart with the sweetest of my recollections.

Madame Huber proved, by her constancy, that she was worthy of the energy which she had manifested: during the forty years of their union, she never ceased to bestow upon her blind husband, the kindest attention; she was his reader, his secretary, his observer, and she removed, as far as possible, all those embarrassments which would naturally arise from his infirmity. Her husband, in alluding to her small stature, would say of her, *mens magna in corpore parvo. As long as she lived,* said he also, in his old age, *I was not sensible of the misfortune of being blind.*

This affecting union has been alluded to by celebrated pens. Voltaire often noticed it in his correspondence, and the episode of the Belmont family, in *Delphine,** is a true description, though somewhat glossed, of Mons. and Madame Huber. What can I add to a picture traced by such masters! Let me hasten then to the works which have placed Huber in the rank of savans.

We have seen the blind shine as poets, and distinguish themselves as philosophers and calculators; but it was reserved for Huber to give a lustre to his class in the sciences of observation, and on objects so minute that the most clear sighted observer can scarcely distinguish them. The reading of the works of Reaumur and Bonnet, and the conversation of the latter, directed his curiosity to the history of bees. His habitual residence in the country, inspired him with the desire, first of verifying some facts, then of filling some

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* *Delphine,* par Madame de Staël, III partie, lettre XIX.

blanks in their history; but this kind of observation, required not only the use of such an instrument as the optician must furnish, but an intelligent assistant, who alone could adjust it to its use. He had then a servant named Francis Burnens, remarkable for his sagacity and for the devotion which he bore for his master. Huber practised him in the art of observation, directed him in his researches by questions adroitly combined, and aided by the recollections of his youth and by the testimonials of his wife and friends, he rectified the assertions of his assistant, and became enabled to form in his own mind a true and perfect image of the minutest facts. *I am much more certain,* said he one day to me, smiling, *of what I state, than you are, for you publish what your own eyes only have seen, while I take the mean among many witnesses.* This is doubtless very plausible reasoning, but it will hardly render any one mistrustful of his own eyes! He discovered that the nuptials, so mysterious and so remarkably fruitful of the queen bee, the only mother of the tribe, never take place in the hive, but always in the open air, and at such an elevation as to escape ordinary observation,—but not the intelligence of a blind man, aided by a peasant. He gives a detailed account of the consequences of the early and the late periods of this aerial hymen. He confirmed, by multiplied observations, the discovery of Schirach, until then disputed, that bees can transform, at pleasure, the eggs of working bees into queens, by appropriate food; or, to speak more precisely, neuters into females; he showed also how certain working bees are able to lay fertile eggs. He described with much care the combats of queen bees with each other, the massacre of drones and all the singular occurrences which take place in a hive when a strange queen is introduced as a substitute for the natural queen. He showed the influence which the dimensions of the cells exert upon the shape of the insects which proceed from them,—he related the manner by which the larvæ spin the silk of their cocoons; he proved demonstratively that the queen is oviparous; he studied the origin of swarms, and was the first who gave a rational and accurate history of those flying colonies. He proved that the use of the antennæ is to allow the bees to distinguish each other, and from the intimate knowledge he had acquired of their policy, he prescribed excellent rules for their economical administration. The greater number of these delicate observations, and which had escaped his predecessors, were due to his invention of various forms of glass hives. One of these, which he called the book or leaf hive, and another which he denominated the flat hive, permitted him to observe the labors of the community in their minutest details, and to follow each bee in its operations. They were greatly facilitated by the skill of Burnens and by his zeal in the search of truth; he braved, without hesitation, the anger of a whole hive, in order to discover the least fact, and he would seize an enormous wasp's nest, in spite of the painful attacks of the whole horde which defended it. We may judge from this of the enthusiasm which his master, (and I here employ the term in the sense, not of the relation of a master to his domestic, but of that of an instructor to his pupil,) we may judge, I say, of the enthusiasm in favor of truth or fact, with which Huber was able to inspire his agents.

The publication of these works took place in 1792 in the form of letters to Ch. Bonnet, and under the title of "*Nouvelles Observations sur les Abeilles.*"* This work made a strong impression on many naturalists, not only from the novelty of the facts, but from their rigorous exactness, and the singular difficulty against which the author had struggled with so much ability. Most of the Academies of Europe, (and especially the Academy of Sciences of Paris) admitted Huber, from time to time, among their associates;—the poet Delille† celebrated his blindness and his discoveries, and from this time he was placed in the first rank among the most skilful, I was going to say, the most clear sighted observers.

The activity of his researches was relaxed neither by this early success which might have satisfied his self-love, nor by the embarrassments which he suffered in consequence of the revolution, nor even by a separation from his faithful Burnens. Another assistant of course became necessary. His first substitute was his wife, then his son, Pierre Huber, who began from that time to acquire a just celebrity in the history of the economy of ants, and various other insects, commenced his apprenticeship as an observer, in assisting his father. It was principally by his assistance that he made new and laborious researches relative to his favorite insects. They form the

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* See the seventh chant in the poem des *Trois Règnes*, which begins with

Enfin de leur hymen savant dépositaire,
L'aveugle Huber l'a vu par les regards d'autrui,
Et sur ce grand problème un nouveau jour a lui, &c.

† One Vol. 8vo. Geneva. Another edition was printed in Paris in 1796 in one volume, 12mo.; in which a short practical treatise on the management of bees was anonymously subjoined to the work of Huber.

second volume of the second edition of his work published in 1814, which was edited in part by his son.

The origin of the wax, was at that time, a point in the history of bees much disputed by naturalists. By some it was asserted, though without sufficient proof, that it was fabricated by the bee from the honey. Huber, who had already happily cleared up the origin of the *propolis*, confirmed this opinion with respect to the wax by numerous observations, and showed very particularly, with the aid of Burnens, how it escaped in a laminated form from between the rings of the abdomen.* He instituted laborious researches to discover how the bees prepare it for their edifices; he followed step by step the whole construction of those wonderful hives, which seem, by their perfection, to resolve the most delicate problem of geometry; he assigned to each class of bees the part it takes in this construction, and traced their labors from the rudiments of the first cell to the completed perfection of the comb. He made known the ravages which the *Sphinx atropos* produces in the hives into which it insinuates itself;† he even endeavored to unravel the history of the senses of bees, and especially to examine the seat of the sense of smell, the existence of which is proved by the whole history of these insects, while the situation of the organ had never been determined with any certainty. Finally, he prosecuted a curious research into the respiration of bees. He proved by very many experiments that bees consume oxygen gas like other animals. But how can the air become renewed, and preserve its purity, in a hive plastered with cement, and closed on all sides except at the narrow orifice which serves for a door? This problem demanded all the sagacity of our observer, and he at length ascertained that the bees, by a particular movement of their wings, agitated the air in such a way as to effect its renovation;—and having assured himself of this by direct observation, he further proved its correctness by means of artificial ventilation.

These experiments on respiration required some analysis of the air of hives, and this circumstance brought Huber into connection with Sennebier, who was much engaged in analogous researches with respect to vegetables. Among the means which Huber had con-

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* The works of Huber on this subject appeared in the Bib. Britannique, under the title of Premiere memoire sur l'origine de la Cire, T. XXV, p. 59; but they have been resumed and extended in the second edition of his researches.

† This part of his researches had already appeared in the Bibliotheque Britannique, in 1804, t. XXVII, pp. 275 and 358, under the title of *letter to M. Pictet.*

ceived for ascertaining the nature of the air of hives, was that of causing certain seeds to germinate in it, founded on a vague opinion that seeds will not sprout in air much deprived of oxygen. This experiment, imperfect as it respects the direct object in view, united the two friends in the engagement of pursuing their researches into the nature of germination, and a curious fact with respect to this association between a blind man and one of clear vision is that more frequently it was Sennebier who suggested the experiments and Huber that performed them. Their works have been published in their joint names, under the title of "*Memoirs on the influence of Air in the Germination of Seeds.*" They fully demonstrated the necessity of oxygen gas in germination, the impossibility of success in a medium deprived of free oxygen, and the formation of carbonic acid, by the combination of this oxygen with the carbon of the grain. This work, conceived principally by Sennebier and edited by him, has but little of the impress of Huber, and it is evident that in separating himself from his loved bees, he took less interest in other researches.

This perseverance of a whole life in a given object is one of the characteristic traits of Huber, and probably one of the causes of his success. Naturalists are divided from taste, and often from position, into two series,—the one love to embrace the *tout ensemble* of beings, to compare them with each other, to sieze the relations of their organization, and to deduce from them their classification and the general laws of nature. It is this class who have necessarily at their disposal, vast collections, and they mostly dwell in large cities: the others take pleasure in the profound study of a given subject, considering it under all its aspects, scrutinizing into its minute details, and patiently following it in all its peculiarities:—the latter are generally sedentary and isolated observers, living remote from collections, and far from great cities. The former may be charged with the neglect of details in consequence of their attention to extensive generalities. The second, from being circumscribed in a limited circle, may be disposed to exaggerate its importance, and hence to judge incorrectly of the connection of parts in the entire series. But such mutual accusations are in reality idle. Natural history requires both these classes, in the same manner as the architect stands in need of the stone cutter for the preparation of his materials, and the stone cutter requires the science of the architect in the construction of the well planned edifice.

Huber is evidently to be placed in the school of special observers; his situation and infirmity retained him in it, and he acquired therein an honorable rank by the sagacity and precision of his researches; but it is plainly perceptible, in reading his works, that his brilliant imagination urged him toward the region of general ideas. Unprovided with terms of comparison, he sought them in that theory of final causes which is gratifying to every expanded and religious mind, because it appears to furnish a reason for a multitude of facts, the employment of which, however, as is well known, is prone to lead the mind into error; but we must do him the justice to acknowledge that the use he makes of them is always confined within the limits of philosophical doubt and observation. He had, in early life, derived ideas of this general nature from the *Natural Theology* of Derham, and from the writings of his friend Ch. Bonnet; they found a ready reception in his sensitive and elevated soul, which loved to admire the author of nature in the harmony of his works. His style is, in general, clear and elegant; always retaining the precision requisite to the didactic, it possesses the attraction which a poetic imagination can readily confer upon all subjects; but one thing which particularly distinguishes it, and which we should least expect, is, that he describes facts in a manner so picturesque, that in reading him, we fancy that we can see the very objects which the author, alas, was never able to see! In reflecting on this singular quality in the style of a blind man, the difficulty appeared to be solved in thinking of the efforts which he must have made in arranging and connecting the statements of his assistants, so as to form in his own mind a complete image of the facts. We who enjoy, often with so much indifference, those invaluable senses by which we are enabled to embrace at once such a diversity of objects, and so many parts of the same object, often neglect to study those parts upon which others are dependent, and which ought to claim the first place in the explanation; our descriptions are often confused, precisely because our impressions of objects are made simultaneously and without effort. But Huber was obliged to listen with attention to the recitals of others, to class them methodically to reproduce an image of the object by his own conceptions; and his written narration, after this laborious operation, presents the subject to our view, under all the aspects which have enlightened his own. I venture also to add that we find in his descriptions so many masterly touches, as to justify the conclusion, that if he had retained his sight he would have been like his father, his brother* and his son, a skillful painter.

* Jean Daniel Huber, a skillful painter of animals.

His taste for the fine arts, unable to derive pleasure from forms, extended to sounds; he loved poetry, but he was more especially endowed with a strong inclination for music. His taste for it might be called innate, and it furnished him with a great source of recreation throughout his life. He had an agreeable voice, and was initiated in his childhood in the charms of Italian music. The method by which he studied tunes deserves to be related, as it may be useful to others. "It was not by simple recollection," his son writes me, "that he retained airs; he had learned from Grétry the counterpoint in a dozen lessons, and in studying by himself, he had become an able harmonist. In teaching him an air, we first dictated to him the base of a musical phrase; he arranged it according to the succession of tones; then came the song which he executed with his voice; a phrase thus disposed he understood perfectly, and a single repetition was sufficient: we proceeded to the second, and so on to the end of the piece, which he would then repeat from one end to the other without tiring the patience of any one who dictated to him: he owed much in this respect to the complaisance of his sister."

His musical talents rendered him in his youth extremely popular, and after his infirmity, it afforded him many agreeable relations, among whom may be mentioned those which he held, at an advanced age, with a female noted for her wit, and between whom there was the double sympathy of being passionately fond of music and being blind.

The desire of maintaining his connection with absent friends, without having recourse to a secretary, suggested the idea of a sort of printing press for his own use; he had it executed by his domestic, Claude Léchet, whose mechanical talents he had cultivated, as he had before done those of Francis Burnens for natural history. In cases properly numbered, were placed small prominent types which he arranged in his hand. Over the lines thus composed he placed a sheet blackened with a peculiar ink, then a sheet of white paper, and with a press which he moved with his feet, he was enabled to print a letter which he folded and sealed himself, happy in the kind of independence which he hoped by this means to acquire.* But the difficulty of putting this press into action, prevented the habitual use of it. These letters and some algebraic characters formed of

* I am indebted for these details, as well as others, here and there stated, to his nephew M. J. Huber, who is distinguishing himself by his literary talents.

baked clay, which his ingenious son, always anxious to serve him, had made for his use, were, during more than fifteen years, a source of relaxation and amusement to him. He enjoyed walking, and even a solitary promenade by means of threads which he had caused to be stretched through all the rural walks about his dwelling. In following them by his hand, he knew his way, and by small knots in the thread he was warned of the direction he was taking, and of his exact position.

The activity of his mind rendered these diversions necessary. It might have rendered him the most unhappy of men, if he had been less favorably connected: but all who lived with him, had no other thought than that of pleasing him and contributing to relieve his infirmity. Naturally endowed with a benevolent heart, how were those happy dispositions too often destroyed by the collisions of the world, preserved in him? He received from all that surrounded him nothing but kindness and respect. The busy world, the scene of so many little vexations, had disappeared from his view. His house and his fortune were taken care of without any embarrassment to him. A stranger to public duties, he was in a great measure ignorant of the politics, the cunning, and the fraud of men. Having rarely had it in his power, (without any fault of his own,) of being useful to others, he never experienced the bitterness of ingratitude. Jealousy, even notwithstanding his success, was silenced by his infirmity. To be happy and prosperous in a situation in which so many others are given up to continual regrets, was accounted to him as a virtue. The female sex, provided their voices were agreeable, all appeared to him as he had seen them at the age of eighteen. His mind preserved the freshness and candor which constitute the charm and happiness of adolescence; he loved young people, for with their sentiments his own were more in accordance than with those of the aged and experienced. He took pleasure, to the very last, in directing the studies of the young, and possessed in the highest degree, the art of pleasing and interesting them. Though fond of new acquaintance, he never abandoned his old friends. "*One thing I have never been able to learn*," said he in his extreme old age, "*and that is, to forget how to love*." Thus had he the good sense justly to appreciate and enjoy the balance of advantages which were furnished him by the very condition in which he was placed. He appeared to be afraid, either of the loss of many of his illusions, or of the excitement of hopes in which he might be deceived, for he always repelled the proposition of having a portion of his sight restored by an operation on one of his eyes which appeared to be affected only by simple cataract; the other was blinded from gutta serena, which rendered it incurable.

Far be it from me, nevertheless, to attach too high a value to the compensations which he himself found in his infirmity, and for not having put into requisition the nobility and courage of his philosophy. He never was the first to speak of his misfortune, and was disposed to avoid the idea of it. He never complained, and his strong and enlightened mind ranked courage and resignation, and cheerfulness among his primary duties.

His conversation was generally amiable and gracious; he was easily led into the humorous; he was a stranger to no kind of knowledge; he loved to elevate his thoughts to the gravest and most important subjects, as well as to descend to the most familiar sportiveness. He was not learned in the ordinary sense of the word, but like a skilful diver, he went to the bottom of each question by a kind of tact and a sagacity of perception, which supplied the place of knowledge. When any one spoke to him on subjects which interested his head or heart, his noble figure became strikingly animated, and the vivacity of his countenance seemed, by a mysterious magic, to animate even his eyes which had so long been condensed to darkness. The sound of his voice had always something of the solemn. *I now understand*, said a man of wit to me one day, who had just seen him for the first time, *I understand how young people willingly grant to the blind, the reputation of supernatural inspiration.*

Huber spent the last years of his life at Lausanne, under the care of his daughter, Madame de Molin. He continued to make additions, at intervals, to his former labors. The discovery of bees without stings, made in the environs of Tampico, by Capt. Hall, excited his curiosity, and it was a high satisfaction to him when his friend Prof. Prevost procured for him, at first a few individuals, and then a hive of these insects. It was the last homage which he rendered to his old friends, to whom he had devoted so many laborious researches, to whom he owed his celebrity, and what is more, his happiness. Nothing of any importance has been added to their history, since his time. Naturalists of unimpaired vision have found nothing of consequence to subjoin to the observations of a brother who was deprived of sight.

Huber retained his faculties to the last. He was loving and beloved to the end of his days. At the age of eighty one, he wrote to one of his friends; *there is a time when it is impossible to remain neglectful; it is, when separating gradually from each other, we may reveal to those we love, all that esteem, tenderness, and gratitude have inspired us with towards them.* * * * *I say to you alone,* adds he farther on, *that resignation and serenity are blessings which have not been refused me.* He wrote these lines on the 20th of December last; on the 22d he was no more; his life became extinct without pain or agony while in the arms of his daughter.

I have always admired the sagacity of his researches, his resolute perseverance, his love of truth, and his resignation at once mild and stoical. I loved his amiable conversation, and his benevolent disposition. While living, I consecrated his name to the gratitude of naturalists by giving it to a genus of beautiful trees from Brazil.* I have now endeavored to render the last homage to his memory; happy shall I be if those who have known and loved him, find the portrait correct, —if young people learn from his example the value of resolute determination in the direction and concentration of labor; and especially if those who are subject to the same misfortune, should learn, by the example of Huber, not to yield to discouragements on account of their condition, but to imitate his admirable philosophy.

Bib. Univ. Fév. 1832.

Art. XX.—*On the Uses of Chlorides and Chlorine;* by A. Chevallier.

Translated for this Journal by Prof. Griscom.

The employment of chlorine and chlorides in the arts of salubrity, in therapeutics, &c. has been so multiplied of latter time, it is conceived that benefit will arise from a statement of their uses at the present period.

1. The use of chloride of lime in destroying the *odor of fresh paint.* For this purpose the chloride is found to be effectual. *Method.* Provide shelves or boards about three feet long and two wide. Over them spread some hay slightly moistened. Powder this hay with the chloride, and leave it a few days in the apartment

* Huberia laurina. Memoir on the Melastomaceæ, p. 61, pl. 10. Prodr. 3. p. 167.

newly painted, and carefully closed. The chlorine emanating from the chloride from the decomposing action of the carbonic acid of the atmosphere will spread through the apartments and neutralize the odor of the paint.

If it be desirable also to remove the dampness of the apartment, a few pieces of chloride of calcium, (or muriate of lime,) placed, in earthen dishes in the room, will answer the purpose.

It is wrong, in such a case, to use fresh lime, along with the chloride, because the latter is effectual only in proportion as the chlorine is disengaged by the action of the carbonic acid and moisture of the air, and the presence of quick lime only serves to attract the same things, and therefore to retard the decomposition of the chloride.

The same purpose, as it regards odor, may be effected by the separation of chlorine gas, by placing an earthen cup, containing an ounce of oxide of manganese and three ounces of hydrochloric (muriatic) acid, on a hot brick, or over a furnace with a few live coals, or in a vessel of hot water, stirring the materials, and closing the apartment for twenty four hours.

By heating in the same manner chloride of lime, dissolved in or mixed with water sharpened with sulphuric acid, the same purpose is effected.

2. The use of chloride in correcting the unhealthiness of *manufactories of cat-gut*, or other *fabrics from animal materials.*

Manufactories of this nature are apt to emit a highly disagreeable odor. The free use of chlorine, liberated in the way above indicated, will effectually correct the unhealthy emanations.

3. In disinfecting *the mud and filth of sewers.*

Agreeably to the experimental investigations of a committee chosen by the police, it appears that it would require 576 grammes of dry chloride of lime to disinfect one cubic foot of semi-fluid mud, weighing 10 kilogrammes, or 620 grammes of chloride, one foot of more solid filth weighing 10 kilogrammes 50 decagrammes.

The expense, therefore, deduced from these data, of disinfecting sewers which have become very foul, is considered to be too great, even at the reduced price of chloride of lime, and they therefore prefer the purification by ventilation through the agency of fire.

4. In disinfecting the air of rooms in *which silk worms are kept.*

The experiments of M. Bonafous, very carefully conducted, have proved that silk worms, exposed to the putrid exhalations of their litter and excrements, to the odor of dead worms, &c. will be injured or destroyed by these and other unwholesome effluvia, much sooner than if their apartments are seasoned by the corrective influence of chlorine. The gas, however, must be very gently and slowly liberated, or its effects will be too powerful. The method recommended is to place in a dish or vessel one part of chloride of lime and about thirty parts of water, or an ounce of chloride with a quart of water, with such a quantity of worms as will issue from an ounce of grains, (eggs.) Stir the materials, and when precipitated, renew the water, and repeat the operation two or three times in twenty four hours, as necessity requires. The chloride is to be changed only as it ceases to yield an odor.

In this operation it appears that the carbonic acid arising from the fermenting materials, unites with the lime, and sets the chlorine free, which by its avidity for hydrogen, decomposes the miasms which it meets with.

This mode of fumigation does not remove the necessity of frequently renewing the air of the chambers, and of promoting its currents by fires.

5. In removing from *urine and the vessels employed to receive it,* the disagreeable odor emitted from them.

It is well known that the odor of urine, (which is at first aromatic, and often partakes of the smell of the food, especially after eating asparagus, cauliflowers, peas, &c.) becomes exceedingly repulsive and communicates its effects to the vessels employed with it.

These odors are completely removed by a small portion of chlorine. Thus, half a gallon of urine which would not lose all its odor by being treated with four ounces of acetic acid, would yield it by the addition of six, eight, or at most ten drops of chlorine or chloride of lime.

If night tables and other utensils of a room which may have absorbed the odor of urine contained in chamber vessels be washed with a sponge dipped in a solution, prepared by adding an ounce of chloride of lime to a gallon of water, they will be preserved from taint.

6. In destroying *the gases which blacken silver and bronze vessels, and varnish containing metallic oxides.* It has happened that in emptying privies and in other analogous operations, the effluvium has produced disagreeable effects on furniture and metallic surfaces. This may be completely prevented by suspending cloths soaked in a solution of chloride in the apartment, or placing them in the apertures through which the gas issues.

It has happened that in our two manufactories of porcelain ware, the white enamel of the vessels, by being incidentally exposed to a rupture of foul emanations of this nature before it was perfectly dry, has become very much discolored. A remedy has been found in opposing solutions of chlorine to the current of sulphuretted hydrogen, although the emanations have continued for weeks together.

7. In destroying *emanations that may occasion a plague.*

M. Felix D'Arcet, a member of the committee sent to Egypt in order to make experiments relative to the plague, furnished M. de Lasteyrie with the following details extracted from a letter from Tripoli of June 14, 1829.

"The most important point to be determined was whether the pestilential virus could resist the action of the chlorides.

"The Vice Consul of France obtained for us six garments of persons who had died of the plague, all within the last two days. These garments were soiled with blood, sanies, and sweat. After the Consul had taken an account of their condition, I immersed them during sixteen hours, in a solution of chloride of sodium, and after drying them, each of us put on a shirt next to our skin, and then the remains of the dress. The spots still existed on them but much faded. We slept in these garments, and after wearing them eighteen hours, replaced them. It is a week since the experiment, and neither of us have experienced the least change. Our natural constitutions are also, it may be remarked, very different."

It was proposed by M. Pariset that the effect of chlorine should be tried on other contagious diseases, and accordingly three experiments were made with it, in relation to the measles. The chamber of a child, exposed to the measles, was disinfected, and his shirt was dipped in a solution of one ounce of liquid and concentrated chloride of lime, and three gallons of water. When dried it exhaled, very slightly, the odor of chlorine.—He escaped the infection.

8. In the *cure of epidemic diseases among dumb creatures.*

In 1829 an epidemic malady broke out among fowls in the vicinity of Paris. The disease spread rapidly, manifesting itself by an inflammation of the head, tears in the eyes, blueness of the skin, and the issue of blood from the beak. The animals soon sunk under it. Bleeding and other means of restoration were employed without effect. The author being consulted, directed the chickens which were still unaffected, to be placed in an enclosure by themselves, and those on which the disease had made some progress, in another enclosure.

These places being then sprinkled with chloride of lime, the healthy fowls remained healthy, and the others were successively restored to health.

The same remedy was applied by M. Capliu, at Vaugirard. The healthy fowls were preserved from the epidemic, and the sick were soon restored.

The solution employed on these occasions was prepared by adding two ounces of chloride of lime to half a gallon of water, carefully mixing, filtering the solution, preserving it in well closed bottles, and using it as occasion required. The cause of this Epizootic was not ascertained, but it was perceived that the fowls which were confined in roosts exposed to the north were not attacked by it.

In a letter from M. Recluz, pharmacien at Vaugirard, it is stated that during an epidemic among the fowls at that place, it was found that those feeders who were careful to keep their fowl-yards clean, and who put clean straw in their roosts and stables, preserved their stock from the attack, whence it was inferred that the disease arose from the effluvia of putrefaction from the dung which was suffered to accumulate on the floors. In one instance fifteen fowls out of twenty three had died of the infection and three more were sick. The yard or roost was then well cleaned, washed with common water, and then sprinkled twice a day with a solution of one ounce of chloride in a pint of water. From that time not a fowl died. Similar results were obtained by other persons, one of whom stated that when he commenced the use of the chlorides, all his fowls were sick, and from the time of the first sprinkling with it they all recovered. M. Recluz regrets very much that he had not had recourse to the same remedy in a disease among cows at Vaugirard. A single dairy man lost nine of his cows in two months, without perceiving whence the sickness proceeded.

The chloride has also been successively used in disinfecting the pens or casks in which rabbits are kept. The solution is applied with a brush, and the casks are drained before the rabbits are returned. Some which were very sick and refused to eat, were restored promptly by this disinfection.

9. In *the treatment of tainted fish.*

When tainted fish are treated with chlorine, they are said to exhale an odor of bromine; but the author states than on applying chloride of lime to a spoiled turbot, the odor was different both from that of chlorine and of bromine. The fish was washed, and on being cooked the smell disappeared, and it was eaten. Whence he infers that the odor from fish disinfected by chloride is not injurious to the health like that from putrid fish.

The baskets and other utensils used by fishermen may be deprived of the unpleasant odor which they contract, by the use of the chlorides.

10. *In the exhumation and removal of bodies which have been for some time buried.*

It is proposed that on occasions of this nature, when putrefaction has doubtless occurred, after opening the grave, to water the excavation and ground adjacent with a strong solution of chloride, to lay a cloth wet with the solution over the coffin, to place the coffin in a box on the bottom of which is a layer six inches thick, of a mixture of fifteen parts of charcoal in coarse powder, and one part of dry chloride of lime, and to surround the sides and top with the same mixture. With such a precaution the exhumation and removal to a great distance of a corpse long buried may be safely effected.—*Jour. de Connaissances Usuelles, tome* 12, *p.* 65.

Art. XXI.—*Action of Chloride of Lime on Alcohol; by* M. E. Soubeiran.

Translated for this Journal, by Prof. Griscom.

The interesting substance formed by the action of chloride of lime on alcohol, first manufactured, in considerable quantity, by Samuel Guthrie, at his laboratory on Lake Ontario, and made known to the chemists and physicians of this country through the medium of this Journal, possesses properties which will render the following investigation acceptable to our readers.

"When chlorine is passed through alcohol, the products are hydrochloric acid, a little carbonic acid, a small quantity of a material rich in carbon, and a peculiar ethereal fluid, constituted, agreeably to the analysis of Despretz, of 1 atom of chlorine and 2 atoms of percarburetted hydrogen.

In the supposition that the compounds called *chlorures d'oxides* are really combinations of chlorine with oxygenated bases, the same products ought to be obtained by bringing *them* into contact with alcohol, the acids being saturated as fast as they are formed.

To be certain of this, I mixed a solution of chloride of lime, very concentrated, with alcohol; the mixture grew warm and an odor of chlorine was manifest; in raising it to ebullition, an abundant white precipitate was formed, and a liquid passed over, of a very sweet odor and a sugary taste.

The matter remaining in the retort was alkaline, and the precipitate effervesced with acids. It was carbonate of lime, mixed with a little caustic lime. Not the least portion of carbonic acid was disengaged during the action.

The distilled product being redistilled or rectified, a weak alcohol remained in the retort, and the distilled fluid had a more penetrating ethereal odor. The following process will ensure a notable quantity in a state of purity.

Into a retort of the capacity of about a gallon, introduce a mixture of 1 part alcohol at 33°, and from 30 to 32 parts of very concentrated liquid chloride of lime, (1 part, by weight, of chloride and 5 of water;) attach a receiver, which must be kept cool, apply heat to the retort and as soon as ebullition commences, withdraw the fire, as the distillation will then proceed without it. The process must be stopped when no more ethereal fluid passes over.

In the receiver are two distinct strata; the heavier is the new ether,—the lighter is a solution of that substance in weak alcohol. The whole is to be shaken with a little mercury, to absorb a small quantity of free chlorine; it is then placed in a retort, to which are added the rinsings of the receiver, with a little water, and distilled afresh from the heat of a water bath. The ether is thus obtained, with a supernatant fluid of weak etherized alcohol, which may be reserved for a new rectification.

The new ether is not pure. The alcohol which it contains may be removed, by agitating it several times with water, and finally allowing the water to remain in contact, several hours, with plenty of dry muriate of lime, and then distilling at a temperature not exceeding 160° F.

It is proper to observe, that the chloride of lime which is used in the making of this ether, must be limpid, or at least must contain but very little lime in suspension, otherwise the mass will swell very much. I have endeavored to avoid such a mass of fluid, by using a cream of the chloride of lime, but it was almost impossible to conduct the distillation.

This new etherized liquor is a compound different from all those hitherto observed by chemists. Its elements are chlorine, hydrogen and carbon. Various experiments which have been made upon it, prove that it contains no oxygen.

The decomposition of it, by means of oxide of copper, has proved to me the relation of its component parts. It is extremely difficult to effect the combustion of its hydrogen and carbon, doubtless on account of the great quantity of chlorine that it contains.

After a careful analysis, the author determines that this ether is composed of

1	atom of	carbon,	14.39
2	"	hydrogen,	2.35
2	"	chlorine,	83.26
			100.00

It may be considered as a compound of chlorine and per-carburetted hydrogen, and may be provisionally called bi-chloric ether.

The bi-chloric ether is an ethereal liquid, very limpid, and colorless, with a penetrating and very sweet odor. When breathed, the vapors which penetrate to the palate develope a taste decidedly saccharine. It may almost be said to have a saccharine odor. Its density is greater than water, and its boiling point is 158° F.

It cannot be burned alone in contact with air. If used in a lamp, the cotton wick does not kindle until all the ether is evaporated. In directing a jet of its vapor on the flame of a spirit lamp, it burns and diffuses much smoke. It may easily be kindled when mixed with an equal volume of alcohol. It then gives out a black and thick smoke, of a penetrating odor, and the soot which it deposits, washed with water, is acid, and forms an abundant precipitate with nitrate of silver. Paper of tournesol, moistened with this etherized alcohol, is reddened on the spots which have been burned.

Water dissolves very little of it, and acquires a saccharine taste. Alcohol mixes with it in every proportion ; and if the alcohol is not very concentrated, and the ether be mixed with it in suitable proportions, a saccharine liquor is obtained of a very agreeable aromatic flavor.

Iodine dissolves in the new ether, and does not appear to alter it.

Potassium decomposes it at common temperatures ; the action is very slow ; and hydrogen, containing some carbon, is disengaged.

Barytes and lime decompose it with heat. At the moment of reaction, they become incandescent. A metallic chloride is formed, carbon is deposited, and an inflammable gas, with aqueous vapor, is disengaged.

A concentrated solution of caustic potash produces a slow decomposition of the chloric ether. Mixed with an equal volume of alcohol, the addition of the caustic potash produces instantaneous decomposition when slightly heated. The action is strong, and there is formed along with chloride of potassium, an oily matter, which separates on the addition of water. It is of a yellow color, and its odor aromatic, and somewhat like that of cummin. It is volatile.

Sulphuric acid appears to exert no action on bi-chloric ether. In heating the latter with nitric acid, vapors of nitrous acid are very slightly exhaled. Hydrochloric acid does not change it even with heat. Nitrate of silver appears not to decompose it; at least a mixture of alcohol and ether with nitrate of silver produced no deposit in the course of a month, of chloride of silver.

The memoir of M. Soubeiran is extended to the investigation of various other compounds of chlorine, of which our limits will not admit the detail. The summary of his results is as follows:—

1. That the gas called protoxide of chlorine, is a mixture of chlorine with the deutoxide of chlorine.

2. That the compounds known under the name of chlorides of oxides, (chlorures d'oxides,) are mixtures of a metallic chloride, (chlorure metallique,) with a chlorite.

3. That chlorous acid, (acide chloreux,) is without doubt formed of two volumes of chlorine and three volumes of oxygen.

4. That mineral or organic substances brought into contact with chlorites, become oxidized by the oxygen of the chlorous acid, and sometimes by that of its base.

5. That the bleaching by chlorites results from an oxygenation of the elements of the coloring matter by the oxygen of the chlorous acid.

6. That chlorine has a power of decoloration, greater than that of the chlorites.

7. That chloride of lime, in decomposing alcohol, gives rise to a new ether, represented by two atoms of chlorine and one atom of per-carburetted hydrogen.

8. That chlorous acid and ammonia can unite without decomposition, but that the compound which they form, is changed by water into chlorine and azote.

9. That the oxide of chlorine, obtained by the method of Stadion, is composed of one volume of chlorine and two volumes of oxygen, and is the same as that obtained by Davy.

10. That the chlorous acid may become a constituent part of an ether which is singularly disposed to a transformation into acetic ether.—*Annales de Chim. et de Phys. Oct.* 1831.

Art. XXII.—*Vegetable Physiology in relation to Rotation of Crops;* by M. Macaire.

Translated for this Journal by Prof. Griscom.

In a memoir inserted in the transactions of the *Societé de physique et d'histoire naturelle of Geneva,* this gentleman has developed some physiological facts, interesting to science and to practical agriculture.

A judicious rotation of crops is known to be a matter of great importance. One kind of vegetable (A) will grow and flourish well in a soil from which another kind of vegetable (B) has just been gathered, while an attempt to raise another crop of the first vegetable (A), or a crop of a third vegetable (C) immediately after the first (A) in the same soil will be attended with little or no success. The discovery of this fact which is almost as ancient as agriculture itself, is supposed to have led to the practice of fallowing. A piece of fallow ground will, almost to a certainty, be covered with a crop of weeds. These being plants of a different nature, do not unfit the soil, but prepare it for a succession of the same crop as that which preceded them. But science or experience has taught the enlightened farmer to substitute useful plants in the room of weeds, and thus to keep his grounds in profitable activity.

Various reasonings have been employed to account for the necessity of this rotation. 1st. That different plants absorb different juices from the same soil, and that a piece of ground exhausted by culture, may still be rich for another class of vegetables. But it is known to physiologists, that plants absorb all the soluble substances that the soil contains, whether injurious to their growth or not. 2d. That the roots of different plants being of different lengths, extend into different layers of the soil, and thus derive from it appropriate nourishment.

But the roots of all plants, at the period of germination, must be in the same stratum, and of course be equally dependent upon it; and besides, the culture of the farmer turns up and mixes the various layers of the soil together, so as to render them, in all probability, homogeneous. It is known also that plants of the same family, such as clover (trèfle) and lucerne do not prosper in succession, although their roots are of very different lengths.

The true explanation of the necessity of rotation, appears to be founded on the fact stated by Brugmans, and more fully exposed by De Candolle, that a certain portion of the juices which are absorbed by the roots of plants, are, after the salutiferous portions have been extracted by the vessels of the plant, again thrown out, by exudation, from the roots and deposited in the soil. It is probably the existence of this exuded matter, which may be regarded, in some measure, as the excrement of the preceding crop of vegetables, that proves injurious to a succeeding vegetation. It has been compared to an attempt to feed animals upon their own excrements. The particles which have been deleterious to one tribe of plants cannot but prove injurious to plants of the same kind, and probably to those of some other kinds, while they may furnish nutriment to another order of vegetables.*

The author endeavored to subject these theoretic views to the test of experiment. After various attempts to raise plants in pure siliceous sand, pounded glass, washed sponge, white linen, &c. he decided upon pure rain water. After cleansing and washing the roots thoroughly, he placed them in vials with a certain quantity of pure water. After they had put forth leaves, expanded their flowers and flourished for some time, he ascertained, by the evaporation of the water, and the use of chemical reagents, that the water contained matter which had exuded from the roots. He satisfied himself that this is the fact with respect to nearly all the phanerogamous plants.

Several plants of Chondrilla muralis, perfectly clean, were placed with their roots in pure water. At the end of a week, the water was yellowish and emitted an odor like opium, and had a bitter taste. Sub-acetate and acetate of lead produced a brownish flocculent precipitate, and a solution of gelatine disturbed its transparency. As a

* I have been assured, by farmers, of a fact somewhat analogous in relation to animals. Hay, which has been left in the manger of a horse, or which has otherwise received the impregnations of his breath, will not be touched by another horse, but will be freely eaten by cows or sheep.—G.

proof that this matter was the result of excretion from the roots, it was found that neither pieces of the root nor of the stem, when macerated in the water during the same time, occasioned either taste, smell, or precipitate.

To determine at what period, whether night or day, this discharge from the roots takes place, a plant of common bean (Phaseolus vulgaris) was carefully cleaned, placed in rain water and kept a week during the day time in one vessel, and during the night in another, being well wiped at each transfer. In both the fluids there were evident marks of excretion from the roots, but that in which the roots were immersed during the night contained a very notable excess of the transpired matter. Numerous other experiments gave the same result. As it is well known that the light of day causes the roots to absorb their juices, it is natural to suppose that during the night absorption ceases and excretion takes place.

To prove that plants employ, (if we may so speak,) the excretory power of their roots in order to get rid of hurtful substances which they may have imbibed, the following experiments were made. Some plants of *Mercurialis annua*, were well washed in distilled water, and placed so that one portion of their roots dipped into a weak solution of acetate of lead, and another branch of the same root into pure water. Having vegetated in this manner very well for several days, the water was tested by hydro-sulphuret of ammonia, which proved, by the black precipitate which it formed, that a notable portion of the lead had been absorbed and deposited by the branch which dipped in the pure water. Groundsel, cabbage, and other plants gave the same result. Some plants grew very well for two days in acetate of lead. They were then withdrawn, their roots well washed with distilled water, carefully wiped, again washed in distilled water, (which being afterwards tested, was found to contain no lead,) and then placed to vegetate in a vessel of rain water. In the course of two days, this water was found to contain a small quantity of acetate of lead.

The same experiments were made with lime water, which, being less injurious to plants, is preferable to lead. The roots being partly placed in lime water and partly in pure water, the plants lived well and the pure water soon shewed the presence of lime by oxalate of ammonia,—and plants which had grown in lime and then transferred with every precaution to pure water, soon disgorged into it a portion of lime.

Similar trials were made with a weak solution of marine salt, and with a like result. Learning from M. De Candolle that marine plants when transported in a healthy situation, frequently grow well at a distance from the sea, and that in such cases the soil in which they grow contains more salt than the surrounding soil, the author endeavored to imitate nature by taking a few common plants, placing their roots in rain water, and wetting their leaves with a solution of marine salt. None of the salt was discoverable in the water, and it may therefore be inferred either that solutions of salt cannot imitate the delicate process of nature, or perhaps more probably that soda plants alone have the power of absorbing by their leaves, marine salt and rejecting a portion of it by their roots.

There can be no doubt then that plants have the power of rejecting by their roots, soluble salts which are injurious to vegetation. The author gives a few interesting details of experiments on some particular families of plants.

Leguminous Plants.—The only plants which he tried of this family were peas and beans. They live and grow well in pure water. After sometime, the liquid, being examined, has no sensible taste, its smell is faintly herbaceous. It is quite clear and almost colorless in the case of kidney beans, (haricots,) more yellow in peas and common beans, (fêves.) The fluid when examined by chemical tests, evaporation, &c. is found to contain a matter very analogous to gum and a little carbonate of lime.

It was found that when the water in which these plants had lived was pretty well charged with this excrementitious matter, fresh plants of the same species soon withered in it and did not live well. To ascertain whether this was for want of carbonic acid in the fluid, (which plants derive from the earth as well as from the air,) or from the presence of the excreted matter, which they repudiated, the author put into the fluid, some plants of another family, and especially wheat. This lived well, the yellow color of the fluid became less intense, the residuum less considerable, and it was evident that the new plant absorbed a portion of the matter discharged by the first. It was a kind of rotation experiment performed in a bottle, and the result tends to confirm the theory of De Candolle. It is not impossible that by experiments of this kind, results may be obtained of practical importance to agriculture. The author would infer that wheat may follow with great advantage a crop of beans.

Gramineous Plants.—Wheat rye and barley were examined. They do not grow well in rain water, probably from the notable quantity of mineral substances, especially silex, which they contain, and which they cannot derive from pure water. The water in which they have vegetated is clear, transparent, without color, smell, or taste. It contains some salts, alkaline and earthy muriates and carbonates, and only a very small portion of gummy matter. He thinks these plants reject scarcely any thing but the saline matters foreign to vegetation.

Chicoraceous Plants.—The *Chondrilla muralis* and the *Sonchus oleraceus* live very well in rain water. The latter acquires a clear yellow color, a strong smell, and a bitter taste. Treated with tests, and concentrated by evaporation it is found to contain tannin, a brown gummo-extractive substance, and some salts.

Papaveraceous Plants.—Plants of field poppy (*Papaver Rhœas,*) will not live in rain water; they speedily fade. The white poppy (*papaver somniferum*) lives very well. The roots produce a yellow color, a vinous odor, a bitter taste, and the brownish residuum might be taken for opium. This plant is one of those which neither the roots nor the stems cut into pieces and steeped in water, produce in it, any of the changes which the growing plants communicate.

Euphorbiaceous Plants.—The *Euphorbia cyparisias* and *E. peplus*, are the plants from whose roots Brugmans observed the exudation of drops during the night. The author has not been able to verify this fact by direct observation. The plants vegetate well in rain water, giving a very strong and persisting odor. Boiling alcohol dissolves the residuum and deposits by evaporation, a granular, gummo-resinous, yellowish white, very acrid substance, leaving a strong after taste.

Solanaceous Plants.—The only plant of this family which I have tried in water is the potato. It lives well in rain water and puts forth its leaves. The water is scarcely colored, leaves little residuum, gives but little taste, which induces the belief this is one of the plants whose roots secrete little or nothing of a decided character. This however is the result of only a single hasty experiment made upon a plant at an early stage of its development.

The inferences which the author deduces from his experiments (acknowledging however that more extended trials on a greater number of families and individuals are desirable,) are, 1st, that the greater number of vegetables exude by their roots substances unfit for their vegetation. 2d, That the nature of those substances varies according to the families of the plants which produce them. 3d, That some being acrid and resinous may be injurious, and others being mild and gummy may assist in the nourishment of other plants. 4th, That these facts tend to confirm the theory of rotation due to M. De Candolle.—*Bib. Univ. Mai*, 1832.

Art. XXIII.—*Facts in relation to several Remarkable Deaths attributed to Hydrophobia.*

INTRODUCTORY REMARKS.

The death of a friend,* in the parish of Chester, in Connecticut, having called me to that place in July, 1830; the occasion of his funeral brought me into contact with some of the surviving friends of four persons who, not many years before, had died there under very remarkable circumstances. From the father of one of them, I received a very painful statement of facts, of which I had heard, somewhat vaguely before, and which had excited, in my mind, no little interest and curiosity. This bereaved father, a sensible and judicious, elderly man, expressed to me, in the most decided terms, his belief, that his son died of the hydrophobia. As the circumstances of my visit did not permit me, to make a full investigation, a letter was sometime after, addressed to the Rev. William Case, the clergyman of the village, (a gentleman upon whose zeal, intelligence, and candor, the fullest reliance could be placed,) requesting him to transmit to me a statement of the facts.

There is no wish on his part or on mine, to agitate medical theories; and every one will, of course, form his own opinion as to the possibility of the communication of the hydrophobic virus, from one human being to another. On physical principles, no satisfactory reason can be assigned, why the human subject of this malady should be unable to transmit the poison of the infected saliva to the fluids of a wounded person, although it is confidently asserted,

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* The late Dr. Burr Noyes. Chester is thirty miles north east of New Haven, in the town of Saybrook, near the mouth of Connecticut river. Dr. Noyes was much esteemed as a physician, and was in attendance in the case of C. C., described in the succeeding pages.

that no such case has ever occurred.* As to the time during which the virus may lie dormant, popular opinion is perhaps in one extreme, and philosophical caution in the other. It is stated that "the development of the morbid symptoms rarely takes place before the fortieth or after the sixtieth day."† There are, however, very many well attested cases in which the virus has lain much longer in the system, and the limit seems not to be, as yet, definitely established.

Proof sheets of the annexed statement, having been communicated to a number of medical gentlemen of high standing, most of them were of the opinion, that although the facts stated in the Chester cases are not, *diagnostically*, conclusive, they are interesting, and also important, in as much as they may induce caution in those who attend upon hydrophobic patients. So rare is hydrophobia in this part of the United States, that although the gentlemen consulted had practised medicine extensively, most of them for many years, in five different geographical locations, remote from each other, only two of them had ever seen a case of undoubted hydrophobia. One of these‡ had attended on two unequivocal cases, both of which terminated fatally; and this physician considers the facts that occurred at Chester to be such as belong to hydrophobia, and that there is nothing in the cases inconsistent with this supposition. The narrative is given, however, not as a medical, but as a popular statement, believed to be true by judicious people, personally acquainted with the cases. The facts in Part II. are added for illustration and comparison.—*Editor of the Am. Jour. of Science and Arts.*

Statement of facts by the Rev. William Case.

PART I.

TO PROFESSOR SILLIMAN.

Chester, October 14, 1831.

Dear Sir,—In compliance with your request, I have endeavored to collect the facts, respecting the supposed cases of hydrophobia in this

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* "There is no instance of the rabies having been communicated from one person to another;"—Encyclopædia Americana, Vol. VI, p. 511. And it is asserted also, in the same work, that the hog, sheep, and cow are incapable of communicating the poison, but these statements are contradicted by cases in this article.

† Encyclopædia Americana, Vol. VI, p. 511.

‡ Dr. Eli Ives, Professor of Theory and Practice in the Medical Institution of Yale College.

place, and the transmission of the poison from one human being to another. I ought, perhaps, to state that most of the physicians, consulted in the three cases of supposed transmission from one human being to another, attributed their death to some other disease, such as might be supposed to be attended by symptoms similar to those which characterize this malady. It is believed, however, that the material facts, in these cases, were never fully made known to these gentlemen. Neighbors and attendants, in whose possession they were, feared, perhaps, to disclose them.

Allow me to say that I was in some measure prepared to feel the dangers of this disease, from having, in my early years, assisted in destroying several rabid animals. The first was a dog nearly spent with the disease. He was killed by a gun, in my father's barn-yard. The utmost care, I well remember, was taken to avoid touching the animal, and to remove, and bury with him, the straw and loose materials on which his saliva had fallen. At a subsequent time, while the family were at breakfast, a fox appeared in the same yard, in pursuit of the fowls. He ran after them, and when they flew, jumped high to seize them. He was not intimidated at the sight of men, or by the throwing of clubs and stones. Fears were entertained of his being rabid, and the life of a noble dog was risked in preference to suffering the animal to escape in this state. He was too feeble to run with great speed, and the dog overtook, and seized him at the distance of a hundred rods. I followed in the pursuit, and with the aid of the trusty dog, a billet of wood, and a stone, killed the fox. The poor dog, which every member of the family regretted to lose, was shut up in a small stable, and fed and watered, daily, with care. In about fourteen days he began to refuse food, and to be averse to water. He soon began to loll, to discharge saliva, jump towards the scaffold floor, bite sticks that were thrust through the sides of his prison, and, when excited, to fly at its sides with such force that he broke off his long teeth. It became evident that he was rabid, and he was killed to shorten his sufferings.

In 1807, W. C.* was bitten and wounded by a mad dog, when at the age of eleven years, and on his way home from school. After

* The rabid dog, which bit W. C., was seen, when he was bitten by another supposed to be rabid. I had the facts from a gentleman now residing in Ohio, and as nearly as I can recollect, they are as follow :—A strange dog crossed the orchard adjoining his house, and was seen, without provocation, to seize and bite the dog which bit W. C. The gentleman's daughter, then a small girl, now the widow of C. C., was in the

biting this youth, the dog was confined in a small apartment in his owner's house, where he was seen by many persons, and where he exhibited all the symptoms of hydrophobia. A person, in company with others, with a gun in hand, ascended the chamber stairs, displaced a part of the floor, and through the aperture, shot and killed the dog. These facts are attested by a man who was an eye witness, and they are corroborated by many others.

At the time of the bite, in 1807, W. C. is said to have had a feeble constitution, but it is testified on all hands that he grew up without sickness. It is said, he conducted strangely, by turns, sometime before his last sickness. The disease appeared in him fifteen years after the bite, and was preceded by mental irregularity. He had a short season of strange excitement, during public worship on the Sabbath. At a neighbor's house, the next day, he suddenly jumped, screamed, broke windows, and ran out at the door, with great nimbleness of foot. He soon became quiet and returned; and when his friends remonstrated with him for such conduct, he said he could not avoid doing thus, for he had been bitten by a mad dog. During the progress of the disease, he gnashed his teeth;* discharged large quantities of saliva, had distressing spasms, and was set on biting every body and every thing. The pillow cases, through which he made holes, by taking them in his teeth and shaking them, are now to be seen. He spit on persons who came in, and on all parts of the room. He was averse to swallowing any thing. He watched for opportunities to bite persons, and if he could bite any one it seemed to afford him pleasure, and was followed by laughing. He lived after his attack, fourteen or fifteen days. It required four or five able men to attend upon him. He died Sept. 1st. 1822, aged twenty six years.

L. T. C., S. W. H. and C. C. a brother of W. C., were all bitten by W. C. while attending on him in his last sickness. The

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orchard at the time, and her mother seeing the dog in the act of biting the other, and being alarmed, called her in. The circumstance she well remembers, and says the bitten dog fled into her father's house, instead of his owner's, not more than four rods distant, and ran under the bed. The stray dog afterwards appeared in front of the house and sat down. The gentleman pointed out the spot, described his appearance, and said he had not a doubt of his being mad. If I do not misremember, he was destroyed. The bitten dog bit W. C. between two and three weeks after he received his own bite.

* It is stated also that he howled and growled, but it is easy to suppose that the imagination may convert groans and shrieks of distress, into imitative sounds.

bite in these three cases, drew fresh blood from the hand or wrist, and this fact is attested by many witnesses. These three cases were preceded by mental anxiety, and followed by spasms, delirium, and lucid intervals. The first spasms were of short duration, and attended by jumping, hopping, and screaming. Successive spasms continued longer and became more severe. The eyes of all assumed a glassy and watery appearance. What I have termed, discharge of saliva, was, in all these cases, called frothing at the mouth.

L. T. C. was a strong athletic man, he was bitten in 1822, by W. C. and after a sickness of two weeks, died March 13, 1826, aged thirty two years. Some weeks before his confinement, he exhibited symptoms of mental aberration.* He would hop backward and forwards, and talk incoherently, for a few minutes, and then say he was sorry he conducted so, but he could not avoid it. His attendants say, the taking of water or drinks made him rave. A spectator observes, that he sometimes called for drinks, when it seemed as if he thought they would be refreshing, and do him good; but no sooner had he filled his mouth with the fluid, than he would spirt it in the face of him who offered it, and decline to swallow the drink. So strong was his aversion to swallowing, that a near relative questions whether he could swallow. Another says, that drinks were sometimes forced down; but he shuddered at swallowing. With his mouth he seized by the arm, a person attending upon him, and through thick clothing, left upon his flesh the print of his teeth. He immediately said, "Now I have hurt you, and I am sorry; but I could not avoid it; I must either die myself or bite you." If he had not been confined, says one, I have no doubt, he would have bitten every person in the room. A part of the time, it required seven able men to keep him to his bed and in his chamber. It is said that he was not known to walk to, or from the bed; but always leaped off and upon the floor; he would whirl suddenly around, and shift his position on the bed, and sit on his feet, and the by-standers imagined that he imitated the motions and the barking of a dog. He frothed at his mouth and ran out his tongue. He spirted drinks

* It is not supposed that there was any proper delirium, but merely that degree of aberration which might be supposed to arise from the violent paroxysms of the disease in a very strong muscular subject. L. T. C. and C. C. particularly were very powerful men, and C. C. was unrivalled as a wrestler.

into the face of his attendants, spit on them, on every body and every thing, and all over the room.* His efforts in spasms exhibited such strength as literally to frighten his attendants.

S. W. H. sickened and died Aug. 10, 1827, aged thirty years. He was sick five days. Although he had been for years subject to epilepsy, yet there was no appearance of this disease in his last sickness. He was bitten by W. C. in 1822, and carried the scar of the bite to his grave. At the time, there was no general apprehension of hydrophobia, nor any excitement on the subject. It is not known, that the fact of his bite was mentioned to his physician. His disease was pronounced to be something else. Whatever it might have been, it was preceded by mental anxiety, and attended by the following symptoms. He at first inclined to wander from his house, and gave indications of mental aberration, and of a great dread of water. He resided near a small lake, and before being confined to his room, requested his companion to keep him from the water, and be sure and not let him get into that lake; if he did it would kill him. He is represented as having had, in the first stages of his disease, a constant dread of water, but six hours before he died, he called for some, and drank of it. Before his spasms commenced, he entreated his wife, that if he should be as W. C. was, she would procure some strong man to take care of him, and be careful to get some one who would make him mind, lest he should hurt others. During one of his spasms, he bit his tongue and loosened a piece of it. He requested his wife to take the scissors and cut it out, but to take care and not get any of the blood on her. He would take drinks to oblige his friends and attendants, but they say, he always swallowed with a convulsive effort, such as they cannot describe. The disposition to wander continued to the last. He tried various expedients to be released, and to escape from the house. He would grin and fix his glaring eyes on his attendants, when near him, in such a manner as to make them guard against being bitten. He would take a handkerchief and bed clothes in his teeth, and bite and shake them. He is represented as of a peaceable disposition, and some of his friends think that he made great efforts to curb the disposition to bite.

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* The prevailing popular impressions on this subject are well known; perhaps it is not surprising that some of the distressing and various appearances in hydrophobic patients should be attributed, by the terrified beholders, to a specific canine influence. Medical men do not admit the genuineness of these appearances.

The death of L. T. C. and S. W. H. left on the minds of the community an impression of mystery. There was a general feeling that the cases were very singular. Individuals, who witnessed their sickness, and were acquainted with the facts above mentioned, firmly believed, that they died of hydrophobia, but no professional man had encouraged that belief or laid stress on the facts which supported it, and the friends, for obvious reasons, were not forward to express it.

Things remained thus, till C. C. a brother of W. C. sickened and died, March 24, 1828, aged thirty seven years. He was sick but eleven days. He was a strong laboring man, and had never before been the subject of sickness. After attending a meeting in the evening, he retired to rest, and slept as usual. About midnight, he suddenly sprang from bed, and ran undressed, into the street, screaming so loudly as to alarm his neighbors. From this first decisive appearance of his disease, remedies seemed not even to abate his distressing symptoms. Nor was his malady suspected by his attending physician, till the third or fourth day. On my making inquiries of a parishioner, in regard to the sick man, he said to me, " He is no better. Do you know what people say about C.? They say he was bitten by his brother W. who died with hydrophobia, and they can prove it, and they know he is mad." I immediately made inquiries, and became satisfied that this was not mere talk. I saw, the next day, his attending physician, and having mentioned the facts to him, I asked if he had suspected the nature of this disease. He replied no. I then inquired if he would not examine his authorities and look for the symptoms of the disease, with sole reference to them. His next visit to the sick man resulted in his conviction that his disease was hydrophobia. The physician had told the attendants, that if they would preserve some of the saliva, and inoculate a dog with it, he would become rabid in a certain number of days. They had carefully taken up on a woollen string and dropped into a phial, a quantity of this and corked the phial. They had selected the victim and the place of his confinement, and were holding the corked phial in the hand, when the man was seized with his last spasm. The phial was suddenly dropped, and all search for it in future proved ineffectual—a circumstance deeply to be regretted, for had the experiment been made, the result would probably have removed from every mind, capable of appreciating it, all doubt respecting the sick man's disease.

The following are some of the facts as stated to me by his physician,* and corroborated by his widow, and those who attended him. The sight of water produced a recurrence of distressing spasms, or in the language of attendants, made him rave. In the intervals of spasms, he was rational. In one, he requested his father-in-law to remove and hide his razors, for he did not know what he might be left to do in his turns. In another, he gave this caution to his wife. "I wish you to keep away from me when I have these turns; I know not why it is, but I want to bite, and I fear I shall bite you." His attendants think he strove to curb the disposition to bite. It was however very evident. A neighbor one evening entered the room. On seeing him, he immediately said in a pleasant way, "How do you do, Mr. B———? I am glad to see you. Come here; I want to shake hands with you." The neighbor approached, and extended his hand. The sick man seized it instantly, and with a convulsive spring, rose from the lying posture, and drew it to his mouth. The attendants who stood near, and expected this result of shaking hands, instantly seized Mr. B———, and forced him from the sick man's grasp before he was bitten. He talked much about biting, and the attendants, as usual in such cases, imagined that he growled, snapped and barked, like a dog. The shaking of pillows and bed clothes in his teeth, was a frequent exercise. His eyes were glassy and watery. He spit much, the night after he left the bed, and during his sickness. He spit to all parts of the room, and watched the opportunity to spit on persons who came into it. During his sickness, and especially the night before his death, he screamed and hallooed dreadfully.

On the supposition that these are to be regarded as cases of real hydrophobia, the facts will stand thus:

1. W. C., first victim, bitten by a rabid dog in 1807. Sick fifteen days. Died fifteen years after the bite, in 1822, Æ. 26 years.

2. L. T. C., second victim, bitten by W. C. in 1822. Sick fourteen days. Died short of four years after the bite, in 1826, Æ. 32 years.

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* Dr. Noyes who was the attending physician in the last case, intended to collect the facts and draw up the statement. We had conversed on the subject, and agreed in our views of its importance, and he had consented to undertake it. His early removal prevented. I shall always regret that the task had not devolved on some member of the medical profession.

3. S. W. H., third victim, bitten by W. C. in 1822. Sick five days. Died five years after the bite, in 1827, Æ. 30 years.

4. C. C., fourth victim, bitten by W. C. in 1822. Sick eleven days. Died short of six years after the bite, in 1828, Æ. 37 years.

These facts are well established, and they preclude the necessity, if not the propriety, of referring the symptoms of their disease to what is sometimes termed spontaneous hydrophobia. Nor did the previous habits of life, in a majority of the patients, at all favor such a reference of their symptoms.

C. C. was a constant spectator of his brother W. C. in his last sickness. They died in the same house. C. C. also watched with L. T. C. and S. W. H., and repeatedly told his wife, as she now affirms, that they were sick just as his brother was. A sensible man who witnessed three of the cases, says the persons were sick alike as nearly as the difference of natural dispositions, and habits of life would permit. Different individuals, who observed attentively two or three of the cases, bear the same testimony, in such numbers, as to include in it all the four. With persons at all acquainted with the facts and the cases, it is now the general opinion that the disease was hydrophobia.

All four dreaded confinement, and exhibited great quickness of apprehension in regard to persons, and circumstances which surrounded them. There was uncommon agility and sprightliness in their motions, and an evident display of cunning, especially in their efforts to escape and to bite persons. Till within about two days of the termination of the disease, the patients were not only inclined to escape, but a primary object of the intended escape was to have opportunity to run. It is the opinion of the attendants, that if they could have escaped, they would have run till they dropped down dead. One, among other things, pretended to have business at a place sixteen miles distant. He plead with his attendants to let him place his feet on the door steps, and assured them that if he might do it, he would run so that no man could overtake him till he had reached the place.

The fears of all were that they should injure others. One was, at times, afraid of receiving injury from others; but this fact, it is believed, may be explained, by a reference to circumstances peculiar to himself. All that is claimed, however, is that there was a general concurrence in the class of symptoms to which allusion has been made. From momentary agitations, connected with slight mental aberration, the spasms gradually increased, in duration and force, to the last. One attendant says the strength of the patient seemed to increase during the spasms, till he finally sunk under them. This man's services have always been sought, and freely rendered in extreme sickness. He affirms that he never witnessed cases at all resembling these. In attending on the last individual, he covered with rags spots of fractured skin on his hands, lest the saliva of the patient should reach them. Another procured and constantly wore, a pair of stout gloves. An attendant in one of the cases, says, that twelve hours' service at a time, was as much as he could endure, and that others were obliged frequently to change, and retire from the scene, and suspend the efforts required of them when present.

Many testify that there was in all the cases, during the spasms or spells as termed, an uncommon scent from the patient's breath. This was observed in every case by numbers. Some designate it by the epithet strong; others say they never experienced the like before, nor since, and they cannot describe it. All seem to remember it as perfectly distinct in its character. One person in endeavoring to convey an idea of it, said it resembled that of cats and dogs when fighting. This smell was not perceived, except at the times when the patient raved, or had spells, and frothed at the mouth.

It is the opinion of attendants, that the patients were literally stiffened during the spasms, and that in the latter stages of the disease, they might have been raised up erect, by the application of force to the head, without any bending of the body. The corpses were stiff immediately after dissolution, and the jaws set so as to require no muffler. On them, and near the surface of the skin, blue spots appeared, which some mistook for indications of mortification. One was kept four days, and on this body the spots wholly disappeared, and it underwent no other visible change. It is stated that the spots appeared as soon as the patient was supposed to be struck with death, and that when they disappeared, they left the skin slightly affected, and of a greenish hue. It is said the corpses had a strange appearance, the countenance resembling that of a living person in health when cold. Some designate this appearance by the epithet blue.

P. S. An intelligent medical man, who has heard the above statement, and conversed largely with witnesses, believes these cases to have been hydrophobia. Two of them have been attributed by others to delirium tremens, but the previous habits of the patients did not favor that idea; none of the four were addicted to the use of ardent spirits, and one of them had a constitutional aversion to distilled liquors.

PART II.

HYDROPHOBIA :—*Extent, ease of transmission, dangers of exposure, time during which the virus lurks in the system, &c.*

If hydrophobia should ever become as frequent in the United States, as it has been in some countries, it would be a subject of regret that we have no regular statistics of the disease. We have statistics of other diseases, as well as of vice and crime. The labor of collecting them, is more than compensated by the diminution of suffering, which their publicity occasions. The present is deemed a favorable time for inviting attention to hydrophobia, as it is believed that the disease is more prevalent in the country than at any former period of its history. During the last year especially, the cases have been frequent; and there is reason to believe, that with more knowledge of the disease, and of the dangers of exposure, some at least, of the many fatal terminations which have occurred, might have been avoided.

'A table, containing a statement of the number of deaths by hydrophobia, in the different parts of the Prussian monarchy, was published in Hufeland's Journal for March, 1824. From this table, it appears that the deaths in ten years amounted to one thousand six hundred and sixty-six.

Years.	Deaths.		Years.	Deaths.
1810	104	-	1815	79
1811	117	-	1816	201
1812	101	-	1817	228
1813	85	-	1818	268
1814	127	-	1819	356

'The deaths occurred more frequently in some provinces than in others. The greatest number mentioned in one province is two hundred and twenty-eight. In several provinces, the cases were very rare, or totally absent. Dr. Hufeland accounts for this great diversity, by remarking that the provinces in which it is frequent are contiguous to the forests containing wolves, as those of Poland, Prussia, and the Ardennes.'*

* United States Literary Gazette.

This table is cited, not only as a specimen of useful research, but as furnishing palpable evidence of the gradual increase of the disease, in a single country, in a period of ten years; the deaths by it being two hundred and fifty-two more in the tenth year, than in the first of the series. It also suggests that the disease continually finds victims to prey upon, among animals which roam in the forests. In this country, farmers have frequently destroyed foxes which fearlessly approached them in open day, without, perhaps, suspecting that they were rabid. From this species of animals, many dogs unquestionably derive the disease, and transmit it to others, and they to other domestic animals, and to human beings. From the fact that the poison is transmissible from one species of animals to another, and from animals to human beings, it appears highly probable that it may be transmitted from one human being to another. Man then, of all the animal creation, is most exposed to this fearful malady. He alone is endowed with reason to ascertain its nature, and use the means of self-preservation. To contribute, in some degree, to this object, is all that this article attempts.

The following cases, it is believed, are well authenticated. They are quoted with names, dates and references, so that if any error exists, it may be easily discovered.

1. Hydrophobia from the hair of a rabid animal. Time of the virus lurking, eight or ten weeks.

A young man, named Morehead, suddenly expired at Cincinnati, on the 3d of May, 1831. It is stated that all the usual characteristics of the disease were manifested during his short illness, and that a subsequent examination of the body, satisfied the four physicians who attended him, that the case was precisely such an one as is produced by the bite of a mad dog; although it was ascertained that he had never been bitten by one. He was a tanner by trade. As several domestic animals had died of hydrophobia during the winter, it is supposed that one of them, which had besmeared its own hair with saliva, had been skinned, and its hide sent to the tan yard, where the poison might have been imparted to those who handled it. The opinion of professional gentlemen is, that the poison, applied to the sound skin, cannot excite the disease, but the victim, in this instance, had a burn on one of his fingers, and the sore had a scab on it at the time of his death.*

* New York Observer, June 18, 1831.

2. Hydrophobia, from giving medicine to a rabid animal. Time of the virus lurking, eight or ten months.

Mr. David Rock, of Bedford, Pa., died of hydrophobia, January 1, 1832. Eight or ten months previous to his death, he attempted to administer medicine to a sick heifer, which subsequently proved to have been mad. In the act of giving the medicine, he wounded one of his fingers, and thereby is supposed to have caught the infection which resulted in his death.*

3. Hydrophobia, from the bite of a mad dog. Time of the virus lurking, about five weeks.

The subject was Mr. Street, who resided near Sharon, Hamilton County, Ohio. Near the first of June, 1831, he observed a dog in the stye, biting his swine. In attempting to drive him out, the dog flew at Mr. S., and bit him severely. Nine days after, one of the swine died in a rabid state. Nearly thirty-five days after, on retiring to bed, Mr. S. complained of being unwell. The succeeding morning, on putting his hands into water, for the purpose of washing, he was seized with violent spasms, and forced to recoil several paces. After repeated trials, he succeeded in washing himself.

He is represented as having been, from this moment, fully conscious of his danger; he was a pious man, and was supported by religion in his extremest suffering, and in the hour of dissolution.

"The strange spectacle was here presented to the living, of a man in his full strength, who, while walking about the room, conversing with his friends, and exhorting them to prepare for death, and yet perfectly conscious that he must die in a few hours, was foaming at the mouth, and exhibiting, by the convulsions of his whole frame, and the horrible distortion of his countenance, and the unnatural expression of his eyes, which seemed ready to burst from their sockets, that a terrible poison was drinking up his spirits, the progress of whose destructive energy, no power on earth was able to resist."†

4. Hydrophobia, from the bite of a mad dog. Time of the virus lurking, fifty-four days.

The subject was a little girl, named Johnson, two and a half years old. On the 20th of April, a small dog entered the yard, No. 138 Christie Street, New York, where she was at play, and lacerated her nose severely. The child soon recovered of her wound, and

* Philadelphia Saturday Evening Post, Jan. 7, 1832.

† New York Observer, July 30, 1831.

continued well to the 13th of June, when she became fretful, and complained of pain in the head and stomach. The mother prepared an infusion of senna, and when she attempted to administer it, the child wonld shudder and become convulsed. The first circumstance that attracted the attention of the mother, was the peculiar actions of the child when she drank, for she was thirsty, and asked for water, but when she swallowed the water, she would choke and spit it out.

On the succeeding day, Dr. Mead, of Cliff Street, from whom the particulars were derived, was called to attend the child. "He found her lying quietly on her bed, cheerful and intelligent, for the child was remarkably sprightly for her age, and seemed pleased with the idea of being made well. She said she had no pain, except a little in her stomach; she allowed her person to be examined freely, but when the nose was touched, she would recoil with shuddering, and when it was pressed she would thrust out her tongue with a shriek, and catch her breath as if suffocated. This was not incidental, for it was tried several times with the same result. The cicatrix of the wound appeared perfectly well, and there was no appearance of disease, or discoloration of the part. She was asked to drink some water. She seemed thirsty, and readily assented. A cup was brought, and she rose in bed, grasped it with both hands, and filled her mouth, but in an instant she dashed the cup from her, and seemed to spit or blow the water from her mouth, with a force and sound, as if it were ejected from a heated crucible, and fell upon the bed in horrible convulsions. In a few moments she was quiet and composed again. These experiments were forbidden, as they added greatly to the sufferings of the child. Several attempts were made to administer medicine, but unsuccessfully; for every effort to swallow even the smallest quantity, would bring on a spasm and a distressing constriction of the throat, which would eject it from her mouth. The dread of water continued to increase, to such a degree, that if a person approached her with a tumbler of water, it would bring on a recurrence of the paroxysms. The spasms occurred spontaneously with increased power and frequency, until she exhibited all the horrors of this fearful malady. The eyes were wild and protruded, there was gnashing of the teeth, until the tongue became lacerated; with frequent spitting and foaming at the mouth; and retching which was peculiar. It returned at regular intervals of a few moments, attended with but one effort, as if the stomach were suddenly affected by a spasm, and forcibly expelled through the constricted pharynx, a little frothy mucus. Then again returned the horrible convulsions and shrieks not to be described, and dreadful to behold, until she became gradually exhausted, and expired forty hours after the invasion of the disease, and fifty-seven days after the infliction of the wound. Several physicians saw the child, and no doubt was left on their minds as to the nature of the disease."*

Such are some of the details in relation to this fearful disease. The list might be greatly extended, but these are deemed sufficient, to render highly probable the following conclusions respecting it.

Animals known to have been exposed, or slightly suspected of the disease, ought to be immediately confined. On the decisive appearance of the disease, they ought to be immediately destroyed. There is an instinctive dread of animals infected with the disease, as there is of certain poisonous reptiles. Numbers, however, delight in exhibiting a useless bravery, in approaching them without sure means of defence at hand. It can never be safe, in any way to trifle with a poison, so deadly in its effects, and at the same time so easily conveyed into the system. One moment the rabid animal may be quiescent, and apparently harmless, and the next moved by convulsions, and a strong propensity to bite; to inflict a death wound on the unsuspecting being who shall be within its reach.†

It appears evident that the transmissible poison is contained in the mucus or saliva of the diseased animal, and that the disease may be produced by almost any minute portion of this mucus or saliva, if it only come in contact with the fluids of the system. The poison also appears to be permanent, and active, at least, for a considerable time after the death of the diseased animal.‡ No doubt therefore need remain, as to the active nature of the poison, or the ease with which it is transmitted. In the case of animals diseased or dead, it

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* Journal of Commerce, June 18, 1831. 2d page, 1st col. top.

† A dog which had imparted the disease to several domestic animals, afterwards approached his master, licked his hand, and suffered himself to be caressed, without offering to injure him. He suddenly turned from his master, to a little child standing near, and in the act of biting her, was prevented, by a severe blow on the neck, from the child's father, who was anxiously watching the motions of the dog.

‡ In the case of reptiles, this fact is of general notoriety, as persons who destroy them, always sink the head to a great depth in the earth. The poison of a dead reptile, applied to the outer bark of a green stick filled with sap, will produce no action. If a hole be made through the bark, and the poison be placed in contact with the sap, its rapid diffusion may be detected by the eye, since it will raise the bark as it proceeds, and render visible its actual progress, for some distance from the place of contact.

is not safe for persons having fractured skin, or open wounds to approach, or handle them, either for the purpose of administering medicine, or for the operation of skinning. It is better in all cases to sacrifice the small value of the skin, than to endanger life in attempting to save it. Nor can the hides of such animals, be safely handled for the purpose of dressing. It is unsafe for persons free from wounds, to approach such animals, just in proportion as they are in danger of being wounded, or in any way liable to take the poison.

If substantially the same poison rages in beasts of the forest, in domestic animals, and in human beings: as is evident from the sameness of its effects—if it is transmissible from one species of animals to another, and from them to human beings, as facts clearly prove; then it is reasonable to conclude, that it may be transmitted from one human being to another. On this ground, the greatest caution is required of those who have the care of the victims of this disease. It is imprudent for persons having uncovered wounds of any description, to attend on the human victim afflicted with this disease. The poisonous mucus or saliva may be, and often, if not always, is thrown to every part of the room in which he is confined. It may strike a small uncovered wound, and be as effectually transmitted, as from the tooth of a fox, a wolf, or a dog. The utmost care is requisite on the part of attendants, not only to avoid bites, but to prevent the ingress of the virus, in any quantity through an aperture of the skin.

The time during which the virus lurks in the human system, has been stated, not to be short of ten days, nor to exceed nineteen months. This statement was the result of an observation of a given number of cases. Facts, however, are not wanting, to prove that it acts short of the least term, and lurks beyond the greatest. The time of lurking may depend on the stage of the disease in the animal, or human being from whom the poison is transmitted; it being reasonable to conclude, that if taken in the earlier stages of the disease, it will be less likely to operate soon, than if taken, when the disease has reached its maximum, or in the later stages. It may also depend on the *quantity* as well as on the *power* of the virus transmitted.* Both these circumstances may, in different individuals,

* In reference to the four cases of supposed hydrophobia, stated in part I, of this account, it is an ascertained fact, that the person bitten by the dog, was bitten on the first day of the appearance of the disease in the dog; and that the three who were bitten by this person, were all bitten in the earlier stages of his disease, and during the first manifestation of his disposition to bite; and that the wound, inflicted on the one who died first, was more severe than on either of the others, and the wound on the one who died last the slightest of the three.

vary the symptoms of the disease as well as the time of its appearance. Difference in age, constitution, habits of life, and state of health, at the time of exposure, may cause a difference in the symptoms of the disease, and in the time intervening, between exposure and its development, and between its development and fatal termination. Facts indicate this difference, some falling under its power in a very short period, and others enduring it longer. In some the disease appears soon, and in others, years elapse before its development.

As a practical rule, in relation to this strange and hitherto uncontrollable poison, it is deemed strictly philosophical, to fix the time of its lurking, in every instance, by the known facts which mark its development, and altogether unphilosophical, when it appears with marked symptoms, to deny its existence, because it appears long after exposure. To deny the possibility of its lurking beyond a short period, has an evident tendency to multiply the dangers of exposure, preclude the explanation of facts which occur, and increase the chances of malpractice. It may appear very improbable, that so active a poison should lurk in the system for years; but since its development is affected by so many circumstances, facts may render it morally certain, that it does remain inactive, in the system, for a period of years. Facts constitute a firmer basis of belief, than any theory, however nicely contructed, and however fully supported, by that kind of evidence, on which all theories depend. Is it the greater improbability, that the poison should remain long inactive in the system; or that the disease should appear with marked symptoms, and be wholly separate from the only known exciting cause? It invites consideration, whether a preconceived opinion, that the poison does never remain long inactive in the system, has not caused many genuine cases of this disease, to be passed over in silence; inquiries respecting the cause of others, which might have proved successful, to be suppressed; and others still to be designated spontaneous hydrophobia. *Causa latet*, is a rule of safe application to effects witnessed in one connexion, without a circumstantial knowledge of the cause, with which, in other connexions, they have been invariably associated.

It may not be difficult to trace the close analogy between these views of hydrophobia, and that scornful defiance of rules and limits, which characterizes almost all other inveterate diseases; and from that analogy to infer their probable correctness. If they err, it is on the safe side. A disease of such power and terror, which has rarely if ever been cured, should, if possible, be avoided. The more secret and undefined the modes of transmitting the poison, the more unceasing and vigilant should be our endeavors, to hedge up every possible way of access to it.

In thus adverting to the secondary causes of this disease, in glancing at the wide field on which they may act, and in attempting to set up beacons, to warn the unwary to stop short of the point at which danger commences, we do not forget that unseen Power, on whose will the action of all secondary causes depends, and by whom their every action is hastened or suspended at pleasure; nor our obligations of gratitude, that in limits so circumscribed, as those which constitute the boundaries of human knowledge, we may arrive at fixed truths, which, by disclosing hidden dangers, pointing out the means of avoiding them, and inspiring us with salutary caution, shall ward off the fatal dart, that was covertly aimed at our life, prevent, in many instances, the exquisite sufferings of our fellow beings, and impose, at least, partial restraints on the progress of one of the direst maladies, before whose energy man is ever forced to bow in death.

APPENDIX.

"COMMON SALT A REMEDY FOR ANIMAL POISON."

"The Rev. S. G. Fisher, a missionary in South America, says he actually and effectually cured all kinds of painful and dangerous serpents' bites, after they had been inflicted for many hours, by the application of common salt, moistened with water, and bound upon the wound, without any bad effect ever occurring afterwards. I, for my part, says he, never had an opportunity to meet with a mad dog, or any person who was bitten by a mad dog. I cannot, therefore, speak with experience as to hydrophobia, but that I have cured serpents' bites, always without fail, I can declare in truth. He then cites a case from a newspaper, in which, a person was bitten by a dog, which, in a few hours, died raving mad. Salt was immediately rubbed, for some time, into the wound, and the person never experienced any inconvenience from the bite. Mr. Fisher was induced to try the above remedy from a statement made by the late Bishop Loskiel, in his history of the missions of the Moravian Church, in North America, purporting that certain tribes of Indians, had not the least fear of the bite of serpents, relying upon the application of salt as so certain a remedy, that some of them would suffer the bite for the sake of a glass of rum."—*Ann. de Chimie.**

Salt is generally known as the most efficacious remedy, for the stings of insects, which to some persons are extremely poisonous. It is also extensively used, as a certain remedy by fishermen, and persons obliged to stand in water, to whom the bite of blood-suckers is poisonous.

The following fact may be relied upon as well authenticated. In 1807, a boy, at the age of four years, was severely bitten by a mad dog, and wounded in the arm. A lad several years older was bitten by the same dog, on the same day, and has since died of the disease. No remedy was applied to his wound. The arm of the lad bitten at the age of four years, was immediately done up in common salt. The wound swelled badly, suppurated freely, and finally healed. He has since experienced no inconvenience from the bite, and is now a healthy, active man. A respectable physician, to whom the particulars were subsequently related, approved of the course pursued, and assured the anxious mother that she had done the best thing which it was in her power to do. There is reason to hope, that this may prove a cure, and if so, the cure was effected by so simple an agent as common salt.

Query.—If salt has any power to counteract animal poison, might it not afford relief, by being administered to persons afflicted with hydrophobia?

The above statement and the annexed fact, are made public, not so much from a conviction that salt is a remedy, as from the hope that they will lead to experiments, which shall decide the point, whether salt has the power to neutralize or destroy animal poison. If such is not the fact, a prevalent tradition should be forthwith corrected. If it has such a power, immense good would result from having the fact scientifically established, and universally promulgated.

Chlorine is known to destroy instantly every species of virus to which it has been hitherto applied. Is it possible that the chlorine in common salt may become so far active, as to destroy the poison? We have no fact as yet ascertained that can sustain this conclusion, but it may perhaps be worthy of some attention.—Ed.

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* New York Observer.

MISCELLANIES.

FOREIGN AND DOMESTIC.

1. *Museum of* GIDEON MANTELL, Esq. of Lewes, in Sussex, England.—We have for some time intended to publish a notice of this museum, which, in the sciences to which it relates, is one of the most remarkable and instructive in the world, especially when it is considered that it is the result of individual effort. We are happy to manifest, in this manner, our respect for the character of the distinguished and excellent proprietor, and to exhibit this museum, as a model worthy of imitation in this country, especially in the vast secondary, tertiary and diluvial region of our middle and southern Atlantic coast.

We shall adopt Mr. Mantell's own account in his published catalogue of 1829, which is introduced by the following eloquent and beautiful passage from Sir H. Davy.

"If we look with wonder upon the great remains of human works, such as the columns of Palmyra, broken in the midst of the desert; the temples of Pæstum, beautiful in the decay of twenty centuries; or the mutilated fragments of Greek sculpture in the Acropolis of Athens, or in our own museums, as proofs of the genius of artists, and power and riches of nations now past away; with how much deeper feeling of admiration must we consider those grand monuments of nature which mark the revolutions of the globe; continents broken into islands; one land produced, another destroyed; the bottom of the ocean become a fertile soil; whole races of animals extinct, and the bones and exuviæ of one class covered with the remains of another; and upon the graves of past generations—the marble or rocky tomb, as it were, of a former animated world—new generations rising, and order and harmony established, and a system of life and beauty produced out of chaos and death; proving the infinite power, wisdom, and goodness of the Great Cause of all things!"

Sussex, and the adjacent parts of Hampshire, Surrey, and Kent, are composed of beds of gravel, chalk, clay, limestone, sand, and sandstone, lying upon one another in a certain order, and having a general inclination towards the south-east in Sussex, and north-east in Surrey and Kent. In these beds are found, more or less abundantly, the remains of animals and vegetables; but the organic bodies discovered in some of the strata, are not to be met with in others; for instance, in certain beds the fossils are entirely of terrestrial or fresh water origin ; while in others they are marine. Now it is obvious that the strata which contain marine bodies only, must have been deposited under very different circumstances to those which contain fresh water fossils ; hence we have two natural divisions—namely, the marine, and the fresh water formations. The chalk, and the sands and marls associated with it, belong to the former ; the weald clay, and the sand and sandstones of the interior of the country, to the latter. The subordinate divisions of the strata refer principally to their mineralogical characters. There are also beds of gravel, sand, and clay, containing boulders, &c. the debris of the regular deposits, and which, although of vast antiquity, are of far more recent origin than those on which they repose ; these contain bones and teeth of large terrestrial quadrupeds.

The strata are grouped, and named as follows, beginning with the uppermost or newest bed.

Alluvium.—The silt, clay, sand, gravel, &c. formed by the rivers now in action. Lewes Levels afford a familiar example.

Diluvium.—Sand, gravel, &c. containing the debris of older formations, bones of the horse, elephant, deer, whale, &c. The cliffs between Brighton and Rottingdean are diluvial.

Tertiary Strata.—These consist of regular beds of sand, clay, &c. resting on the chalk, and are characterised by their organic remains. Castle Hill, at Newhaven, Bognor Rocks, Clay at Bracklesham, are examples of these strata.

Chalk Formation.—This comprises,

1. The chalk, with and without flints ; it forms the Sussex, Hampshire, Surrey, and Kent Downs.

2. Grey marl, forming the base of the Downs, and generally appearing on the *weald* escarpment of the chalk ; at Hamsey, Stoneham, and Southerham there are marl pits, where the usual fossils occur.

3. Galt,* or blue chalk marl, a stiff blue clay ; its fossils have their shells beautifully preserved. It is seen at Ringmer, near Lewes ; and on the road-side from Wannock stream to Eastbourn ; at Newtimber it appears under the grey marl.

4. Shanklin Sand, so called from Shanklin Chine, in the Isle of Wight, where it is beautifully exhibited. This sand forms hills, that rival the Downs in altitude in the west of Sussex ; near Lewes it oc-

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* A provincial term, used in Cambridgeshire.

curs but obscurely. Ditchling stands on a hillock of it; Norlington Green, near Ringmer, is another locality.

The organic remains found in the above strata are *entirely marine.*

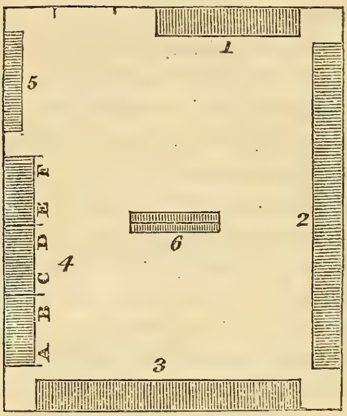
Hastings Sands and Clays.—These strata, with but very few exceptions, contain fresh water fossils only; hence they are naturally separated from the above, and constitute a well marked, distinct formation. They are subdivided into,

1. Weald Clay, in whcih the Sussex limestone or marble is found. This occurs at Laughton.

2. Strata of Tilgate Forest, well displayed in the cliffs near Hastings.

3. Clays and limestones of Ashburnham.

PLAN OF THE MUSEUM.



Case I.—Contains minerals, recent shells and corals, from various parts of England, and other countries. Some fine specimens of *Sulphate of Barytes* from Nutfield, in Surrey; Tourmalines; Native Gold and Silver; polished Sections of Ammonites; Crystallized Sandstone of Fontainbleau, &c.

Case II.—The fossils of the strata of Tilgate Forest, and the other subdivisions of the Hastings formation.

These consist of many hundred specimens of the bones, &c. of reptiles, turtles, fishes, and birds; of the stems of enormous vegetables, allied to the Dragon-blood plant, and Euphorbia; Ferns of extinct species and genera, &c.; the whole presenting the characters of a *Fauna* and *Flora* of an unknown tropical region. The intelligent observer will at once perceive, that such an assemblage can be explained only by supposing the strata to have been formed in the bed of a river or estuary. Imagine a river flowing through a country inhabited by lizards, turtles, &c., and clothed with forests of plants, allied to the palms and arborescent ferns. If the country were composed of primitive rocks, as granite, &c. we might expect depositions of clay, and siliceous sand and sandstone, with particles of mica, quartz, pebbles of various sizes, derived from the veins in the granite; bones, more or less rolled, of the lizards and turtles; associated with the remains of the fishes and shells that lived and died in the river, and the stems and leaves of the vegetables that grew upon its banks; in short, such a collection of organic remains, imbedded in clay and sand, as the one in the case before us.

In the strata of Tilgate Forest, the remains of four enormous reptiles have been identified, and there are also bones and teeth which belong to others not yet determined. The following are the most remarkable.

*Iguanodon.**—An herbivorous reptile, related to the Iguana. This monster of the ancient world must have equalled the elephant in bulk, as the enormous bones in this collection indisputably prove. Its remains have been found in Sussex only, and were first described by the author in a memoir, published in the Transactions of the Royal Society for 1825. Of this gigantic reptile, the collection contains bones of the head, teeth, vertebræ, clavicles, coracoid bone, ribs, chevron bone, femur, leg bones, (*tibia* and *fibula*,) metatarsal bones, phalanges, ungueal bone, and *horn*. The femur, tibia, and fibula lying together in the lower division of this case, were found near each other, and belonged to the same limb; from their immense size some idea may be formed of the gigantic proportion of the leg and thigh of the original animal.

Megalosaurus.—A reptile allied to the Monitor,† but almost of as enormous a magnitude as the Iguanodon. Its remains occur also in the slate at Stonesfield, near Oxford, and were first described by Dr. Buckland. In this case there are teeth, vertebræ, femur, and other bones.

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* So called from its teeth resembling those of the Iguana.

† There are stuffed specimens of the Iguana and Monitor in the Collection, for comparison.

Crocodile.—Two, or more, enormous species of this genus of Saurian reptiles, were contemporaries of the Iguanodon. There are teeth, vertebræ, humeri, chevron bone, ribs, &c. One of the species resembles a fossil crocodile found at *Soleure*, and described by Baron Cuvier.

Plesiosaurus.—Of this extinct genus, first described by Mr. Conybeare, vertebræ, teeth, humeri, and other bones, occur in the strata of Tilgate Forest.

*Chelonian Reptiles.**—The bones and scales of these animals are of frequent occurrence in the Hastings beds. They are referable to the following :—

1. A fresh water species, allied to the *Trionyx.*
2. An unknown species of Emys, resembling a fossil fresh water turtle found in the Jura limestone.
3. A marine species, belonging to the subgenus *Chelonia*, and related to the fossil turtle of Maestricht.

Fishes.—Their remains consist of *dorsal fins*, of great strength, and armed with spines, resembling those of the *Silurus* ;† teeth of various forms, some tricuspid and striated ; others hemispherical, the bufonites of the older geologists ; and palates of various kinds. In the collection there are two splendid specimens of a fish with lozenge-shaped scales ; one showing a pectoral fin ; the other, portions of the opercula of the gills.

Vegetable Remains.—These are numerous, although belonging to but few species. The most remarkable is the

Clathraria‡ *Lyellii*,§ of which there are specimens of the internal and external parts of the stem, in a beautiful state of preservation. The original probably attained a considerable height ; it is related to the *Dracæna draco*, (Dragon-blood plant). Some examples show traces of the base of the flowers ; and the fossil seed-vessels found in the same strata, are supposed to belong to this plant. The other large vegetable of this period is the *Endogenites erosa*, of which there are many enormous stems : the original was evidently a monocotyledonous plant, bearing an analogy to the Cacti and Euphorbia. Almost all the specimens are flattened by the compression of the strata, when in a softened state.

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* Tortoises and turtles.

† The Silurus is a fish that inhabits the rivers of Europe and the East, and is the largest of fresh water fishes.

‡ From the chinks on its surface.

§ Named in honor of C. Lyell, Esq. F. R. S.

There are also the remains of several kinds of ferns in the Tilgate strata: one of the most elegant is the species named by M. Brongniart, *Sphænopteris Mantelli.* Another is the *Lonchoteris Mantelli*, distinguished by the beautiful reticulated structure of the leaves.

Besides the fossil vegetables above noticed, there are stems of other plants; and vegetable matter in the state of lignite, (an impure coal,) is abundantly dispersed throughout the strata.

Birds.—Long slender bones occur which were supposed to have belonged to birds; but from the discovery of the bones of the Pterodactylus, (a flying reptile,) in the lias at Lyme Regis, it is now believed that the specimens in question belonged to that extraordinary reptile.

Shells.—These consist of univalves and bivalves, allied to recent fresh water genera. In some instances they constitute entire beds of limestone, of which the Sussex marble is a familiar example.

The specimens above described are distributed in the cabinet as follows:—

Shelf No. 1. Stems of vegetables, bones of Saurians, &c.*

2. Vertebræ, ribs, humeri, and other bones of the Iguanodon, Megalosaurus, Crocodile, Plesiosaurus, &c.

3. A series of specimens, illustrative of the Geology of Sussex, commencing with the rocks of Bognor, and ending with the strata at Hastings.

4. Bones of Turtles; teeth of Iguanodon, &c.; horn and claw of ditto; remains of Fishes, Birds, &c.; vertebræ of Crocodile and Plesiosaurus.

5. Vegetable remains: Clathraria Lyellii, Endogenites erosa, Ferns, Lignite, &c.

6. Bones of the extremities and pelvis of the Iguanodon, &c.

In the drawers of the Cabinet, No. 6, there are also many fossils from the Tilgate strata.

From the examination of these organic remains, the following inferences arise:—

1st. The reptiles and vegetables must have been inhabitants of a country, enjoying a much higher temperature than any part of Europe; and the former, from their enormous magnitude and osteological characters, clearly belong to an order of things, of which the present state of the earth affords no example; the epoch of their existence may, indeed, be termed the *age of reptiles.*"

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* On this Shelf there is also part of the fossil rib of a whale, from Brighton Cliffs.

2dly, The broken and rolled state of the greater part of the bones, the pebbles, and the conglomeritic character of many of the deposits, prove that the strata were formed in the bed of a river, or an estuary.

3dly, It is equally obvious, that the Hastings, or Tilgate strata, must have been formed and consolidated before the chalk, which rests upon and once covered them, was deposited. It follows, that after the Hastings' beds were formed, they must have been submerged beneath the ocean which deposited the chalk formation; for the latter, as we shall presently shew, contains nothing but marine remains, and not one fossil of the Hastings' beds.

4thly, The ocean of the chalk, in its turn, must have passed away, and the consolidated chalk have been covered by the waters which deposited the tertiary strata, for the latter contain fossils entirely distinct from those of the chalk.

Lastly, The tertiary, in common with the chalk and Hastings' beds, must have been subsequently broken up, probably by volcanic agency, and the wealds of Kent and Sussex formed, and the chalk dislocated and separated, by the upheaving of the central strata of the Hastings' formation: the lateral fissures in the chalk now constituting the vallies, through which the existing rivers flow, and effect the drainage of the country. To this epoch may probably also be referred the formation of the beds of diluvium.

Case III.—With but few exceptions, the fossils in this Case are not from Sussex.

Shelf 1. Teeth of Elephants, from the diluvial beds forming the cliffs at Brighton and Rottingdean: horns of Aurochs, fragments of the antlers of the fossil Elk of Ireland, &c.

2. Tusks of elephants, horns of buffaloes and aurochs, &c. from Walton, in Essex, presented by G. B. Greenough, Esq. Shoulder-bone, (scapula,) of a Mammoth, from North America.

3. and 4. Teeth and bones of mammoths, rhinoceroses, crocodiles, plates of turtles, fossil vegetables, &c. from the diluvial plains forming the banks of the Irawadi river, two hundred miles below Ava, in the Burmese Empire. Collected and presented by J. Craufurd, Esq. F. R. S.

5. Remains of *Ichthyosauri*, from Lyme Regis; skull of the extinct fossil bear, (Ursus spelæus,) from the caverns of Gaylenreuth; bones in limestone, from Gibraltar; tooth of a mammoth, from Siberia, &c.

6. Fishes from Dorsetshire, Monte Bolca, Purbeck. A magnificent suite of fishes and insects, from Aix, in Provence. Collected by Charles Lyell and R. Murchison, Esqrs. in 1828. A beautiful fossil palm leaf, from Aix, by C. Lyell, Esq.

7. A series of models, accurately colored from nature, of nearly seventy of the most interesting fossils in the *Museum at Paris.* Presented by M. le Baron Cuvier. Among them are teeth of the *Mastodon;* jaws and teeth of the extinct animals found in the quarries near Paris; paddles and skull of the Ichthyosaurus, &c.

The drawers of this case contain fossils, from the diluvial deposits near Lewes, Bognor rocks, Bracklesham Bay, Castle Hill, near Newhaven; chalk fossils, from the South Downs, near Lewes; Galt, Shanklin sand, &c.

Case IV.—The principal contents are from the chalk strata near Lewes.

Compartment A. Ammonites, Nautili, &c. from the chalk and marl.

Remains of fishes and shells of great beauty and interest.

B. Fossil Zoophytes, allied to the Sponges and Alcyonia. A fine series of the Ventriculites, first figured and described by the author in the Linnæan Transactions, Vol. XI.

C. Mass of Pectunculi, from the rocks at Bognor; Nautilus imperialis and Pinna affinis, from ditto; Plagiostoma gigantea, ostreæ, &c.; Zoophytes, from Warminster Common; presented by Miss Benett, of Norton House: from near Bristol, Dudley, Malta, &c.

Several magnificent specimens of fossil fish, from Lewes. In some, the air bladder, dorsal fin, gills, teeth, and even the tongue are preserved.

D. Remains of fishes allied to the Muræna; groups of palates of an unknown fish; Teredines; Zoophytes. A matchless collection of Turrilites, from Hamsay and Middleham; an Ammonite, with the Siphunculus beautifully exposed; Nautilus elegans; Ammonites catinus; Ammonites Lewesiensis.

E. Crystallized carbonate of lime; wood in chalk; breccia, from Castle Hill.

Subsulphate of alumine, from Castle Hill, near Newhaven; chalcedony; crystallized quartz, &c. from near Lewes.

A beautiful series of Fishes, allied to the Zeus, from the chalk-pits near Lewes; one of these is a matchless specimen, the mouth being open and entire.

F. Pecten beaveri and other shells.

A fine suite of specimens of the large fibrous bivalves of the chalk, —the Inocerami.

Case V.—A mahogany cabinet.

The drawers contain, a beautiful suite of the vegetables of the coal formation ; fossil ferns ; insects in amber ; Zoophytes from Dudley, Faringdon, &c.

Encrinites and Pentacrinites ; Pear Encrinite of Bradford, &c.

Pentacrinite, Echinites, &c. from the oolite of Gloucestershire.

Terebratulæ, and other shells, from Derbyshire, Shropshire, &c.

Shells, converted into chalcedony, from the Whetstone Pits, Devonshire.

Shells, from the Firestone, or Upper Green Sand of Wilts ; presented by Miss Benett.

Chalk Zoophytes of Wilts, by Miss Benett.

Case VI.—The Glass Case contains an interesting collection of the remains of Crustacea, from the chalk near Lewes, and several splendid fossil fishes, of great beauty. Vertebræ of the *Mososaurus*, the celebrated fossil reptile of Maestricht : jaws aud palates, and vertebræ of fishes.

In the drawers are,

Specimens from the Strata of Tilgate Forest ; among these is an interesting collection of the teeth of the Iguanodon, Crocodile, Megalosaurus, &c.

Specimens illustrative of the strata near Horsham, Hastings, Burwash, Tunbridge Wells, &c.

Fossil bones, shells, &c. from Stonesfield, near Oxford. Presented by Charles Lyell, Esq. F. R. S., &c.

Shells from the Craig of Suffolk. Presented by the late Mrs. Cobbold of Holywell's Park, near Ipswich.

Shells from Hordwell Cliffs. Presented by Miss Benett of Norton House.

Shells from the London clay, Highgate Tunnell, Isle of Sheppy, &c.

Specimens illustrative of a recent formation of rock marl from Bakie Loch, Forfarshire, Scotland, by C. Lyell, Esq. F. R. S.

Specimens, illustrative of the geology of the Isle of Wight, by C. Lyell, Esq. F. R. S.

Teeth and bones of Ichthyosauri, pentacrinites, fishes, &c. from the Lias, by C. M. Hutchinson, Esq.

Belemnites, crustaea, shells, &c. from St. Peter's Mountain, Maestricht.

Specimens of the tertiary formations of France, &c. Presented by M. le Baron Cuvier.

Fossil shells from Grignon. Presented by M. le Baron Cuvier.

Ammonites, Scaphites, Turrilites, &c. from Rouen in Normandy. Presented by M. Brongniart.

Shells from the tertiary formations of France and Italy. Presented by M. Brongniart.

Teeth and bones of hyenas, bears, deer, foxes, &c. from the celebrated Cavern of Kirkdale, in Yorkshire.

Bones and teeth of the Hippopotamus and Rhinoceros, from the Vale of Arno, &c.

A glass case in the center of the room contains numerous specimens of fossil teeth of sharks and other fishes from the chalk near Lewes.

A thigh bone (femur) of a Mammoth from Cheshire.

A most elegant and perfect specimen of the antlers of the celebrated extinct Fossil Elk of Ireland, measuring nearly eleven feet from one extremity to the other.

RESULTS.—There have been discovered in the strata of Sussex, exclusively of the organic contents of the modern alluvial deposits, the remains of nearly four hundred species of animals and vegetables, of which the following arrangement exhibits a condensed view.

Vertebrated Animals.

MAMMALIA,	*Pachydermata:* four species belonging to as many genera.		
	Cetacea	one species	one genus.
BIRDS,	One or more.		
REPTILES,	*Chelonia*	three species	three genera.
	Sauria	nine species	four genera.
	Pterodactylus?		
FISHES,	Twenty-four or more species.		18 genera.

Invertebrated Animals.

TESTACEOUS MOLLUSCA,	*Multilocular,* fifty species belonging to eight genera.		
	Univalve, (9 fresh water) 77 species belonging to 34 genera.		
	Bivalve, (12 fresh water)	130 species	42 genera.
	Multivalve,	3 species	3 genera.

ANNULOSA,	Eleven or more	10 genera.
RADIATA, ECHINODERMATA,	*Echinidæ*, 24 species . .	5 genera.
	Asteriadæ, two or more .	1 genus.
	Crinoidæ, . three . .	3 genera.
ZOOPHYTA, ...	Twenty-seven,	10 or more genera.

Vegetables.

Acotyledonous, ten or more species . . .	6 or more genera.
Monocotyledonous, four	3 genera.
Dicotyledonous, one	1 genus.

Total.—Mammalia, 5. Birds, one or more. Reptiles, 12. Fishes, 24. Testaceous Mollusca, 260, of which 21 are fresh water. Annulose Animals, 11. Radiated Animals, 29. Zoophytes, 27. Vegetables, 15.*

The following notice is from the English Magazine of Natural History, and was drawn up by Mr. Robert Bakewell, the well known author of an excellent elementary work on Geology :

"The collection consists principally of Fossil Organic Remains, illustrative of the Geology of Sussex. They are in admirable preservation, and are very tastefully and judiciously arranged. Many of the specimens in this collection are unrivalled and unique; indeed, we are entirely indebted to the scientific investigation of Mr. M. for the knowledge of their existence ; for when he first commenced his researches in the vicinity of Lewes, no fossil organic remains had been collected there, nor had the quarry-men noticed them in the beds in which they were working. Yet in the course of a few years Mr. M. succeeded in obtaining the finest collection of Chalk Fossils in the kingdom; many of them are described in a splendid work which he published in 1822, with forty-two plates, by his lady, Mrs. M. The most important discoveries were made in the beds of Weald clay, &c. below the chalk and green sand formation. He observed that though the latter strata, as is well known, contain exclusively the remains of marine animals, the strata of the former contain almost exclusively the remains of terrestrial plants, and shells analogous to fresh-water shells, or the bones of vertebrated animals, some of which were of enormous magnitude, and were evidently formed for walking on solid ground. The strata in which these are found must have

* As the imperfect and undetermined species are not enumerated, the number is actually much greater.

been deposited in a fresh water lake or estuary, or in the bed of a mighty river, on the sides of which lived and flourished plants and animals analogous to those of tropical climates; these strata compose a great fresh water formation below the chalk.

"It was fortunate that the ardent and intelligent mind of Mr. M., enlightened by anatomical and physiological science, connected with his professional pursuits, perceived the true value of his discoveries, but to make them properly appreciated by his own countrymen, the testimony of Baron Cuvier was wanting. This illustrious anatomist pronounced the Iguanodon, discovered by Mr. M., to be a reptile more extraordinary than all those previously known. It is indeed most extraordinary, not only from being the largest amphibious or terrestrial animal known, but from its peculiar structure, as an herbivorous masticating reptile. These observations are made chiefly to prove to country readers, how much may be done for the promotion of science, even in situations not favorable to its pursuit, at a distance from public museums, and removed from the excitement produced by associating with others engaged in kindred studies.

"The room in which the objects are placed, has been recently erected by Mr. M. for the purpose, and is well lighted from above; the larger specimens are arranged in glass cases, and the smaller ones in drawers below. It has already been stated that the collection of Chalk Fossils is the finest in the kingdom; it will not be necessary to particularize them, but it may be observed that the stone in which the most delicate animal remains are imbedded, has been partly removed with a degree of science and care, that I have noticed in no other museum, and they are displayed to the greatest advantage. The beautiful fossil fishes allied to the Zeus or Doree, from the chalk near Lewes, are particularly interesting; one of them is an unrivalled specimen, the mouth being open and entire.—But the most remarkable circumstance in some of Mr. M.'s specimens, is the uncompressed and perfect form of the bodies, which was doubtless chiefly owing to the preservation of the air-bladder, for it appears unbroken in many of the specimens. This is an important fact, as it proves that the bodies were completely incased in the chalk before the putrefactive process had commenced. In some of the fossil fishes, the fins, gills and teeth, are preserved, as well as the air bladder and tongue; the scales are also very distinct. Vegetable remains in chalk are extremely rare; there are, however, in this collection fine specimens of wood in chalk, and in the centre of flints, and also various remains of marine plants in chalk. Among the most interesting objects in this museum, are the fossils from the Sussex beds beneath the chalk formation. Many of the vegetables appear allied to the ferns and palms, &c. of tropical climates, and prove the existence of dry land, at or before the period when the strata that contain them were deposited. Of these vegetable remains there are numerous fine specimens in this collection, comprising all the fossil species discovered in Sussex. But it is the remains of large animals evidently formed for walking on land, that renders the museum of Mr. Mantell so unique. In the strata of Tilgate Forest, Mr. M. has identified no less than four gigantic reptiles. The Iguanodon, so named from its resemblance in many respects to the living Iguana, is justly regarded by Mr. M. as the most gratifying result of his labors. To form some notion of the immense magnitude of this animal, it may be useful to mention, that I measured the circumference of the condyle, or joint of a thigh-bone, in the museum, and found it to be thirty-five inches! and the thigh-bone of a larger animal at a distance from the condyle, measured twenty-five inches in circumference; were this thigh clothed with muscles and integuments of suitable proportions, where is the living animal with a limb that could rival this extremity of a lizard of the primitive ages of the world?

"Among the other bones in this museum, from Tilgate Forest, there are some of one or more species of birds. It ought, however, to be remarked, that as the supposed bird's bones found in the Lias, have been discovered to belong to a flying lizard, it may be doubtful whether these bones do not belong to a similar species of reptile; Mr. M., whose authority as a comparative anatomist ought to have great weight, is, however, inclined to refer these bones to birds.—There are also the remains of three species of Turtles from the Sussex beds, two of which are supposed to be fresh-water; the remains of fishes are also numerous: they consist chiefly of detached bones, teeth, and scales; no entire skeleton has been found.

"A very satisfactory description of the Fossils and Strata of Tilgate Forest, is given in the second volume of Mr. Mantell's Illustrations of the Geology of Sussex, a work which ought to be in every library where natural history is cultivated: the forty-two plates of the first volume, it has already been mentioned, were engraved by Mrs. Mantell, without whose able co-operation it would have been impossible for Mr. M., occupied as he is in the arduous labors of an extensive medical practice, to have effected so much for the advancement of science.

"Besides the collection of Sussex Fossils, this museum contains many interesting organic remains from various parts of the world.

"Mr. M., with much liberality, allows the museum to be seen on the first and third Tuesdays of every month, from one till three, application having previously been made by letter.

"Hampstead, Sept. 1829."

We learn from Mr. Mantell, that his principal additions since the above notices were written, are splendid fishes from the chalk, and many gigantic bones of reptiles from Tilgate forest. A fine suite of geological specimens of rocks and organic remains, illustrative of all the British formations, from the granite to the tertiary inclusive. Most beautiful tertiary shells from Palermo, collected and presented by the Marquis of Northampton. Many objects of comparative anatomy. Skeletons of Iguana, Monitor, Alligator, &c.

Mr. Mantell has also received from Dr. Morton and others, many specimens of American fossils and minerals, and their identity with those of England has been particularly remarked. The mososaurus was an inhabitant both of the old and the new world.

Mr. Mantell, at the great scientific meeting held at Oxford University in June, 1832, exhibited the first hippurites that have been found in England; they were from the chalk beds near Lewes. He shewed also drawings and specimens of the horn, claw, clavicle, os quadratum, femur, tibia and fibula of the Iguanodon.

In a mass of grit stone, blown into fifty pieces by the quarrymen, in Tilgate forest, Mr. Mantell has recently found many bones, which, with great difficulty and labor, he replaced, so as to form a slab four and a half by two and a half feet, exhibiting twelve vertebræ, eight in place, with many ribs, coracoid bones, omoplates, chevron plates, &c., and several of those curious dermal bones which support the scales. In another slab were found some beautiful metacarpal bones. In the mass of vegetable matter which enclosed the animal, were found six cropolithes, and many paludinæ and limones.

Through the kindness of Mr. Mantell, we have received an interesting and instructive suite of specimens, illustrative of his museum and catalogue. Among them are bones of his Iguanodon, of the Megalosaurus of Prof. Buckland, &c. It appears that the vegetable remains of the ancient geological periods were exuberant, and some of them gigantic, indicating a warmer climate than any now found in Europe. Several kinds of ferns appear to have constituted the immediate vegetable clothing of the soil: the elegant *Hymenopteris psilotoides*, which probably never attained a greater height than three or four feet, and the beautiful *Pecopteris reticulata*, of still lesser growth, being abundant every where. But the loftier vegetables were so entirely distinct from any that are now known to exist in European countries, that we seek in vain for any thing, at all analogous, without the tropics. The forests of *Clathrariæ* and *Endogenitæ*, (the plants of which, like some of the recent arborescent ferns, probably attained a height of thirty or forty feet,) must have borne a much greater resemblance to those of tropical regions, than to any that now occur in temperate climates.

If we attempt, says Mr. Mantell, to pourtray the animals of this ancient country, our description will possess more of the character of a romance, than of a legitimate deduction from established facts. Turtles of various kinds, must have been seen on the banks of its rivers or lakes, and groups of enormous crocodiles basking in the fens and shallows.

The gigantic Megalosaurus, and yet more gigantic *Iguanodon*, to whom the groves of palms and arborescent ferns would be mere beds of reeds, must have been of such prodigious magnitude, that the existing animal creation presents us with no fit object of comparison. Imagine an animal of the lizard tribe, three or four times as large as the largest crocodile; having jaws, with teeth equal in size to the incisors of the rhinoceros, and crested with horns; such a creature must have been the Iguanodon! Nor were the inhabitants of the waters much less wonderful; witness the Plesiosaurus, which only required wings to be a flying dragon; the fishes resembling *Siluri Balistæ*, &c.*

Mr. Mantell's principal work is the Geology of Sussex, in two quarto volumes, the first of which appeared in 1822, consisting of 320 pages, with forty-two plates, executed by Mrs. Mantell, who has most nobly and skilfully aided her husband in his important researches and publications. The second volume appeared in 1827; it consists of ninety-two pages, with twenty plates, and is particularly remarkable for containing the drawings and description of the bones

* Mantell's Geology of Sussex, and Fossils of Tilgate Forest.

of the gigantic extinct fossil animal, the Iguanodon; both volumes now lie before us. Mr. Mantell's other philosophical works are,

1. Letters on the Geology of the Environs of Lewes. Published in the Sussex Advertiser, 1813.

2. Description of a Fossil Alcyonium (Ventriculites.) Published in the 11th Vol. of the Linnæan Transactions.

3. The Fossils of the South Downs, or Illustrations of the Geology of Sussex, 1 vol. royal 4to, with 42 plates, engraved by Mrs. Mantell; London, 1822.

4. Notice on the Hastings Strata in the Geological Transactions, 1826.

5. Memoir of the Geology of the Environs of Lewes, in the 1st Vol. of the History of Lewes, 1824.

6. Notice of the Iguanodon, a newly discovered Fossil herbivorous Reptile, from the Strata of Tilgate Forest. Philosophical Transactions for 1825.

7. A Folio Plate of remarkable Fossil Fishes, from the Chalk near Lewes, 1826.

8. Notice on the Geological Position of the Strata of Tilgate Forest. Edinburgh Philosophical Journal, 1826.

9. Sketch of the Geology of the Rape of Bramber, with Map and Plate, 3rd Vol. of the County History of Sussex.

10. Systematical Catalogue of the Organic Remains of Sussex, in Illustration of a Paper on the Strata of the South-eastern Part of England, by Dr. Fitton. Geological Transactions.

Mr. Mantell has other philosophical labors in hand, the result of which we may hope to hear of in due time.

We must not omit to mention the History of the Antiquities of Lewes and its Vicinity, by the Rev. T. W. Horsfield, F. S. A., of which the part relating to Natural History is by Mr. Mantell. This work is in two splendid quarto volumes, rich in plates, illustrating buildings ancient and modern, scenery, ancient tombs, coins, weapons, utensils, &c. &c. It is a most curious and instructive work, and possesses a familiar interest even to a transatlantic reader. Sussex and the vicinal counties were, for centuries, the principal seat of the Roman Empire in Britain; and in this part of the island happened many memorable battles, and other great events in Danish, Saxon and Norman warfare, and political sway. Hastings, where Harold lost, and William the Norman gained a crown, is but a few miles from Lewes. We, in this country, have almost an equal interest with the English in tracing our descent from those warring and discordant nations; and their antiquities must ever be objects of gratifying research to Anglo-Americans. England is rich in splendid local histories, and that of Sussex is probably one of the most remarkable.

Mr. Mantell has published also an interesting account of the visit of their present majesties to Lewes in October, 1830. The quarto is adorned by beautiful engravings of the royal personages.

We discover, here and there, that Mr. Mantell is not unacquainted with the muses; he like Sir Humphry Davy, exhibits the philosopher and the elegant scholar united, and proves that he is capable alike of exploring the most obscure and minute facts in science, and of rising into flights of euphonious and elevated verse. This appears in the concluding ode of the work just mentioned, contrasting the peaceful visit of William IV. in 1830, with the bloody visitation of Henry III. in 1264, when, after a destructive battle near Lewes, finished in its very streets,* this king granted to force, what William IV. has peacefully conceded—a reform in the national representation.

Mr. Mantell, actively engaged in the very responsible duties of a laborious profession, and notwithstanding the interruptions to which he is liable from the numerous visits, not only of scientific men, but of the gentry, passing to and from Brighton, the modern Baiæ, which is but seven miles from Lewes, still redeems time from repose, to write instructive and interesting works, and to sustain an extensive correspondence with scientific men both at home and abroad. The fine old town of Lewes, presents many ruins, among the most interesting of which are those of its Abbey, of the Priory of St. Pancras, and of its Castle, all of which were in full glory at the time of the visit of Henry III. and afforded protection to that monarch and his fugitive followers. The Castle, judging from the views of it in the History of Lewes, is still an imposing ruin; and Mr. Mantell's house is at the foot of a bank, which is joined by a small garden to another bank, on which the castle stands. Its venerable ivied towers hang immediately over, and form the best substitute for an extensive and more distant prospect; a fit residence for a philosopher and a philanthropist; for every friend of man must rejoice in viewing the *ruined*

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* With his revolted barons.

fortresses of an iron age, of arbitrary power, and although it is not appropriate to this work, we shall still be pardoned in indulging the wish that this favored abode may long remain sacred to science and domestic happiness.

2. *British Association for the Advancement of Science.*—The second meeting of the British Association for the advancement of Science, was held at Oxford, on Monday, the 18th June, and continued on the subsequent days of that week. It may be proper to recal to the minds of our readers, that the first meeting of this great association took place at York, last year, under the most distinguished patronage. The present meeting, held within the venerable walls of the University of Oxford, and under the patronage of some of its most distinguished ornaments, has been attended with the most brilliant success.

Monday was occupied with preliminary arrangements, and especially the formation of sections and committees, in which the numerous papers on different branches of science submitted to the association on this occasion, were to be read, and where the votaries of science were collected together to enjoy the advantages of a mutual interchange of ideas. On the evening of that day, the members of the Association were invited to attend at the Clarendon building, for the purpose of scientific conversation.

At ten o'clock on Tuesday morning, the following committees met in different apartments of the Clarendon building:

1. The Committee of Mathematical and Physico-Mathematical Sciences.

2. Of Chemistry, Electricity, Galvanism, Magnetism, and Mineralogy.

3. Of Geology and Geography.

4. Of Natural History (including Medicine.)

These committees appointed each its own chairman and secretary, and were employed, between the hours of ten and one, in their respective departments of science. At one o'clock the various committees met in the great theatre. Lord Milton, the president of the preceding year, delivered an eloquent address, on resigning his duties to Dr. Buckland, who, on taking the chair, opened the business of the meeting by an appropriate speech. Professor Airey, of Cambridge, then read his promised report "on the state and progress of astronomical science, in reference particularly to physical astronomy." He was followed by the Rev. Professor Whewell, of Cambridge, who read a report furnished by J. W. Lubbock, Esq. Vice-President of the Royal Society, "on the means of calculating the time and height of high water." These valuable reports were listened to with the utmost attention, by a crowded audience, which included the beauty and fashion of Oxford.

The members of the Association resident in Oxford, afterwards gave a sumptuous entertainment to their fellow members in the great Hall of New College. Two hundred and fifty-three noblemen and gentlemen sat down to dinner on this occasion. Dr. Buckland was in the chair, supported on his right hand by Lord Milton, and on his left by the Vice-Chancellor of the University. Among the company present, we noticed the Marquis of Northampton, Lord Selkirk, Lord Morpeth, Lord Sandon, Viscount Cole, Sir Thomas Acland, Sir Thomas Brisbane, Sir David Brewster, Mr. Davies Gilbert, Professor Hamilton of Dublin, the Rev. A. Sedgwick of Cambridge, &c. &c.

A variety of appropriate toasts and speeches enlivened this social meeting. On the following morning the whole Association breakfasted, by invitation, with the Vice-Chancellor, the head of Exeter College. The hall of this College being insufficient to accommodate the numerous party assembled, tables were laid in the gardens. At ten o'clock the Association adjourned to the Clarendon, where, separating into their respective sections, scientific business was resumed, as on the preceding day.

Many interesting papers upon different branches of science were read at the sectional meetings on this and the subsequent days, which want of space prevents us from enumerating. We must make an exception, however, in favor of one paper, bearing more directly than others upon medical science,—namely, Dr. Prout's important "Observations on Atmospheric Air;" in the course of which, this distinguished philosopher pointed out, that, in London, the air underwent a remarkable and sudden increase in its specific gravity, at the precise period when cholera first appeared there.

The reports read at the *General* Meeting, on Wednesday, were—"On Thermo-Electricity, and on the allied subjects in reference to the discoveries recently made in them," by the Rev. Professor Cumming, of Cambridge. "On the present state of Meteorological Science," by James David Forbes, Esq. F. R. S. L. & E.; and "On the Phenomena of Sound," by the Rev. Robert Willis, of Cambridge.

On the evening of Wednesday, Mr. Ritchie, of the Royal Institution, delivered a popular lecture on the recent discoveries in electro-magnetism. Dr. Turner gratified a numerous audience by a display of experiments illustrating the phenomena of chemical action.

The morning of Thursday was set apart for the ceremony of conferring, in full convocation, honorary degrees on four of the most distinguished cultivators of science, members of the association, unconnected with the university of Oxford—namely, Sir David Brewster, Mr. Brown, the well-known botanist, Mr. Faraday, and the venerable John Dalton. At the conclusion of this ceremony, honorable alike to the university and the association, Dr. Buckland proceeded, with a numerous equestrian party, to survey the geology of the neighborhood; while Professor Henslon, with a party of pedestrians, enjoyed a botanical excursion. Sectional meetings were held in the evening, in which important discussions took place.

The reports read at the general meetings of Friday and Saturday, were, "on the progress of optical science," by Sir David Brewster; "on the state and progress of mineralogical science," by the Rev. Professor Whewell, of Cambridge; "on the phenomena of heat," by the Rev. Professor Powel, of Oxford; and "on the recent progress of chemical science," by James F. W. Johnston, Esquire, F. R. S. E. The business of the meeting concluded on Saturday with an interesting lecture "on fossil remains," by Professor Buckland.

It was agreed that the next annual meeting should be held at Cambridge, and the association separated with the most lively feelings of gratitude towards the university of Oxford for the uniform attentions and hospitality bestowed upon them during this week, so memorable in the annals of British science. We doubt whether upon any former occasion so many distinguished ornaments of science from all parts of the British dominions were ever assembled together.

In consequence of the unanticipated extent of this Association, and the great accumulation of matter, the meeting not being previously prepared with a suitable plan of organization to meet the emergencies, the sister sciences of medicine do not appear, at the late meeting, to hold that place in the programme to which their importance and interest entitle them. Several scientific members of the profession appeared at different periods of the week, and enrolled their names; but the display of animal and vegetable physiology was somewhat meagre. The arrangements for sectional papers and oral communications were, we understand, thrown into some confusion latterly; and a forthcoming report by Mr. Broughton, on some recent physiological investigations, could not obtain a hearing before the morning of the last day, when the greater proportion of the members devoted to such subjects had left Oxford.

The popular exhibitions of the two great leaders in geology—Professors Buckland and Sedgewick—absorbed the almost undivided attention of the meeting, whenever these two talented geologists lectured; so that other sectional communications were necessarily postponed upon such occasions.—*London Medical Gazette, June*, 1832.

3. *Leipsic Fair, Autumn*, 1831.—The Leipsic catalogue of books for the Michaelmas or autumnal fair, in 1831, announces two thousand seven hundred and thirty eight new works. At the Easter or spring fair for the same year, the German press had put into circulation two thousand nine hundred and twenty works. The number, therefore, of new publications in Germany for the year 1831, is five thousand six hundred and fifty eight, which is two hundred and sixty eight less than for the year 1830.

Among the two thousand seven hundred and thirty eight works of the last fair, we find ninety written in foreign modern languages, seventy nine romances, twenty seven theatrical pieces, one hundred and twenty five on the cholera morbus, and very nearly as many upon the politics of the day. The affairs of the several states of the German confederation have given rise to some pamphlets, but the greater part of these are devoted to the cause of Poland. The lively interest felt in Germany for this unfortunate people is not less manifested in their romances, many of which have their heroes and heroines taken from among the defenders of Poland.

In general, we remark in this catalogue the absence of great names and of important works for the advancement of the sciences. Yet the department of history has not furnished fewer valuable publications than in former years; and in this branch Germany has preserved its usual preeminence. In proof of this, we mention the following publications: the sixth and last volume of the History of the Roman Law during the middle ages, by Savigny; the History of the Macedonians, by Flathe; additions to the History of the Teutonic Order in Prussia, by Schubert; an Essay upon the Commerce of the Middle Ages, by Wilda; the Cities of Suabia during the Middle Ages, by Jäger; the History of the City of Vienna, by Mailath; the History of the City of Augsburg, by Seida; the History of Tyrol, by Mersi; the sixth volume of the History of Germany, by Luden; the fourth volume of the Modern History of the Germans, by K. A. Menzel; the History of Ferdinand I., by Buchholz; the Conspiracy against Venice in 1618, by Ranke; the fourth part of the translation of the History of the Crusades, by Michaud; Monumenta Boica, published by the firm of Cotta; a new edition of the History of Modern Times, by Hormayer; Letters written from Paris on the History of the sixteenth and seventeenth Centuries, by Raumer; the Almanac of Modern History, by W. Menzel; a work upon the Prussian Campaigns in 1793, from posthumous papers, by Wagner; the Military History of the years 1813—1815, by Stuhr; the History of the War between Russia and Turkey, by Ehrenkrenz; the History of France under Louis XVIII., and under Charles X., by P. Kobbe; the History of secret Associations in Germany, Poland, and Russia; the Memoirs of Baron Julius Soden; a Historical Almanac, by Raumer; an Abridgement of Universal History, in four volumes, by Rotteck; the History of Painting, by Lanzi; the third part of the second volume of the History of the Church, by Neander; the Critical History of primitive Christianity, by Gfrörer. Grimm has published the third part of his celebrated German Grammar. A collection of the works of J. Muller and Westerreider has been published. Among biographies, we notice the Life of Durer, by Neller; the Life of Keppler, by Breitschwert; Letters of J. H. Voss, those of Bagesen, and the sixth number of the Life of John Paul.

The natural sciences are enriched with numerous medical works, and some interesting accounts of travels, such as the Description of the Black Forest, by Buhrlen; Burkhardt's work on the Bedooins; China and Manchooria, by Plaths; the Travels of Heber in India; Geognostic Observations in the Uralian Mountains, by Hoffmann; a work on Japan, published at Berlin, by Hasselberg; Travels in Egypt and in the Holy Land, by Prokesch; the second part of Travels in Colombia, by Gosselmann; Travels of Wenchs and of Martius in Brazil; the third part of Russia as it is, by Sainte-Maure; Travels of Lessing in Norway; Travels of Horn in Germany, considered in respect to medicine, &c.

For theology, besides the works upon ecclesiastical history which we have already mentioned, we notice three works on Saint Simonism, of which one is by Carové; a new edition of False Theology, by Steffens; and the Apotheosis of Lutheranism, by the same author.

Philosophy is at this time rather poor in important works. We find in the catalogue but one new Encyclopedia, by Herbart; the third part of the History of Philosophy, by Ritter; the Anthropology of Heinroth; and a new edition of the Critique of Reason, by Fries. We mention also a new work of this last author on the organization and administration of the German States. Schelling, the veteran of German philosophy, who obliges us still to wait for his great work announced so long ago, has published a little treatise on Method in philosophical studies.

The letters of Börne are not found in the catalogue. As to political pamphlets, published anonymously, the most remarkable are, that of Murhardt upon the sovereignty of the people, and another by Troxler.

Literature, properly so called, is, as usual, rich in new publications. There are complete editions of the works of Spindler, Van Der Velde, Eberhard, of Madam Schopenhauer, collections of the works of W. Alexis, L. Schefer, and of Madam Th. Huber. Of the lyric kind, we notice the fifth edition of the poems of Uhland; a Latin translation of all Schiller's poems, by Feuerlein; a German translation of the songs of Béranger. The sixth volume of Shakspeare, by Tieck and Schlegel, has just appeared; also some novels by Tieck, and the fifth edition of Don Quixote. The firm of Weidmann announce the approaching publication of Russian Legends. We shall not pass over in silence the work of the unfortunate Lessman, the Travels of a melancholy man and his preparation for death. Harro Harring, who has recently published Memoirs of Poland, announces additions to his work. Among romances, the most worthy of notice, are those of Beckstein, Bronikowski, Chézy, Agnès Franz, Gersdorf, Hanke, Herloszsohn, Lewald, Pichler, Storch, Wolf, &c.

In communicating to our readers this recent information upon the state of the German press, we would draw their attention to the new character which it has begun to assume, especially since the French revolution of July, to wit, the political bearing of their publications. We all have felt the most lively joy in learning the happy issue of the persevering efforts of Welker, of Rotteck, of Mebold, of Jordan, who have sustained with so much devotion a courageous contest for freedom of thought in their country.—*Revue Encyclopédique, Nov.* 1831.

CHEMISTRY.

1. *New Experiments in Caloric*, by MM. Nobili and Melloni, *performed by means of the Thermo-multiplier.* (Translated and abridged from the Annales de Chim. et de Phys. Oct. 1831, by C. U. Shepard.)—The Thermo-multiplier is a species of thermoscope, which is so delicate an indicator of temperature, as to be sensibly affected by the natural heat of a person, placed at the distance of twenty-five or thirty feet. The principal parts of the instrument are: 1st, a thermo-electric pile; 2ndly, a galvanometer with two needles, which are specially designed for the thermo-electric currents. It is the first part of this apparatus which constitutes it a thermoscopic instrument; the second serves simply as an index. The heat excites the electric currents in the pile; these currents pass through two metallic wires which connect the two kinds of apparatus together, are transmitted to the galvanometer, and act through their influence upon the steel needle, by causing it to turn round from its natural position of equilibrium with a force more or less striking, according to the intensity of the calorific emanation.

Heat radiates freely through the atmosphere; it traverses also under the radiant form, glass and rock crystal. This would induce us to imagine, that the instantaneous passage of the rays of heat through bodies, depends upon the same circumstances which allow of their permeability by the rays of light; or, in other words, that the instantaneous passage of radiant heat through bodies, depends upon the degree of their transparency. This in fact, is what generally happens; for the heating rays traverse with more or less facility, selenite, mica, oil, alcohol, and nitric acid. Of this we assured ourselves by the following experiment. Laminæ, or strata of these different substances, were placed successively at the extremity of the cylindrical appendix, whose axis was vertical and superior to the reflector. At a certain distance above it, a ball of iron, heated either in live coals or boiling water, was rapidly passed; and at the same instant, the steel needle was seen to deviate more or less from its position in equilibrio.

But if the general law of the rapid movement of the caloric through the transparent substances above mentioned, is thus established, it is altogether the reverse as respects the most useful and the most widely diffused liquid in nature. Water intercepts the instantaneous passage of the calorific rays: it intercepts them entirely; and the obstacle which it opposes to them is so insurmountable, that it is in vain for us to reduce the thickness of ... w... n to the least possible film, or even to heat the iron ball to r... and to pass it slowly over the thermo-multiplier; the index always preserves the most perfect immobility.

After the foregoing experiments, it could not be imagined that this singular property of water should be owing to its fluidity; since the alcohol, the oil, and the nitric acid, all partake of the same physical constitution, while they conduct in a manner totally different. We had a right therefore, to attribute the effect to the chemical constitution of water. Nevertheless, we were disposed to resolve the question directly, by performing the experiment upon solid water. With this intent, we took two thin layers of very transparent ice; we applied them to the appendices of the thermo-multiplier, which, in the present instance, were two equal cylinders. By this means, the radiation towards the ice being the same on both sides, the needle assumed the place of zero on the scale. We then presented the heated ball at a little distance from the upper layer of ice; the needle experienced no alteration in its position.

These experiments, which we have repeatedly made, show, in the most satisfactory manner, that water owes to a peculiar property, dependant upon the nature of its molecules, the remarkable exception which it presents among transparent bodies of assisting the instantaneous passage of radiant caloric.

It has been very generally admitted until recently, that insects do not possess a temperature independent of the medium in which they are situated. Notwithstanding, the carbonic acid which is formed in the atmosphere from the action of these little animals, placed beyond a doubt the existence of a slow combustion in the interior of their bodies,—a combustion which must of necessity give rise to the extrication of heat. This has in fact been demonstrated of late through the experiments of John Davy, who measured the temperature of several insects by making incisions into their bodies, and introducing the bulb of a thermometer. He perceived that their temperature was in general a little superior to that of the atmosphere. Among twelve insects taken from different classes, he found two, the *scorpion* and the *julus*, whose temperature, instead of being higher, was 2° below that of the surrounding air. The method of Davy was unsatisfactory, inasmuch as it was inapplicable to all insects, except such as possess extraordinary dimensions; besides, it did not give the temperature of the animal in the natural state, but in a maimed and suffering condition [illegible] thermometer must have been affected by the evaporation [illegible] fluids of the insect. The thermo-multiplier, slightly modified, offers the means of repeating these experiments without incurring any of the inconveniences above alluded to. As the result of our experiments, it must be admitted that insects possess a temperature of their own, however slightly superior it may be in some cases to that of the surrounding medium. Without enlarging upon the names of the different insects submitted to our instrument, or stopping to particularize the effects produced on each individual, it will suffice to say—that we have experimented upon more than four hundred indigenous insects, selected from all the different classes, and in all the states of metamorphosis in which these animals are ever found. The differences of temperature amount in some cases to 30°; but all the divisions of the needle were positive; that is to say, in the calorific sense of the insect.

In comparing the different results obtained in the order of the Lepidoptera, we observed a law, which seems worthy of remark; viz. "The caterpillars always possess a more elevated temperature than the butterflies or the chrysalides."

Now the respiratory system of insects in the caterpillar state, is much more developed than that of the same animals metamorphosed into chrysalides, or into butterflies; and we should say from these signs, that the insect, in the first period of its life, where its nourishment is abundant and its growth rapid, converts into carbonic acid a much greater quantity of oxygen, than at subsequent periods. It follows from admitting these considerations and the law announced, that the heat of the animal will vary, so to speak, proportionally to the quantity of oxygen employed in the act of respiration.

The theory which attributes animal heat to a slow combustion of the blood, appears then to be supported not only by the comparison of birds and mammifera, of mammifera and reptiles, which possess a temperature as much more elevated as their respiratory system is more active; but also by the relation which subsists between the vivacity of the respiration of certain insects and their temperature.

There are many bodies which, like insects, give us reason to believe that they possess a temperature independent of the surrounding air. These may be submitted to the trial of the thermo-multiplier. It is thus, for example, that we have obtained a deviation of 50° in introducing into the interior of our apparatus a very small piece of phosphorus—a substance which, in contact with the most delica thermometer, affords no indication of heat. Phosphorus has bee cited as an example of the disengagement of light unattended by caloric: we see, therefore, that the supposed separation of these two agents is not real. With respect to the temperature of the luminous rays of the moon, the different means we have adopted in order to decide upon this subject have not completely succeeded; but we think that we are able to assert, that, if the rays of the moon really possess a peculiar temperature, it cannot happen except to a fraction of a degree excessively small.

The thermo-multiplier, possesses many advantages in determining the reflecting powers of different surfaces. Our experiments prove that Mercury is the best reflector of caloric: after which, come copper and the other metals, in the order indicated by Leslie. Polishing increases the power of reflection, but to a much less degree than is ordinarily supposed. Non-metallic substances have scarcely any power of reflecting heat, whatever may be the nature of their surfaces.

The method which we employed for ascertaining the absorbing powers of different bodies, is very simple. The substances, upon which we wish to experiment, are attached to equal disks of sheet-tin, to the opposite side of which is attached a stem, perpendicularly from its centre. The substances are exposed for several minutes to the rays of the sun, and are then presented to the instrument. By operating thus, we do not obtain results absolutely free from error; but we learn with a high degree of precision, whether one surface has a higher absorbing power than another. Here follows the order of our experiments.

In the first place, we wished to assure ourselves, whether, what has so long been admitted, the state and the color of surfaces have any influence upon the absorbing power. In order to resolve the first of these questions, we employed two metallic disks, one in its natural state, the other was covered with furrows or scratches: the motion of the needle took place constantly from the side of the furrowed disk. As to the second question, we could not resolve it directly, since in altering the color of a surface, we necessarily alter the chemical nature of the surface which composes it. It was necessary therefore to resort to an indirect solution. With this view, we colored many pair of disks black, or white, with all sorts of vegetable and mineral pigments; we covered others with layers of marble or of wood, with fabrics of silk, wool and cotton. The absorption was always ıe strongest by the black surfaces. Now, since the effect was the ıme, whatever the chemical composition of the coloring matter, it is proper to infer that it is wholly independent of the coloring matter, and that is derived simply from the action of the color.

But are these two circumstances of color and surface, the only ones which communicate to bodies the faculty of absorbing calorific rays? In order to ascertain this point, it was necessary in the first place to proceed independently of the said circumstances of surface and color. For this purpose, we took white fabrics of silk, of cotton, of wool, of hemp and of flax; all exactly equal in the size of the thread, in the tissue and in the shade. The five tissues were applied with gum to the disks, exposed to the sun, and presented to the instrument. We obtained the following order for the absorbing power: *silk*, *wool*, *cotton*, *flax* and *hemp*. This is just the inverse order of their conductibilities.

There are no very great differences in the tone or the tints which the common metals present; and if we except lead and tin, we can communicate to them all nearly the same degree of polish. We covered, therefore, several disks with equal sized metallic layers, and in submitting them to the instrument, we obtained the same result. The scale of the conductibility of the metals is, as is known, *copper*, *silver*, *gold*, *steel*, *iron*, *tin* and *lead*. Our experiments upon the absorbing powers of different substances show, therefore, that it is precisely the reverse of their powers of conduction.

Many mineral substances are found which affect the yellowish color of wood: we selected therefore, plates of wood and of stone, equal as nearly as possible as to the state and color of their surfaces; and we repeated upon them the same experiments as upon the metals and the tissues. The woods, which were worse conductors than the minerals, were nevertheless, those which showed the greatest absorbing power. Finally, we compared lead with a stone of similar color. The substance possessed of least conductibility, proved the most absorbant; that is to say, the stone gave an absorbing force superior to that of the lead.

At first, we were tempted to believe that this inverse relation between the absorbing and conducting powers, exists only in appearance; and is derived from the resistance, more or less considerable, which the motion of the caloric experiences from the action of the bodies: so that the caloric, not being able to pass freely through the internal strata of the non-conducting substances, accumulates at its surface in greater quantity than in substances of higher powers of conduction. But then the under surface, in the disk composed of non-conducting matter, evidently ought to acquire a less elevated temperature than in the disk formed of the body whose conducting power is better: and in turning from the side of the pile the face of each disk which has not received the direct impression of the solar rays, we ought to perceive an opposite effect. But this does not take place; for whichever of the surfaces of the disks we present to the instrument, we always obtain the same result. We conclude therefore, that "the color and state of the surface of bodies being the same, one body is possessed of greater absorbing power, in proportion as its power of conduction is less." This law, new and unexpected, seems destined to play an important part in the theory of radiant caloric.

Extracted and Translated by Prof. Griscom.

2. *New process for obtaining Morphine.*—Ant. Galvani, (Ann. delle Scienze, etc. Maggio et Giguno, 1831,) describes a method of obtaining, directly from opium, morphine free from narcotine. He admits that his process is a modification of that contrived by M. Guillermond, apothecary at Lyons. It consists essentially of reducing, by evaporation, the alcoholic solution of opium, to the density of an extract, then by successive solutions and filtrations, to separate from all the resinous matter of the extract, which causes the narcotine to be separated from the morphine;—a prolonged ebullition with calcined magnesia, a succession of filtrations, washings and desiccations, produces at length very pure morphine, completely separated from all narcotine.

With respect to the resinous matter, by dissolving it in dilute sulphuric acid, and decomposing the solution by potash, the narcotine is precipitated, and must be purified by treating it again with sulphuric acid and ammonia, filtering, resolution in alcohol at 24°, and crystallization. In making, with one pound of opium, five tinctures in alcohol of different degrees of strength, the author was enabled, by the foregoing process, to obtain from it eight drachms of very pure morphine.

3. *Action of Oils upon Oxygen gas, at the temperature of the atmosphere;* by Theod. De Saussure.—The experiments upon this

subject were made over mercury in cylindrical vessels which contained 180 or 200 cubic centimetres of oxygen, extracted from chlorate of potash. The oil formed at the surface of the metallic fluid, a stratum of 33 millimetres in diameter, and about three millimetres thick, (about $\frac{1}{10}$ of an inch). The receivers were replenished, as it became necessary, by fresh gas. They were exposed to a diffused light, and to a temperature not exceeding 75° F. in summer, and approaching to zero in winter. The volumes were reduced to 60° F., and to a pressure of 29.2 inches.

1. *Olive Oil.*—This was exposed during five months without any sensible action on the gas, and without absorbing more than its volume of oxygen. The most rapid absorption was in the sixteenth month. In the course of four years, it had observed 380 cubic centimetres of gas. The oil was then a little thicker, and had entirely lost its color. It was very rancid. The residue of the gas, 124 c. c. consisted of

Carbonic acid, - - - - - -	81.7
Azote, - - - - - -	14.9
Hydrogen, - - - - - -	23.2
Oxygen, - - - - - -	4.2
	124.

2. *Oil of Sweet Almonds.*—In the first week it absorbed 3 c. c., in one year 140 c. c., and in four years 427 c. c. In the last year the absorption was 30 c. c. The remaining 142 c. c. of gas contained

Carbonic acid, - - - - -	96.
Hydrogen, - - - - - -	20.4
Azote, - - - - - -	18.7
Oxygen, - - - - - -	6.9
	142

3. *Hemp Seed Oil.*—This oil is siccative. The two former are not drying oils. It was of a deep greenish yellow. The absorption during three months was slow, then increased in rapidity, and the color gradually disappeared; the oil thickened, and a gelatinous pellicle appeared on the surface. In the course of a year, the oil had absorbed 577 c. c., in the second year 29 c. c., and in the third 14 c. c. The whole gas disappeared, amounted to 620 c. c. The oil was semi-fluid.

The residuary gas contained,

Carbonic acid,	90.7
Hydrogen,	26.4
Azote,	17.8
Oxygen,	3.6
	138.5

4. *Nut Oil.*—In seven months it absorbed but 3 c. c.: in six weeks following, it increased to 7 c. c.; in the next week it suddenly absorbed 27 c. c. per day, under a temperature of 73° F. It absorbed in the whole 578 c. c. of oxygen, and was almost entirely discolored by the operation, and was reduced to so gelatinous a condition as not to stain paper.

It thus appears that the drying oils form less carbonic acid than the non-siccative oils;—olive and almond produce one volume of acid gas, for the fourth or fifth of the oxygen absorbed,—and the nut and hemp, one volume for the seventh of the oxygen.

Volatile Oils: 1. *Lavender.*—The same quantity of these as of the former were similarly exposed. The total absorption of lavender oil 443.5 c. c. The remaining gas was,

Carbonic acid,	82.6
Oxygen,	51.0
Azote,	24.5
Hydrogen,	6.9
	165

The oil turned yellow and preserved its fluidity nearly unimpaired.

2. *Citron Oil.*—Quantity of gas absorbed, 528 c. c. in the course of about one year. It was colored brownish yellow.

Residue of air,	Carbonic acid,	61.9
	Azote,	25.2
	Oxygen,	16.8
	Hydrogen,	10.8
		114.6

3. *Turpentine.*—Quantity absorbed in a year, 440 c. c., and in thirty three months, 475; color deep brownish yellow.

Residual air,	Carbonic acid,	66.
	Hydrogen,	20.5
	Azote,	13.8
	Oxygen,	.3
		100.6

It is remarkable that oxygen deprives fixed oils of their color, and colors volatile oils.

Experiments of this nature will give rise to the discovery of other products. The oxygenation of the essence of lavender, for example, affords a compound which, treated with potash, yields an abundant salt, unchangeable in the air, and remarkable for its beautiful and easy crystallization.

4. *Naphtha.*—The naphtha of Amiano, when rectified, has a much weaker action on the air than any of the preceding oils. 2.145 c. c. of this naphtha, kept over mercury in a cubic decimetre of air, for one year, did not change its volume. In six years, it had absorbed 9.4 centim. cub. of oxygen, and formed 1.3 c. c. of carbonic acid. The naphtha preserved all its transparency and whiteness; but it had deposited on the sides of the receiver, a thin coating of a yellow color, and the mercury was covered with a small quantity of black powder, which had all the character of a sulphuret of mercury.

The author found that a kilogramme of natural and impure naphtha, furnished by careful rectification, about 20 grammes of white naphtha, density .755. It has then an elastic force equal to 2.8 inches of mercury at 68° F. It begins to boil at 158° F. in a platina crucible, but it acquires by ebullition a constant temperature of 192° F. It dissolves in the cold, in all proportions, in absolute alcohol. One hundred parts of spirit of wine, (density .835,) dissolve only 14. Its analysis, by distilling it slowly through incandescent iron turnings in a porcelain tube show it to consist of

Carbon, - - - - - -	84.65
Hydrogen, - - - - - -	13.31
Oxygen, - - - - - -	1.04
Sulphur, - - - - - -	a trace.

Bib. Univ. Fév. 1832.

4. *On the injurious action of gases on Vegetation;* by M. Macaire.—At the suggestion of M. De Candolle, the author performed several experiments to ascertain whether certain gases were equally injurious to plants by day as by night. Agriculturists have sometimes complained that certain manufactures injured the vegetation around them, whereas chemists who have been appealed to, have found from their experiments that the plants were not injured by the action of those gases. From the suspicion that their experiments were always

made in the day time, and that the result might be different in the night, the following trials were made.

Plants of Euphorbia, Mercurialis, Senecio, Sonchus, and Cabbage, were placed, in the morning, in a large vase into which chloride of lime was introduced. The roots of the plants were immersed outside the vase. The quantity of chlorine disengaged was far from being sufficient to affect the vegetable tissue. In the evening the plants had not suffered, and the odor of the chlorine was natural. The same plants, without any addition whatever to the chlorine, were all faded the next morning, after having passed the night in the chlorine, except the cabbage, which had resisted its action. The odor of the chlorine had disappeared, and in the room of it, a disagreeable acid odor was manifest. The experiment was several times repeated, with an increased quantity of chlorine, and with the same result; and the plants which during the day supported a strong atmosphere of chlorine, were always withered in the night by a smaller dose.

Nitric Acid.—With the vapor of nitric acid, introduced in the evening, the plants were found withered in the morning, some of the leaves being browned by the action of the acid. When the experiment was commenced in the morning, although some of the leaves were browned, the others were not withered.

Nitrous acid gas.—Appeared to be a violent poison to plants, and killed them in the night by very small doses. Nevertheless, by day they were not sensibly altered, though the disengagement of gas was abundant.

Sulphuretted hydrogen.—The same result precisely. Plants left in it during the night were all withered in the morning, although they were not in the least altered in the light.

Muriatic acid gas.—The same results. The plants do not perish by day, even when there is gas enough to brown one or two of the leaves. They are entirely dead in the morning, leaving the peculiar odor before mentioned. Cabbage is still an exception.

It appears then, that several gases are injurious to vegetation, but that their action is exerted only in the absence of light, as M. De Candolle had foreseen.—*Idem.*

5. *On the Distillation of Bread.*—Finding it announced in the English Journals, that alcohol is distilled from bread during the baking, and may be collected by condensing the vapor, M. Lejeune and B. Moneuse were induced to repeat the experiment. Having

adjusted tubes of large and small diameter to the oven, connected them with a worm, and luted the mouth of the oven, they procured, from the baking of two hundred loaves, by means of the large tubes, about 50 litres (=13¼ gallons) of a limpid fluid, of a yellow color, a sweetish taste, and emitting the odor of rye bread. Reagents indicated the presence of acetate of lead resulting from the tubes of that metal, acetic acid, *but not a trace of alcohol.* When the distillation was performed through small tubes, the quantity of liquor obtained was but three or four litres. Surprised at finding no alcohol in the product, according to the statements of the English Journals, the process was varied, but with the same result, and as a counter proof, a quantity of alcohol was placed in a vessel in the middle of the oven, but instead of a simple distillation, it was decomposed or absorbed by the materials, and the quantity of acetic acid was sensibly augmented. From this it may be inferred,

1. That the materials of an oven are too permeable to prevent the alcohol from passing through them.

2. That at the temperature of 300° cent. the alcohol, if it exist, is immediately transformed into acetic acid by the air contained in the oven, or that which percolates through the materials. Whether an oven constructed of iron plates would furnish alcohol has not been determined, at least in France, and to prevent the disappointment into which speculators may be led, the writers were induced to make known the result of their experiment.—*Idem, tome* 15, *p.* 190.

6. *Imitation Silver.*—Cutlers, and all those who have occasion to imitate silver, often purchase, very dear, an alloy called mailchior for escutcheons and other ornaments. It possesses considerable tenacity, and may serve as a substitute for silver in certain instruments of surgery. The two following prescriptions are both practised according to the uses of the metal. Their preparation requires the same precautions.

Melt in a Hessian crucible of the capacity of a quart, twenty ounces of nickel, six oz. of red copper, two oz. of salt of tartar, and three oz. of good clear glass. When the mixture is liquefied, withdraw it from the fire, and when the crucible begins to lose its redness, project into it 4 oz. of pure granulated zinc, and stir it carefully, that the zinc may be well diffused; place it for a very short time over the fire, and then pour it out on an earthen slab, removing carefully the scoriæ. This mixture is somewhat brittle; the following is more solid.

22 oz. of nickel, 18 oz. of copper, 5 oz. of zinc, and the same quantity as before mentioned. If the zinc contains the least quantity of arsenic, the alloy will be yellow.—*Jour. de Connois. Usuelles, tome* 12, *p.* 89.

GEOLOGY.

Cuvier and Brongniart's *report on* M. Deshayes' "*Tableau comparatif des coquilles vivantes avec les fossiles des terrains tertiaires de l'Europe.*"—Among the organized bodies preserved in the strata of the earth, none are more abundant, more diffused, or more interesting to science, than shells. Their rapid multiplication and their stony nature have contributed, at once, to their preservation in great numbers; so that they furnish the most positive proofs of the condition of the ambient fluid at the period when each bed was deposited on its bottom.

M. Deshayes has undertaken to examine the shells of each stratum, and to compare them with those of the superior and inferior layers, as well as with those now living in the ocean in different latitudes, with a view thereby, to ascertain whether there have been a succession and extinction of races, and to discover how those of the races which have escaped the changes of the surface of the earth have been distributed throughout the various regions of the sea. He was well convinced that he could not arrive at any conclusions on this point that would be free from objections, until he had observed and compared the greatest possible number of species;—that it was not genera but species which must be taken into account,—that genera, which are only creations of the mind, would supply no important information, when they passed from one series of layers to another, while they did not pass in the same identical species.

He has thus been able, by unexampled assiduity, to bring together more than three thousand species of shells, of certain origin, and to arrange them in a tabular form, compared with the known order of the superposition of the beds; to show at what epoch each species commenced and finished; while, from the comparison of them with more than four thousand living species, he shows which of them have been preserved to the present time, and what kind of beds have been deposited upon them since their appearance.

M. Deshayes has thus become convinced that the shell formations may be very distinctly divided into two grand series which correspond with the two series already determined, although with less precision, by their mineralogical relations. The first, which is the most considerable and the most ancient, and which is known under the name of *secondary formation*, contains not a single fossil species, which has an analogous fossil in the second series; so that every race of this epoch is not only now extinct, but most have been so when the formation of the second series began. This assertion does not seem to accord with some of the results announced by M. Dufresnoy; but this was not the principal object of the memoir; and M. Deshayes directs his attention almost exclusively to the second series, which comprehends the *tertiary formations properly so called.* With this series, says the author, begins a new Zoology, which, in its *ensemble* has intimate relations to that which actually exists, and is connected with the present epoch, because it shows us, in proportions varying in each stratum, fossil species identically the same as those which now exist.

In tertiary formations, M. Deshayes discovers three distinct groups, corresponding to three different periods of formation.

In the first group, which is the oldest, the number of species thus far determined is about three hundred, of which forty two are found in a fossil state in the following groups, and thirty eight are analogous to living species.

In the second, there are more than nine hundred species, of which seventy three are found in the superior formation, and one hundred and sixty one are analogous to living species.

For the third epoch, the proportion between the number of species still living, and those which are lost, is much increased. It is in the first group, three per cent.; in the second, nineteen per cent.; in the last, more than fifty per cent.; that is, of seven hundred fossil species belonging to this group, about three hundred and sixty have their analogies among the shells which people our waters. This third epoch forms, of course, in some sort, the commencement of the actual state of things.

Another enquiry still remained, namely, to compare the actual distribution of shells which have their analogous fossils with the ancient distribution over the globe. The author has ascertained that of the thirty eight living species of the first group, some are found in almost all latitudes, the greater number, however, in the intertropical regions. The same thing holds good in sixteen species of the second epoch; the greater number of which are found in Senegal, Madagascar and the Indian Archipelago. A smaller number inhabits the south of the Mediterranean, and some only the European seas. A peculiarity with respect to the analogous species of the third epoch is, that they still inhabit the seas which wash in part the deposits from which they are receding. This is observable at Nice, Rochelle, and in many other places, in which shell formations of this order are in the vicinity of the sea.

The work of M. Deshayes, say the committee, appears to us to be in all respects a model. Founded on the observation of more than forty thousand specimens, every thing is proved by facts, every thing is reduced to figures.—*Rev. Encyc. Oct.* 1831.

NECROLOGY.

Batavia.—Count CHARLES VIDUA LE GONZANO, after travelling through the greater part of Europe, through America, and particularly on its western coast, and through the greater part of Asia, died on the 25th of December, 1830, just as he was returning from the Island of Celebes, and was entering the gulf of Amboyna. He spent several months in the Isle of Java in 1829, traversing the greater portion of it, and displaying often inconceivable corporeal strength in surmounting the obstacles which were presented to his progress. He had proposed to fix, by barometrical observations on the summits of the mountains, a line extending from Samarany to the southern side of the island. He visited the Indian Archipelago, and the Mollucca Islands, whence he made an excursion to the coast of New Guinea. —*Rev. Encyc. Oct.* 1831.

Count Vidua has not published any relation of his travels except a collection of Greek inscriptions which he had collected in the Turkish empire. It is known that his notes were continually forwarded to one of his friends in Europe. The occurrence of his visit at New York about 1825 or 26, his amiable deportment, and the interest he took in the benevolent and literary institutions of our country, are well remembered. G.

OTHER NOTICES.

1. *Case of treatment by carded cotton.*—The authors of the Bib. Univ. say that they guarantee the authenticity of the following case: A girl twelve years of age, who had enjoyed good health, was ta-

ken with measles, which did not acquire a full development. In a few months after, she was seized with pain in her limbs, and especially in the right knee. This was at first treated by leeches, &c., as a rheumatic affection, but without success. The inflammation of the limb and knee became terribly severe; abscesses were successively formed, and although their suppuration and lancing diminished the pain, the inflammation was renewed with increased intensity. Fomentations, and a deep incision in the knee were resorted to without any advantage. This painful condition had continued five months, when it was resolved, in consequence of the success of Dr. Peschier with carded cotton, to make an application of it. The whole leg was enveloped with it. In a few days the suppuration became more free and abundant, the inflammation was sensibly diminished, the pains abated, and her sleep was more tranquil. In a few weeks the change was decided, and in three months, viz. eight months after the first attack, the girl was cured, except that the leg remained weak and stiff, which it was expected that the use of mineral waters would remove. It may be remarked, that before the application of the cotton, there had been some periods of amendment, but always followed by a relapse; whereas, after the first trial of the cotton, the healing went on with perfect regularity.—*Bib. Univ. Jan.* 1832.

2. *Preservation against rust, dampness, &c.*—A piece of linen or cotton cloth, steeped in a saturated solution of lime or sulphate of soda, and carefully dried, preserves from humidity and oxidation, delicate steel instruments, and also preserves parchment and paper.

Steel instruments may also be preserved in quick lime.

A magnetic needle, suspended by a silk thread in lime water, undergoes no deterioration.—*Jour. de Connois. Usuelle's tome* 12, *p.* 89.

3. *Coating for the preservation of Cordage, Leather and Wood, from the effects of moisture.*—The material which has been principally relied on for the preservation of cordage, &c. is tar, in the use of which there are several disadvantages. The following is confidently proposed as a substitute.

Take ten lbs. of common resin, pulverize it coarsely, and expose it to a dry atmosphere, so that all the moisture it contains may leave it; place it in a kettle over a fire, melt it, and continue the heat gently till the swelling ceases, and it becomes transparent; then add by degrees, stirring the mass carefully, 18 lbs. 6 oz. of pure olive oil, (no matter what its age or taste.) The mixture becomes transparent, and acquires, while warm, a syrupy consistence, and when cold it is tenacious, viscous, and looks like turpentine. This mixture, furnishes an excellent varnish for leather, properly prepared, leaving it in a flexible state, and admitting a good polish.

Ten lbs. of resin and fifteen lbs. of fish oil, or oil of rape seed, or colza, afford a proper coating for cordage or oakum, or sail cloth. The cloth must be perfectly dry, and the mixture applied boiling hot. It should then, after the superfluous portions have drained off, be carefully dried in the air, before it is exposed to water. A month's drying is generally sufficient. Oil of linseed, olivette, or beach, can by no means be substituted for that prescribed.

Ten pounds of resin and thirteen and a half pounds of fish oil, make a proper varnish for wood; applied boiling hot. When the wood is duly impregnated, a little quick lime should be sprinkled over it, moistened with water, and then the whole surface well rubbed with a wisp of straw, by which the pores of the wood become completely closed.

As a hydrofuge for walls, the following is recommended: 10 lbs. of resin deprived of its moisture, and 10 lbs. of rape seed oil, melted together and applied to the wall with a tow brush. The wall must be previously made very dry and well warmed.

This coating had better be applied twice, or subsequently a mixture of 10 lbs. of drying linseed oil, 10 lbs. of resin, and 6 lbs. of Bougival white, may be applied as a thin coating. The wall should be rubbed with a very coarse cloth, and allowed to dry. A wall thus prepared may be painted on, or papered, without risk.—*Idem, tome* 15, *p.* 186.

4. *Economy of Sealing Wax.*—In public offices, and other situations, in which letters sealed with wax accumulate to a great extent, it may be well to know that the wax may be preserved and used on other occasions. Two methods have been tried in France, (both effectual,) of separating the wax from the paper. The first is to pulverize the whole in an iron mortar, and then effect the separation by sieves of a proper degree of coarseness. The second is to place the mixture in a wire basket with open meshes, and expose it to the action of steam. The wax melts, runs through, and is thus separated from the paper. It may then, in either case, be cast into sticks or rolls, for use.—*Idem.*

5. *Composition for mending crystals, glass, porcelain and crockery.*—Take half a pound of the curd of skimmed milk, wash it until the water comes from it limpid; press out all the water, mix with this washed curd the whites of six eggs, and to this mixture add the expressed juice of 15 cloves of garlic; triturate the whole together thoroughly in a mortar, then add, gradually, powdered and sifted quick lime, in sufficient quantity to make a dry paste, and stir the whole until it is perfectly mixed.

To use this mastic, rub a small portion of it with a little water, on a piece of glass with a muller; when well rubbed, put it on the fragment to be mended, or in the crack to be filled, and fasten the parts well together, and let it dry in the shade. This cement, if well dried, resists fire and boiling water. Vases and other valuable articles can be perfectly mended by it.

The mixture of curd, whites of eggs, and garlic juice, may be pulverized, mixed with an equal part of quick lime, and kept for use in a well-stopped vial. Such a mixture as this is kept for sale as an English article, in a shop in the Palais-Royal and is in demand.—*Idem.*

6. *Indelible Ink for marking linen.*—The following composition may be used with facility and success: Take nitrate of silver 1 dram, printer's ink 1 ounce; rub the salt with the ink very thoroughly on a glass plate with a glass muller, so as to incorporate them well. A small portion of the ink, put, by means of a ball, on types or letters in relief, and thus impressed on linen or muslin, will remain very distinct through many washings with soap or ley.—*Idem.*

7. *How to boil Potatoes.*—Few persons are aware of the necessity of skill or attention in this common operation. Potatoes should be cooked by steam, either by putting a small quantity of water in the pot, just enough to preserve an atmosphere of steam around the potatoes, or by introducing steam among them through a pipe from a boiler. Strict attention must be paid, that they be not overdone. In general from ten to twenty minutes of steaming are sufficient. Where the right point is attained, they are dry and friable and easily reduced into meal. If the action of the steam is continued even a few moments too long, they become greasy, compact, and acrid, and are not easily mashed, which proves that a change of composition is commencing which alters their qualities. It has been ascertained that potatoes which have thus been in-

jured, or which are naturally acrid, may lose these qualities by the moderate and suitable operation of heat.—*Idem.*

8. *How to boil Rice.*—The grains of rice when properly boiled, remain dry and loose, and are then much more sweet and wholesome than when agglutinated or partially converted into starch. To boil rice properly, add salt to the water, and when boiling hot, stir in the rice. Keep it boiling for twelve minutes by the watch, then pour off the water and set the pot on live coals during ten minutes. The rice is then fit for the table.

9. *Potatoe Cheese.*—In Thuringia and Saxony, potatoe cheese is made, which is an object of considerable research, as it has the advantage of retaining its freshness during several years, provided it is kept in close vessels.

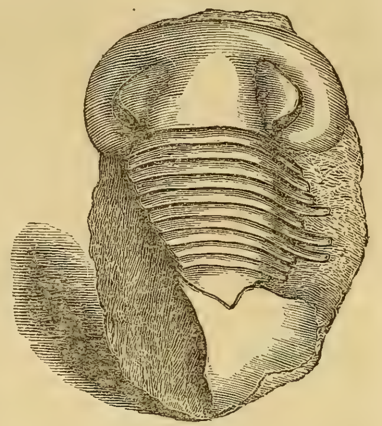
It is thus prepared :—select potatoes of good quality, especially large white ones ; boil them in a kettle, skin them and when cold reduce them to a homogeneous pulp ; add a pint of sour milk to five pounds of this pulp, knead the mass well and keep it covered three or four days, then knead it again, and place it in small baskets to drain ; lastly dry it in the shade and pack it in layers in pots or casks and leave it thus for a fortnight before using it. The older it is the better, as its quality improves by age.

The above proportions are most commonly used ; but four parts of potatoes may be added to two parts of curdled milk, or even other proportions according to the taste of the manufacturer.—*Idem, tome* 12, *p.* 89.

10. *Collecting swarms of Bees.*—In Corsica the following method is employed for collecting swarms of bees. When the swarm comes out, a man follows them with an empty hive swung over his shoulders, the bottom and sides of which are rubbed over with lemon bark. He approaches the swarm and sprinkles it with lemon juice, with which he fills his mouth. The odor attracts the bees, and as soon as a single one enters the hive the rest follow.—*Idem.*

11. *Trilobite.*

Letter to the Editor, from Mr. Fred. Jukes, dated July 4th, 1832, 17 Paradise street, Birmingham, (Eng.)



Sir—My friend Mr. Holmes, on his return to America, having kindly offered to convey to you a parcel, and knowing the interest you take in all branches of natural history, I avail myself of the opportunity, by sending you some casts and a drawing of an extraordinary fossil of the Trilobite kind, which I have in my possession. You may probably have seen some account of it in Loudon's Magazine of Natural History, with remarks upon it by Mr. I. D. Sowerby, in which he refers to some similar specimens discovered in your country at Trenton Falls. The singularity of this tribe of fossils, and the circumstance of their being associated only with the most ancient strata, render them so peculiarly interesting, that no opportunity should be lost in making known the various species which are from time to time discovered.

This fossil was found in a low stratum of transition limestone, at Great Barr in Staffordshire, and though it is more than ten miles from Dudley, where the limestone is so celebrated for its beautiful specimens of the "Calymène Blumenbáchii," there is no doubt but it is a continuation of the same formation, and in all probability this fossil will some day be met with there. The other species which are found at Dudley are, the "A'saphus caudàtus," "Calymène variolaris," and the lower portion of an unknown one, figured 53 in the 4th Vol. of Loudon's Magazine.

Remarks.—The No. of Loudon's Magazine alluded to by Mr. Jukes, is missing from our collection. Supposing however that it may be interesting to American readers to see a figure of this trilobite, we republish the figure, with the letter of Mr. Jukes. The casts alluded to arrived in perfect order, and are of course still more striking than the drawing. We learn from Prof. Jacob Green, that the genus of trilobites, to which the specimen of Mr. Jukes belongs, has not yet been found in this country.—*Ed.*

DOMESTIC.

1. *Fossil Shells of the Tertiary Formations of North America, illustrated by figures drawn on stone, from nature;* by T. A. CONRAD, Philad. 1832.—A work of this kind has long been a desideratum to geologists, and we have now the pleasure to announce the publication* of the first number, with six plates illustrative of twenty three species of American tertiary fossils. The style and spirit in which this work is commenced give great promise of future usefulness: the plates are lithographed by the best artists, and the figures are drawn with such clearness and elegance, as will enable even the learner to detect their character with facility.

"The beauty, variety, and peculiar character of our Tertiary Fossils," says the author, "are such as to recommend them to the mere Conchologist; but when viewed in connexion with Geological phenomena, they will prove, in consequence of their vast extent and continuous beds, even more important than the most celebrated contemporaneous deposits in Europe."

The three great divisions of the Tertiary class, viz. the upper marine, London clay and plastic clay formations are all now positively identified in this country by their *organic remains*, of which Mr. Conrad is already in possession of about two hundred and fifty species. Of these, the upper marine beds furnish a large proportion; the London clay, (or, as Mr. Conrad terms it, the *middle tertiary*,) also affords a profusion of fossils, although hitherto but very partially explored on this continent. The plastic clay, on the contrary, is as yet characterized by few and imperfect species.

Mr. Conrad's *Introduction* gives us a brief but clear view of all these formations,—their mineralogical and organic characters, and geographical distribution, accompanied by various novel details which cannot fail to attract attention wherever geology is appreciated. It is designed to figure *all* the species of Tertiary shells; and the present number contains six species of Arca, two of Pectunculus, eight of Fusus, three of Buccinum, a Murex, a Cypricardia, a Cardita, and an Artemis.

The value of Mr. Conrad's work is much enhanced by the fact, that it is the result of personal observations made during several tours through the formations he describes; and he has announced

* By Mr. J. Dobson, Chesnut Street, Philadelphia.

his intention of visiting, during the present year, the whole Tertiary frontier of our country from New Jersey to Alabama.

It is our intention to resume this subject more in detail on a future occasion, and for the present shall close our remarks with a beautiful passage from the preface of our author.

"The recent shells have been sought with avidity on the shores of every sea, to adorn the cabinets of the curious with the symmetry and beauty of their forms, or the brilliancy of their colors; but the science of Geology has given to the more homely fossils, a charm which amply compensates for the loss of a portion of exterior ornament, inasmuch as they are mute interpreters of those strange revolutions, of which the memory of man has not preserved a solitary trace. They chronicle the various eras of an unknown world, where one ocean has retired to give place to another with its peculiar tribes of animated beings, whose silent eloquence reveals the mysterious operations of nature, when the sudden elevation of mountains, irruption of seas, and destruction of various races of animals and plants, were forming in the crust of our globe those numerous strata, the study of which must ever be an inexhaustible source of pleasure and instruction. Thus have long periods of violence and revolution been necessary to create the beautiful variety of the present surface of the earth, and perhaps to prepare it for the support of man, as all these changes appear to have been effected anterior to the existence of the human race."

It will be agreed by all that this important division of our geology could not have fallen into better hands, and if it were needed, the ablest assistance is easily obtained from Dr. Morton and other gentlemen in Philadelphia, who have already distinguished themselves in this branch of research. Sept. 23d, 1832.

2. *Declination of the Magnetic Needle*; by Mr. George Gillet, *in a letter to the editor, dated Hebron, Conn. May 1st*, 1832.

Sir—In your Journal of Arts and Sciences, the observations of Mr. De Witt and of Dr. Bowditch, for the declination of the magnetic needle, are recorded in direct opposition to each other—one giving an increase and the other a decrease of west declination. In the year 1813, an article appeared in a Philadelphia paper from which the following was extracted.

At that city, "1701, W. declination 8° 30′, by Mr. Scull. 1793, W. 1° 30′, by R. Brooks. 1794, the needle was observed to recede westward, by H. Brooks of Philadelphia, M. Humphrys of Md. and others in Virginia. 1802, more than 1° 30′ W., by R. Howel. 1804, 2° W., by several men of science. 1813, 2° 27′ W., by Thomas Whitney." About the year 1810, the late Mr. Spencer of Litchfield county published in the Connecticut Courant, that for a number of years then past, the needle had declined to the west. Mr. Nathaniel Goodwin of Hartford, than whom there is not a more correct man in that city, has, for many years past, attended to the declination of the needle, and, according to his observations, it has steadily tended to the west. In 1805, I commenced observations, and since that period, the needle has declined to the west more than a degree. The distance between this town and Salem does not exceed one hundred miles. If it is sufficiently proved that while the west declination at Salem has decreased, at other places to the west it has increased, who can account for the anomaly?

3. *Boring for Water.*—In a former volume of this Journal, we gave some account of Mr. Disbrow's operations for obtaining water by boring. We observe with pleasure that the subject is acquiring a fresh interest, in consequence of new and successful experiments, as stated in a pamphlet which appeared in July in the city of New York, with the signatures of John L. Sullivan and Levi Disbrow. We are not, on this occasion, about to discuss the causes of the rise of water from deep perforations, nor, even to agitate the question whether it may always be expected at a certain depth. It is sufficient that it is often obtained. The excavation in New York, of the great well for the city tank to the depth of one hundred feet, sixteen feet diameter, with two horizontal shafts of four feet square, yields eight thousand gallons per diem, or three hundred and thirty-three per hour, or between five and six gallons per minute.

The Bleecker-street perforation of four hundred and forty-two feet, yields forty-four thousand gallons per day, or one thousand eight hundred and thirty-three gallons per hour, or about thirty gallons, nearly a barrel, a minute. It would seem, therefore, that if such a treasure is attainable in these places, it may be in others within the city, and therefore that there should be no hesitation in proceeding vigorously and promptly with the effort. The probability of success justifies a decisive experiment at the expense of even one hundred thousand dollars; and complete success in obtaining abundance of fresh water from the strata below New York, is worth, we will not say millions; *it is beyond all price.—Ed.*

4. *Alluvial Deposits of the Mohawk.*

Extract of a letter from Mr. C. H. Tomlinson to the Editor, dated

"Schenectady, April, 1832.

"*Dear Sir*—I herewith send you specimens of a deposit of leaves which are found ten or twelve feet below the surface of the flats or alluvial banks of the Mohawk River at this place. These, with many other specimens, some of them one and a half feet square and six or eight inches thick, were washed out of a deep hole made in the Erie Canal during the great freshet in March last; when the river broke over the canal banks, three miles above this city, and came down till it was stopped by the high ground on which the city is built. It then rose high enough to break over the canal banks and return to the river. The hole spoken of above was about twenty feet below the surface of the flats across which the canal runs. Judge De Graff of this place, tells me, that in digging a well some years ago, about a quarter of a mile from this spot, he dug through the same deposit of leaves. It was more than six inches thick. I am informed by another person who is familiar with the river, that at low water the same deposit may be seen in the bank of the river, a few hundred yards from the place out of which these specimens were washed."

Remarks.—Every such deposit is interesting, as giving us the means of comparing things that were with those that are. These masses of leaves are perfectly combustible, burning with bright flame and much smoke, smelling like that of recent dry leaves. They are enveloped by a fine black river mud, exactly like that which forms the sediment of the Mohawk at the present time.

Since receiving Mr. Tomlinson's letter, we have visited the spot from which the leaves were taken, and no one who sees the place, can doubt that it was once the upper surface, although it is now lower than the bed of the river.—*Ed.*

P. S. October 11, 1832.—Observing, recently, some excavations going on upon the Genesee River, at Angelica, Allegany county, (N. Y.) for the purpose of forming a mill race, we saw parts of trees brought up from beneath tough and firm clay, some yards below the surface, evincing the shifting of the banks in ancient time.

5. *Detection of corrosive sublimate.*—This is not a difficult task, and the following facts are mentioned, not as being novel, but as affording an example of an easy method of operating with means usually found in the family without resorting to a laboratory.

The preliminary facts, were as follows:—A cider barrel being brought empty to the mill, stood over night and was filled in the morning with fresh made cider. As one head proved leaky, the cider was removed, and some pounds of a substance resembling flour were found in the barrel with several lumps of a heavy white firm matter, doubtless introduced as a poison. The latter was conjectured to be corrosive sublimate, and the opinion was proved to be correct by the following observations and experiments.

1. The substance yielded to a knife blade and a slight blow—flew apart with some elasticity, had a glistening diamond like (adamantine) lustre, was rather acrid to the taste, leaving a lasting metallic impression, and was readily soluble in rain water, to the bottom of which the larger fragments fell, although the fine powder floated for a time.

2. From charcoal, when by the blowpipe, a candle flame was directed upon it, it rose rapidly in white acrid clouds, without any other odor.

3. Placed in a small vial loosely stopped with a cork, the vial being moved rapidly and horizontally over the clear blaze of a candle, the substance readily sublimed and concreted on the cooler side of the vial, partly in a white coating, and partly in crystalline spiculæ. The crystallization was very conspicuous when the substance was sublimed from the bottom of a glass tube bent into the form of the letter U.

4. The solution gave a brick red precipitate with a solution of subcarbonate of soda, and a white one with sub-carbonate of ammonia.

5. A silver quarter of a dollar and a bright copper cent being laid in contact with the cent uppermost, a drop of the solution was placed on the bright part of the cent, and a connexion formed between it and the silver by an iron staple brightened at the points; instantly the mercury began to precipitate upon the copper, and in half an hour there was a distinct silver white coating with minute points or globules of mercury. It is not necessary to say that this was a galvanic circle, and that the mercury was evolved at the copper or negative pole, according to a general law, propounded by Sir H. Davy, in 1806. These metals were used for the circle, because they were at hand. A piece of bright zinc was partly covered with gold leaf, and a drop of the solution being placed on the gold, it became speedily white, even before a metallic communication was established by a wire placed so as to touch both the fluid and the zinc.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*Experiments upon the Solidification of raw Gypsum; by* JOHN P. EMMET, Prof. of Chemistry in the Univ. of Virginia.

THE facility with which burnt gypsum sets, when made into a paste with water, has rendered it not only conspicuous among minerals but highly useful in the arts; hitherto, however, as far as I am aware, it has not been supposed that the raw or natural production is capable of exhibiting the same property. The following experiments, although resulting from an enquiry not professedly connected with the subject of the present communication, and therefore not, perhaps, carried as far as they might have been with advantage, are considered of sufficient importance to receive a distinct notice. They satisfactorily show that native gypsum may be rendered capable of perfect solidification without having undergone the operation of burning, and may perhaps contribute to illustrate or render more available the setting property of this valuable natural production.

Raw gypsum, finely pulverized, is capable of undergoing immediate and perfect solidification, when mixed with certain solutions of the alkali potassa. Among those that answer best, may be enumerated caustic potassa, carbonate and bi-carbonate, sulphate and supersulphate, silicate and double tartrate or Rochelle salt.

In all these cases, the process may be easily rendered more expeditious than when burnt plaster alone is employed, and the resulting solid, after having been properly dried, does not seem to differ essentially from that usually obtained, except in composition. There does not appear to be any exact point of saturation; for the solid masses, when broken up and worked with fresh portions of the solutions, constantly recover their tendency to set, even when the saline matter is in very great excess; yet, no doubt, each case requires a specific amount, in order to produce the maximum of solidity. When water alone is employed, after the first mixture, the paste rarely exhibits any remarkable tendency to become hard; but a fresh application of one of the foregoing solutions never failed to develop it promptly.

There is also a marked difference as to the time required for the operation; solutions of carbonate and sulphate of potassa, if sufficiently dilute, produce their effects so slowly as to admit of complete incorporation, whereas Rochelle salt acts as soon as the powder touches the fluid and all subsequent motion necessarily weakens the cohesion. If crystals of Rochelle salt be triturated with raw gypsum and water, and then brought in contact with the mixture, there will be no apparent interval of time between contact and solidification. This extreme rapidity effectually prevents incorporation by the ordinary mode, and would induce one to imagine that Rochelle salt does not possess the power; for when the gypsum and solution are worked together with a spatula, although the particles feel hard and harsh, they readily crumble, and by continuing the operation, actually assume a semi-fluid condition.

No other salts, but those holding potassa, were found to render raw gypsum capable of solidification. Those of soda, as far as they were examined, invariably produced a contrary effect, if we except Rochelle salt, which, however, seems to operate by its potassa. Yet it is remarkable that several neutral salts of the latter alkali, as the nitrate and chlorate, did not occasion the slightest alteration. The bi-carbonate of potassa invariably produced a brisk effervescence, which considerably impaired, although it did not prevent, solidification. The same disadvantage characterizes the action of super-sulphate of potassa, whenever the mineral contains an admixture of carbonate of lime, as was found to be the case with the specimen of gypsum under examination. As the idea has been advanced that the setting property of ordinary burnt plaster, depends upon the presence of carbonate of lime, most of these experiments were repeated, with equal success, upon pure sulphate of lime obtained by precipitation.

The opinion that carbonate of lime facilitates or causes solidification in the ordinary case, seems but little entitled to belief, when it is considered that the heat, necessary for the burning of plaster, falls far short of that required for bringing limestone to its caustic state, or even to that half-calcined condition which renders it capable of hardening under water; but, whatever may be its agency, subsequent to the application of heat, the operation must be totally different in the present case, since the super-sulphate of potassa completely decomposes all the carbonate of lime in the gypsum.

It is probable, as Gay-Lussac has observed, in his examination of this singular property of burnt plaster,* that we should refer the fact to an inherent property of the mineral; yet I cannot but think the foregoing experiment abundantly proves that it does not always depend upon the simple union with water, and subsequent aggregation of the saturated particles, as seems to be the fact with burnt plaster. These cases may not, indeed, be parallel, as some of the saline solutions, added, *partially* affect the composition of the gypsum; yet I have satisfied myself that the alteration is neither uniform nor essential to the result, although it is extremely difficult to ascribe the solidification, in the foregoing instances, to the proper cause. Both potassa and its carbonate are extremely deliquescent, and do not, therefore, act by rapidity of crystallization; sulphate of potassa cannot affect the composition of sulphate of lime, and, although the former salt may possibly be formed in all the cases of mixture enumerated, it does not seem to form any permanent combination with the gypsum, since the latter, in two experiments, was found to lose one twelfth of its weight by the mixture of the substances and subsequent washing with warm water. The only uniformity observable, in all the saline solutions capable of producing solidification, is the necessity of the presence of potassa, and the rapidity with which the operation takes place seems greatly opposed to the supposition that the result depends upon double decomposition. If we take the pulverized gypsum and saturate it by the solution of carbonate of potassa, all subsequent chemical action, from the same substances, should be prevented, and yet, when the solidified mass, thus formed, is worked up again with a fresh portion of the same saline solution, it sets with equal facility. This property appears but little diminished by three or four repetitions. As plain water does not answer, until after the evaporation of the fluid, it seems more probable that the saline solutions exert a kind of repulsion towards the particles of

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* Annales de Chimie et de Physique, tom. xl. p. 436.

gypsum, and thus tend to promote that solidification which is so very characteristic of it in the burnt state.

The experiment which first exhibited the solidifying property of raw gypsum, was well calculated to give the impression that chemical decomposition was necessary for the result. I wished to determine how far fresh precipitated carbonate of lime was capable of improving gypsum, (intending subsequently to burn the mixture;) with this view, pulverized, raw gypsum was placed on a filter, and a cold solution of carbonate of potassa poured over it. The result was the rapid solidification of the crude mineral and an evident diminution of the alkali. Upon repeatedly returning the same solution through the filter, turmeric paper ceased to indicate the presence of potassa, and reagents showed that sulphate of potassa had taken its place. In this manner, a saturated solution of the latter salt may soon be obtained. Yet, as has been already stated, a further examination proved that the sulphate of potassa is not capable of contracting a permanent union with the gypsum.

Further enquiry will, no doubt, lead to the detection of salts better adapted to the developement of this property than those here noticed, but the cheapness of carbonate of potassa seems more likely to recommend its use for practical purposes, provided it shall be found that the solidification of raw or effete plaster, by the process here indicated, equals, in durability, that which has been recently burnt. Gypsum, it is well known, requires judicious treatment, in order to fit it for taking casts, and unless carefully defended from moisture, will soon lose its valuable property. The process of burning may, moreover, not always be convenient, and in this case, a solution of carbonate of potassa, or, for common purposes, the ley from wood ashes, will always enable the operator to effect rapid solidification, and, as far as I have observed, it is perfect.

Art. II.—*The Practical Tourist, or sketches of the useful arts, and of Society, Scenery, &c. &c. in Great Britain, France and Holland. In two volumes;* by Z. Allen, Providence, R. I. 1832.

COMMUNICATED.

The author of this work is already favorably known to the public by his valuable book on practical mechanics. He made the tour, here noticed, chiefly for the purpose of minutely inspecting manufacturing establishments, and collecting such information respecting their internal operations and general economy, and their influence upon individual character and national prosperity, as would be practically useful to his own countrymen,—a kind of knowledge which, as he justly remarks, could be obtained only "by entering apartments filled with the smoke of furnaces and resounding with the deafening noise of machinery, or by conversing with men devoted to the common handicraft labors of life." For this, if in no other respect, his book is peculiarly valuable. Such information was much wanted, and he has proved himself a very suitable person to furnish it. Besides his individual interest in manufactures, his previous acquaintance, with their condition in this country, and his lucid and pleasing manner of describing what he saw, the author exhibits throughout these volumes, ample proof that he is a candid and faithful observer. With the facts pertaining to the useful arts, there is judiciously blended such matter of general interest, as will render this an entertaining work to all persons who would, at their own fire side, ramble over the same countries with an agreeable fellow traveler, and will also serve as a useful guide to those who may incline to visit the same places personally. The work, as well for the rich entertainment it will furnish to the general reader, as for the important information it contains for several kinds of manufacturers, cannot fail of meeting a favorable reception from the public.

The plan of this journal makes it necessary to notice such facts and observations only, as will interest the scientific manufacturer, and of these even, our limits allow us to admit only a few notices, which will be given, mainly, in the writer's own words.

After describing the gradual improvements made in the carding, spinning and weaving of cotton, from the state such operations were in for ages prior to the middle of last century, and in this country till within the last fifty years, and exhibiting their present advanced state in Great Britain and the United States, he estimates the number of power looms for cotton in the former country in 1832, at about sixty thousand.—He adds concerning steam power that,

"It requires about a one horse power of the steam engine standard, to work twelve looms, with the machinery for dressing the webs. To keep in motion the above number of sixty thousand power looms, would therefore require a steam power rated equal to that of five thousand horses employed during twelve hours each day; but, in reality, equal to the actual force of about ten thousand ordinary horses, which animal is found capable of performing effective labor during only about eight hours of each day. Thus is exhibited at a glance the surprising economy of human strength brought about by the single labor saving contrivance of the *power loom.*"

The amount saved in the expense of weaving in a year, comparing it with the cost of manual labor as formerly practised, our author estimates at ten million of dollars.

"It can hardly be believed, indeed, at this late day, how great were the profits which resulted from the employment of Arkwright's machinery, when first invented. * * An English child employed at a machine was able to produce fabrics of greater exchangeable value than one or two score of able bodied men on the adjacent continent, or in the United States. One of the oldest cotton manufacturers in the latter country, who commenced his business at a period when the richest portion of the harvest of wealth had been gathered in England, has declared, that he would prefer to receive merely the profits of one of his old original cotton mills, after deducting all the cost of stock, labor and other charges, rather than the unconditional gift of the whole product of cloths from a mill of the same number of spindles at the present day. Cotton yarn of No. 100, was sold in England in 1788 at about eight dollars and three quarters per pound, and the same kind of article can now be bought in the same country for about seventy-five to one hundred cents."

In connexion with cotton manufactures the author gives a cursory view of the equally rapid and wonderful extension of the culture of cotton, which now furnishes nearly half of the clothing to the inhabitants of the civilized world.

"The cotton plant itself is a native of the three continents of Asia, Africa, and America, and flourishes in a broad zone of climates. In Hindoostan and South America, it shoots up into a tree with lofty branches, and annually produces its bursting pods as a spontaneous crop for the inhabitants, who gather the locks of cotton with no other labor than that of the harvest. In more northerly latitudes, it becomes dwindled into an annual plant, requiring careful tillage, and the vigilant attention of the cultivator during the seed time, as well as the harvest. The product of the cotton plant seems to vary in quality from local peculiarities of heat and moisture; as that with the black seed, which is raised in the vicinity of the ocean on the sea islands of Georgia, loses its superior excellence of staple when transplanted to the interior country.

"In the early stages of the cotton manufacture in England, the supply of the raw material was derived from the countries of Asia bordering on the Mediterranean, and from the West Indies. In 1705, it appears that only one million one hundred and seventy thousand pounds of cotton were imported into England; and in 1775, at the period of the commencement of the inventions to which we have been alluding, only four million seven hundred and sixty four thousand pounds were imported. Fifty years after this, eight hundred and twenty thousand bags were landed in Great Britain in one year. About seventy two thousand of these having been re-exported, there remained seven hundred and forty eight thousand bags of cotton to supply the annual consumption of this single island. Of this vast quantity, the greater part was brought from a remote country (the United States) where in 1784 not a single bag of cotton was produced as an article of export.

"In 1785 it was ascertained by the English custom house officers at Liverpool, that an American ship had discharged upon the quay eight bales of cotton, which being then an article of import never before brought from any part of the Uunited States, were seized, upon the supposition that they had been brought circuitously from some of the English West India Islands, contrary to the rigid navigation laws, designed to encourage British shipping. For several years subsequent to this period, the culture of cotton was neglected in the United States, on account of the great labor required to free it of its seeds and motes by manual labor; but the invention (by the late Eli Whitney,) of the cotton gin, for cleaning the raw cotton, gave in 1793 a new impulse to the culture in the United States, quite as great as that given to the manufacture of the same staple material by the inventions of Arkwright.

The following table of the comparative rates of wages in England, France and the United States furnishes the best information on the subject that we have seen.

	England.	*France.*		*U. States.*	
	Cents.	Cents.		Cents.	
Wages of a common day laborer, per day, about - - -	73	37 to 40			100
Do. with steady employment, -	60	35			80
Carpenter, - - - -	97	55 to 75			145
Mason, - - - -	103	62	85		162
Mule spinners in cotton mills, -	103	75	85	90 to 137	
Do. do. in woollen mills, -	93	45	55	90	137
Weavers on hand looms, -	73	37	50	80	95
Boys 11 or 12 y'rs old, per day,	24	14	17	25	30
Women in cotton mills, per week,	192	145	175	250	300
do. in woollen mills, - -	192				
Maid servants in private families, per week, board found, - -	60			100	133
Machine makers and forgers, best, per day, - - - -	158			150	167
Do. ordinary, - - -	90			100	117
Children, piecers in mills, for mules and billeys, - - -	14			20	30
Overlooker of carding rooms, -	135			108	150
Slubbers of woollen roving, -	97			80	100
Experienced workmen to attend shearing machines and gig mills for woolens, - - -	82			80	117
Firemen for steam engines, -	91			100	125
Price of coals for steam engines, per ton, (1827) - - -	220*	700†		700‡	106§
Wheat (per bushel of 60 lbs.)	179	117		96	49

The cupidity of English manufacturers requiring more hours of labor from their workmen and especially from children than humanity could sanction, attracted the attention of Parliament, and induced it, in 1831, to establish the following hours of labor in mills for manufacturing silk, cotton, wool, flax, &c.

"No person under twenty one years of age, shall be allowed to work in the night—that is, between half past eight o'clock in the evening, and half past five A. M.

"No person, under the age of eighteen years, shall be employed more than twelve hours per day, and nine hours on Saturday, (excepting in fulling mills and in finishing woolen cloths,) equal to sixty nine hours per week.

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* Manchester. † Louviers. ‡ New York. § Pittsburgh.

"In case of loss of time by drought, or damage to steam engines, the proprietors of mills shall be allowed twelve hours on Saturday, and one hour per day as additional labor.

"No child shall be employed in any description of work in any mill until nine years old, except in silk mills, where they may be employed at seven years of age."

A description is given of the finishing processes by which cotton cloths, after they are taken from the looms, are prepared for various uses. One of these is the singeing of the cloth to impart to it the appearance of linen, which was formerly effected by passing it over red hot cylinders. A blaze of gas is now substituted, "which is made to issue from a tube perforated with a long row of nearly contiguous small holes, like those of the burners of a gas lamp. By kindling the gas issuing from one of the apertures, the blaze instantly flashes along the whole extent of the tube, forming a continued sheet of dazzling flame, shooting upwards. Directly above this is fixed another tube of equal length, and perforated with a long slit exactly adapted to receive into its bottom cavity the jet of flame. The upper tube is connected with large air-pumps, worked by steam power, whereby a rush of air is created into the aperture of the slit. When the cloth is passed between the tubes, the blaze of gas ascending from the lower one, is actually drawn or sucked through the texture between the threads, by means of the slit in the upper tube. The most delicate muslins may be thus passed through a vivid sheet of flame, and become, during the fiery ordeal, not only divested of the rough fibres on the face of the texture, as has been previously accomplished by passing it over the red hot cylinder, but even the rough fibres between the threads are singed off by the penetrating flame, and the exact appearance of the smooth linen thread is produced."

A particular description is given of the above mentioned air-pumps and their mode of operation. This is followed by a sketch of the processes of bleaching, printing, and calendering which differ very little from those employed in the United States. Nor is there much difference in the method which he describes of manufacturing woollen cloth by the English, excepting that they still weave woollen chiefly by hand instead of the power loom. The author concludes this subject by the following interesting comparison.

"Taking the general average of the cost of making a yard of broadcloth in England, and in the United States, including that of the steam and water power, it appears that the American manufacturer produces fabrics of equal quality, as cheaply as they are made in England. But widely different are their respective advantages of obtaining a supply of wool. The raw material is from seventy to an hundred per cent. dearer in New England than in Old England.

"In the manufacture of stuff goods the wool is prepared by first combing the long fibres or hairs by means of a sort of hatchel, precisely as flax is prepared. The operation, however, is performed upon the wool, whilst it is exposed to heat, which renders the fibres permanently elongated. The combed wool is passed successively between sets of rollers, to extend the fibres, and to reduce them to the rudiments of a fine thread, for which purpose machinery is employed similar to that used for manufacturing cotton. After this it is spun into worsted yarn."

It is gratifying to learn from Mr. Allen's book, that small libraries are formed by the proprietors at many of the large manufacturing establishments in England, for the use of the workmen, which are supported by a small periodical payment from those who receive the books. If the comparatively small size of our own manufactories renders such an appendage less worthy of the attention of owners, they might at least unite in large manufacturing villages in forming similar means of mental improvement.

The foregoing extracts are interesting to a comparatively small class of readers only, and present but indifferent specimens of the authors style. They are offered as samples of the more substantial sort of goods which the inquirer may find in this ware-house of information. It would have suited the manufacturer, if this description of goods had been packed separately at the farther end of the building, in the form of an appendix, instead of being thrown about, promiscuously, among castles and abbeys, theatres and gaming houses, cottages and palaces, foundling hospitals and cathedrals, baptisms and funerals. The general reader, however, whose taste the author no doubt consulted, would prefer the book as it is. Although his attention was particularly directed to mills for making cotton, woollen, silk and linen cloths, yet he has not omitted the various workshops for cutlery and other hardware, both useful and ornamental, as well as founderies, coal mines, porcelain works, canals, rail roads, &c. &c.; thus incorporating a mass of useful facts and observations that are becoming of daily increasing importance in our own country, and which tourists are rarely at pains to furnish with such faithful accuracy.*

The following graphic description of a salt mine in Cheshire, is the only extract we shall make that does not bear upon the interests of an American manufacturer. After describing the manner of descending the shaft of the mine, and the appearance of the various strata of earth, the author says, "alighting from our tub upon the firm dry floor of rock salt, the guide observed, that we had descended three hundred and thirty six feet from the surface of the ground. When our eyes had become sufficiently accustomed to the twilight gloom of the vast cavern, we stood motionless with surprise at the sight before us, gazing with wonder at the magnificent aisles extended horizontally to great distances, between huge pillars of salt, and lighted by rows of lamps arranged at regular distances asunder, like those in the streets of a city, some appearing brilliant near at hand, and others faintly twinkling from remote extremities of the mine. The resemblance to a night scene in the street of a city was rendered more striking from the rattling of the wheels traversing the rail roads, and the tramp of the horses' feet.

"Our conductor now began to point out the various objects visible, and to describe the subterraneous works. The excavations, he stated, are made horizontally, as level as a plain, to the extent of about twenty six acres, the height of the roof being eighteen feet. Observe, he said, how perfectly smooth the roof and floor are formed, resembling those of an immense room. Those pillars of salt are left at the regular distance of seventy five feet asunder, to sustain the great weight of superincumbent earth, more than three hundred feet thick. * * *

"There being no seams or fissures throughout the solid mass, no water can penetrate into the salt mine. To convince us of the tightness of the roof of salt, the guide conducted us to the part of the mine directly beneath the canal upon which we had previously seen loaded canal boats floating, more than three hundred feet above our heads supported with all the load of waters by the pillars of salt around us.

"In distant parts of the mine, numerous workmen appeared by candle-light engaged in drilling holes in the salt, which is nearly as

* As a very slight exception, however, to the general accuracy that pervades the book, we may notice, that in describing the process for making alum in Scotland, page 361, the author forgets to add an alkali as an ingredient.

hard as marble; for the purpose of detaching fragments by explosions of gunpowder. They commence working next the roof, and carry forward the excavations in the form of broad steps, breaking up successively the several tiers or layers. The stunning reverberations of the explosions, following one after another in quick succession, cause the startled visitant to shrink back with a momentary feeling of alarm, whilst the very roof seems to be upheaved, and the pillars to tremble under their load.

"In order to show us the extent of the mine, our conductor fired a preparation of gunpowder, termed blue-lights, which he had provided for the purpose of affording a brilliant illumination. On firing the combustible preparation, instantly, countless remote square pillars seemed to start up from a large plain, distinctly visible, as if the resplendent meridian sun had burst in upon the gloomy cavern. After the flashes have thus suddenly illuminated with a dazzling, fearful light, the vast aisles, and pillars of salt, they as suddenly expire, and all the scene, as if conjured up into momentary existence by some magic spell, again becomes shrouded in darkness."

Among the most important manufacturing operations carried on in Manchester, are those connected with the printing of cotton cloths or calico. The mere designing or inventing of new patterns of figures for the printers is of itself a considerable business, furnishing regular employment to many persons, who gain a good living by their ingenuity in this branch of business. The process of engraving the copper cylinders and blocks for printing, is another considerable business. In one apartment, I saw nearly thirty men at work. The small figures and sprigs are engraved, or rather sunk into the surface of the copper cylinders by steel dies, instead of being cut by the graver. The pattern of a flower, or other figure, is thus perfectly impressed in the twinkling of an eye.

"After the process of engraving is completed, the copper cylinder is placed in a strong frame, where it is made to revolve by steam power, with a portion of the under surface constantly immersed in the liquid dye contained in a trough. The dye stuff which adheres to the surface of the cylinder is scraped off by the smooth edge of a steel blade, applied firmly against it. This blade, designated by the singular appellation of the "*doctor*," cleans off the liquid dye stuff only from the smooth surface of the copper, and leaves all the furrowed lines of the engraving full of the coloring substance. The cloth is imprinted whilst passing beneath a roller pressed by heavy weights upon the engraved cylinder, and operating together like two calender rollers. The spongy texture of the cloth sinks into all the engraved cavities and imbibes the coloring matter lodged in them; whilst from the smooth surface of the copper, cleaned by the doctor, it receives no dye to stain it. The cotton cloth is seen to enter between the rollers as white and spotless as pure snow; and as if by a magical transformation to issue from between them on the other side, covered with gay flowers, or with pictured landscapes, spread over the surface in all the fair proportions of hills and dales and winding rivers. Three or more distinct colors may be printed and duly blended together to produce an harmonious effect, at one operation, by arranging an equal number of the printing cylinders, each engraved and supplied with its own peculiar color, to bear or press against the surface of the large smooth central cylinder, around which the cloth to be printed is made to pass. Beautiful chintzes of several bright dyes, thus perfected at one operation, pass off over machinery to be dried nearly as fast as one can walk."

This is followed by a description of block printing which is much used in this country, and is performed with pieces of wood twelve or fifteen inches long, and six or eight inches wide, varying so as to suit the required patterns. They are used on the principle of common type printing, and when several colors are to be printed on one piece, several blocks are passed over it so as to produce the variety of colors required.

"The prints are finally completed by being glazed or polished. This is accomplished by first impregnating the calico or chintz with gum, starch or beeswax as may be best adapted to the purpose for which it may be intended. Thus prepared, the cloth is passed between two cylinders, one of which is hollow, and is heated by red hot pieces of iron inserted in the cavity, or by steam. To one of the rollers is given by the machinery a quicker rotation than to the other. The two calender cylinders are thus not only caused to roll in contact, but also a rubbing effect is produced, owing to the different relative velocities with which the surface of each is caused to move. By this means, the hot surface of the polished cylinder is made to partially slide over the surface of the cloth to be glazed, as the polished surface of a flat iron or sad iron is passed over cloths by the laundress in the familiar domestic operation of ironing.

"Some of the machine shops of Manchester are constructed on a most extensive scale. The proprietor of one of these establishments informed me that he employed three hundred and eighty workmen. The bars of iron are heaped up in his yards like piles of cord wood. A branch of a canal has been formed through the center of his premises, over which there is a bridge that is capable, as it was stated to me, of being raised, for canal boats to pass beneath it, upon the principle of the hydrostatic paradox. The pressure is conveyed through tubes filled with water, and laid beneath the surface of the ground, to act on the movable pistons upon which the bridge rest; and when the forcing pump is put in motion, the bridge rises from the abutments as if by magic."

In Sheffield the author confined his attention chiefly to the manufacture of hard ware, in which, this place, with a population of sixty five thousand persons, has become the rival of Birmingham. The following extracts are less interesting for any new practical information, than for the idea they give us of the scale of business carried on in Sheffield.

"It affords much gratification to a stranger to view the various processes in the manufacture of cutlery, whereby in some cases, a bar of rough iron, brought here from Sweden, is wrought, by the skilful labor of the artists, into articles more valuable than a bar of silver of the same weight. My first visit was to the extensive works for converting iron into cast steel, belonging to the Messr. Naylor & Sanderson. Their brands are well known to the machinists of the United States, as indicating the best qualities of cast steel sent from England. About seven thousand pounds have been made here in one day. The coal used for the works is of a selected quality; in some of the lumps of which the charred particles of the fibres of wood appeared distinctly visible, exactly resembling those perceptible in common charcoal.

"The first process in making the cast steel is to arrange bars of Swedish iron in a long narrow brick box or oven, about two and a half feet wide and three feet deep, and of a length sufficient to receive the longest bars. Between each layer of iron bars, powdered charcoal is sifted and the top of this box is covered with a layer of clay nearly five inches thick, to exclude the air and prevent the powdered charcoal from being consumed by the heat, which is communicated to it through the lining of the brick work. This brick box is enclosed in a regular furnace, in such a manner that the intense heat of the flames may circulate around it and gradually heat the bars of iron, covered up by the charcoal, to an intense glow, for about the period of a week; after which the whole is cooled. If the heat be not properly regulated during the process, the pile of iron bars, as I was told by one of the proprietors, becomes fused into a solid mass. The surface of the bars, after being withdrawn, is found to be covered with blisters, resembling air bubbles half bursting from the swollen surface of the metal, which becomes converted by the operation into steel. From the peculiar appearance of the blisters upon the bars, it is called "blistered steel," and sometimes "steel of cementation," from the process performed; and also "shear steel," from the general use formerly made of it in the manufacture of blades of shears. No iron made in England is equal to that imported from Sweden for the purpose of being converted into steel.

"To make cast steel, the bars of blistered steel are broken into small pieces, from which the imperfect portions are carefully excluded, and the remainder are put into crucibles about eighteen inches deep. Each crucible is set into a small furnace, about twelve or fourteen inches square, and two feet in depth. Many of these furnaces, each containing its crucible, are arranged side by side. About forty pounds of the fragments of the bars of steel are put into each one, and immediately covered up closely by a luting to exclude the air, until the metal becomes melted; after which, it is poured out in a fluid state into moulds to form ingots. Hence the name of cast steel is given to this new product. The ingots are subjected to the action of hammers and rollers, to reduce them into bars like wrought iron, in which state it is prepared for use."

The author visited Birmingham, and after describing the various manufactories and workshops of the place, he adds,

"One of the wonders of Birmingham is the manufacture of a pin, which has been often mentioned by writers on political economy, to demonstrate the benefits resulting from the subdivision of labor. This simple, little article, which occupies so important a station on the toilet of a lady, in the course of its manufacture, passes, in detail, through nearly as many hands as the complicated mechanism of a watch. One person is employed to polish the wire; a second, to cut it into suitable pieces, each of the length of two pins, and a third person takes several of these pieces between the thumb and forefinger, and applies them to a circular steel grinding-wheel or rasp. The pieces of wire, for a dozen or more pins, are thus sharpened at once by the operator, who dexterously causes all of them to turn simultaneously between his thumb and finger; whereby the points are rendered perfectly round and acute. A fourth person divides each of these pieces in the middle to form two pins, and slips on the heads (which are formed by a fifth person) over the shank of the wire. A sixth person now takes the rudely formed pins, rivets the heads and passes them to a seventh workman, who whitens them by means of a composition of melted tin. The scouring and brightening or polishing occupies another hand, and the ninth in the series is busily engaged in sticking the pins into papers for packing. This completes the operation of manufacturing the little article, which for its apparent insignificance, is made the subject of every diminishing comparison; but which, however, in the aggregate amount, forms an important staple article of business, affording employment and the means of subsistence to many hundred persons."

He adds in a note that the quantity of pins annually made in England, as appears from a published statement, has been valued at four millions of dollars. He describes, also, a machine for making them constructed, by an ingenious American, in London, which accomplishes all the above processes except tinning and packing; and several of the machines may be attended by one boy. The pins made by this machinery differ from those made by hand in being headed like cut nails from the shaft of the metal, and therefore the heads are not liable to be slipped over the body of the pin.

The origin of the term *pig-iron* is not generally known, and appears from our author to be this. The metal, in English founderies, flows from the furnace like melted lava, first into a broad deep channel moulded in the sand to receive it; and from thence it diverges and flows into numerous smaller channels, arranged regularly at right angles on each side of the main one. When the iron was originally cast in this form, the workmen regarded the great central channel of molten metal as bearing a resemblance to a sow extended at length; and the smaller channels filled with metal on each side of the large one, they fancied to bear also some similitude to a litter of sucking pigs. Hence they termed these ingots "pig-iron."*

"Instead of bellows of the ordinary form, cast iron cylinders, larger than those of steam engines, and similarly furnished with a working piston, are used in Birmingham furnaces to create the blast of air which is propelled into the glowing furnace through pipes, with a roaring sound, audible at a considerable distance, and truly resembling those of a 'mighty rushing wind.'"†

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* This explanation was current in this country many years since.—Ed.

† This kind of bellows is now used in some of our founderies: e. g. at Canaan Falls, Ct.—Ed.

In all comparisons drawn between the institutions, customs, manners, &c. of the countries he visited, and those of the United States, the author of the Tourist sustains the character of a candid unsophisticated republican gentleman, duly attached to his own country, yet free from those narrow prejudices that obscured the vision of Faux, Fearon, Captain Basil Hall and others in their tour through the United States. Every American reader must fell an honorable pride in contrasting the candid and ingenuous spirit manifested throughout this book, with the disingenuous censure lavished upon us by those authors.

Art. III.—*On the laws of the polarization of light by refraction;* by David Brewster, LL. D. F. R. S. L. & E.

Read before the Royal Society, February 25, 1830.

In the autumn of 1813 I announced to the Royal Society the discovery which I had then made of the polarization of light by refraction;* and in the November following I communicated an extensive series of experiments which established the general law of the phænomena. During the sixteen years which have since elapsed, the subject does not seem to have made any progress. From experiments indeed stated to have been performed at all angles of incidence with plates of glass, M. Arago announced that the quantity of light which the plate polarized by reflexion at any given angle was equal to the quantity polarized by transmission; but this result, founded upon incorrect observation, led to false views, and thus contributed to stop the progress of this branch of optics.

I had shown in 1813, from incontrovertible experiments, that the action of each refracting surface in polarizing light, produced a physical change on the refracted pencil, and brought it into a state approaching more and more to that of complete polarization. But this result, which will be presently demonstrated, was opposed as hypothetical by Dr. Young and the French philosophers; and Mr. Herschel has more recently given it as his decision, that of the two contending opinions, that which was first asserted by Malus, and subsequently maintained by Biot, Arago, and Fresnel, is the most prob-

* In this discovery I was anticipated by Malus.

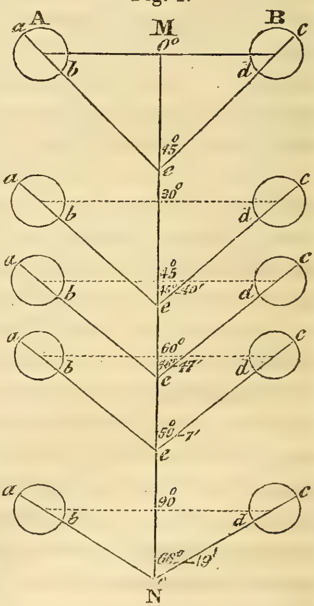
able,—namely, that the unpolarized part of the pencil, in place of having suffered any physical change, retains the condition of common light.

I shall now proceed to apply to this subject the same principles which I have already applied to the polarization of light by reflexion, and to establish on the basis of actual experiment the true laws of the phænomena.

The first step in this inquiry is to ascertain the law according to which the polarizing force of the refracting surface changes the position of the planes of polarized light,—a subject which, in as far as I know, has not occupied the attention of any other person.

If we take a plate of glass deviating so slightly from parallelism as to throw off from the principal image the images formed by reflexion from its inner surfaces, we shall be able to see, even at great obliquities, the transmitted light free from all admixture of reflected light. Let this plate be placed upon a divided circle, so that we can observe through it two luminous discs of polarized light A, B, (Fig. 1.) formed by double refraction, and having their planes of polarization inclined +45° and −45° to the plane of refraction. At an angle of incidence of 0°, when the light passes perpendicularly, the inclination of the planes of polarization will suffer no change; but at an incidence of 30° they will be turned round 40′; so that their inclination to MN or the angle *aec* will be 45° 40′. At 45° their inclination will be 46° 47′. At 60° it will be 50° 7′; and it will increase gradually to 90°, where it becomes 66° 19′. Hence the maximum change produced by a single plate of glass upon the planes of polarization is 66° 19′ − 45° = 21° 19′, an effect exactly equal to what is produced by reflexion at angles of 39 or 70°. It is remarkable, however, that this change is made in the opposite direction, the planes of polarization now approaching to coincidence in a plane at

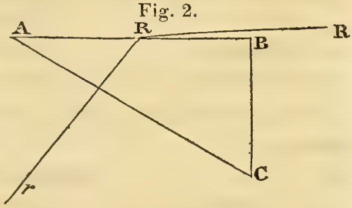
Fig. 1.



right angles to that of reflexion. This difference is exactly what might have been expected from the opposite character of the resulting polarization, the poles of the particles of light which were formerly repelled by the force of reflexion, being now attracted by the refracting force.

In this experiment the action of the two surfaces is developed in succession, so that we cannot deduce from the maximum rotation of 21° 19′, the real action of the first, or of a single surface, which must be obviously more than half of the action of the two surfaces, because the planes of polarization have been widened before they undergo the action of the second surface.

Fig. 2.



In order to obtain the rotation due to a single surface, I took a prism of glass ABC (Fig. 2.) having such an angle BAC, that a ray RR, incident as obliquely as possible, should emerge in a direction R*r* perpendicular to the surface AC. I took care that this prism was well annealed, and I caused the refraction to be performed as near as possible to the vertex A, where the glass was thinnest and consequently most free from the influence of any polarizing structure. In this way I obtained the following measures.

GLASS.

Angles of Incidence.	Inclination of Planes *ab*, *cd*, (Fig. 1.) to the Plane of Reflexion.	Rotation.
87° 38′	54° 15′	9° 15′
54 50	47 25	2 25
32 20	45 22	0 22

I next made the following experiments with two kinds of glass,—the one a piece of parallel plate glass, and the other a piece of very thin crown. The latter had the advantage of separating the reflected from the transmitted light.

	PLATE GLASS.		CROWN GLASS.	
Incidence.	Inclination.	Rotation.	Inclination.	Rotation.
0°	45° 0′	0° 0′	45° 0′	0° 0′
40	47 28	2 28	47 18	2 18
55	49 35	4 35	49 19	4 19
67	52 53	7 53	52 16	7 16
80	58 53	13 53	58 42	13 42
86½	61 16	16 16	61 0	16 0

I was now desirous of ascertaining the influence of refractive power, although I had already determined in 1813, that a greater quantity of light was polarized, at the same angle of incidence, by plates of a high than by plates of a low refractive power. I experienced great difficulty in this part of the inquiry, from the necessity of having plates without any crystalline structure. I tried gold leaf in a variety of ways; but I found it almost impossible to obtain correct results, on account of the light which was transmitted unchanged through its pores.

By stretching a film of soapy water across a rectangular frame of copper wire I obtained the following measure.

WATER.

Incidence.	Inclination.	Rotation.
85°	54° 17′	9° 17′

I next tried a thin plate of metalline glass of a very high refractive power.

METALLINE GLASS.

Incidence.	Inclination.	Rotation.
0°	45° 0′	0° 9′
20	45 42	0 42
30	46 50	1 50
40	48 0	3 0
55	51 12	6 12
80	62 32	17 32

From a comparison of these results it is manifest that the rotation increases with the refractive power.

In examining the effects produced at different angles of incidence, it becomes obvious that the rotation varies with the deviation of the refracted ray; that is, with $i-i'$, the difference of the angles of incidence and refraction. Hence from a consideration of the circumstances of the phænomena I have been led to express the inclination φ of the planes of polarization to the plane of refraction by the formula,

$$\text{Cot } \varphi = \cos (i-i'),$$

the rotation being $=\varphi - 45°$.

This formula obviously gives a minimum at 0°, and a maximum at 90°; and at intermediate points it represents the experiments so accurately, that when the rhomb of calcareous spar is set to the calculated angle of inclination, the extraordinary image is completely invisible,—a striking test of the correctness of the principle on which it is founded.

The above expression is of course suited only to the case where the inclination x of the planes of polarization *ab*, *cd*, (Fig. 1,) is 45°; but when this is not the case, the general expression is

$$\text{Cot}\ \varphi = \cot x \cos (i - i').$$

When the light passes through a second surface, as in a single plate of glass, the value of x for the second surface is evidently the value of φ after the 1st refraction, or in general, calling θ the inclination after any number n of refractions, and φ the inclination after one refraction,

$$\text{Cot}\ \theta = (\cot \varphi)^n$$

When θ is given by observation we have

$$\text{Cot}\ \varphi = \sqrt[n]{\cot \theta}.$$

The general formula for any inclination x and any number n of refractions is

$$\text{Cot}\ \theta = (\cot x \cos (i - i'))^n, \text{ and}$$

$$\text{Cot}\ \varphi = \sqrt[n]{\cot x \cos (i - i')}.$$

And when $x = 45$ and $\cot x = 1$ as in common light,

$$\text{Cot}\ \theta = (\cos (i - i'))^n.$$

$$\text{Cot}\ \varphi = \sqrt[n]{\cos (i - i')}.$$

As the term $(\cos (i - i'))^n$ can never become equal to 0, the planes of polarization can never be brought into a state of coincidence in a plane perpendicular to that of reflexion, either at the polarizing angle, or at any other angle.

In order to compare the formula with experiment, I took a plate of well annealed glass, which at all incidences separates the reflected from the transmitted rays, and in which m was nearly 1.510, and I obtained the following results.

Angles of incidence.	Angles of refraction.		Rotation observed.		Inclination observed.		Inclination calculated.		Difference.	
0°	0°	0′	0°	0′	45°	0′	45°	0′		
10	6	36½	0	13	45	13	45	6	+0°	7′
20	13	5	0	27	45	27	45	25	+0	2
25	16	15	0	32	45	32	45	40	−0	8
30	19	20	0	40	45	40	46	0	−0	20
35	22	19	1	12	46	12	46	25	−0	13
40	25	10	1	30	46	30	46	56	−0	26
45	27	55	1	42	46	47	47	34	+0	47
50	30	29	2	48	47	42	48	24	−0	42
55	33	52	3	54	48	54	48	59	−0	5
60	35	0	5	7	50	7	50	36	−0	29
65	36	53	6	48	51	48	52	7	−0	19
70	38	29	8	7	53	7	53	59	−0	52
75	39	45	9	55	54	55	56	18	−1	23
80	40	42	12	10	57	10	59	5	−1	55
85	41	17	15	45	60	45	62	24	−1	39
86	41	21	16	39	61	39	63	9	−1	30
90	41	28					66	19		

The last column but one of the Table was calculated by the formula,

$$\text{Cot}\ \theta = (\cos\,(i - i'))^2$$

n being in this case 2. The conformity of the observed with the calculated results is sufficiently great, the average difference being only 41′. The errors however being almost all negative, I suspected that there was an error of adjustment in the apparatus; and upon repeating the experiment at 80°, the point of maximum error, I found that the inclination was fully 58° 40′, giving a difference only of 25′ in place of 1° 55′. I did not think it necessary to repeat all the observations; but I found, by placing the analysing rhomb at the calculated inclinations, that the extraordinary image invariably disappeared, the best of all proofs of the correctness of the formula.

In these experiments $x = 45°$ and cot $x = 1$; but in order to try the formula when x varied from 0° to 90°, I took the case where the angle of incidence was 80° and $\varphi = 58°\ 40'$ when $x = 45°$. The following were the results.

Values of x.	Inclination observed.		Inclination calculated.		Difference.	
0°	0°	$0'$	0°	$0'$	0°	$0'$
$2\frac{1}{2}$	7	10	7	20	-0	10
5	9	40	8	19	$+1$	21
10	17	10	16	25	$+0$	45
15	24	42	24	6	$+0$	36
20	32	30	31	19	$+1$	11
25	39	15	37	54	$+1$	21
30	44	10	43	57	$+0$	13
35	49	38	49	28	$+0$	10
40	54	36	54	31	$+0$	5
45	58	40	59	5	-0	25
50	63	10	63	19	-0	9
55	66	58	67	15	-0	17
60	70	18	70	56	-0	38
65	74	8	74	24	-0	16
70	76	56	77	42	-0	46
75	79	20	80	53	-1	33
80	83	23	83	58	-0	35
85	86	23	86	0	$+0$	23
90	90	0	90	0	0	0

The last column but one was calculated by the formula $\cot\theta = \cot x . (\cot 58^\circ\ 40')^2$. The differences on an average amount only to 36′.

In determining the quantity of polarized light in the refracted pencil, we must follow the method already explained for the reflected ray, *mutatis mutandis.* The principal section of the analysing rhomb being now supposed to be placed in a plane perpendicular to the plane of reflexion, the quantity of light Q′ polarized in that plane, will be

$$Q' = 1 - 2\cos^2\varphi,$$

the quantity of transmitted light being unity. But,

$$\operatorname{Cot}\varphi = \cot x \cos(i - i'),$$

and as $\cot\varphi = \frac{\cos^2\varphi}{\sin^2\varphi}$ and $\sin^2\varphi + \cos^2\varphi = 1$, we have the quotient and the sum of $\sin^2\varphi$ and $\cos^2\varphi$ to find them. Hence

$$\operatorname{Cos}^2\varphi = \frac{(\cot x \cos(i - i'))^2}{1 + (\cot x \cos(i - i'))^2}$$

and by substituting this for $\cos^2\varphi$ in the former equation, it becomes

$$Q' = 1 - 2\frac{(\cot x \cos(i - i'))^2}{1 + (\cot x \cos(i - i'))^2}$$

Now since by Fresnel's formula the quantity of reflected light is

$$R=\tfrac{1}{2}\left(\frac{\sin^2(i-i')}{\sin^2(i+i')}+\frac{\tan^2(i-i')}{\tan^2(i+i')}\right)$$

the quantity of transmitted light T will be

$$T=1-\tfrac{1}{2}\left(\frac{\sin^2(i-i')}{\sin^2(i+i')}+\frac{\tan^2(i-i')}{\tan^2(i+i')}.\right)$$

Hence

$$Q'=\left(1-\tfrac{1}{2}\left(\frac{\sin^2(i-i')}{\sin^2(i+i')}+\frac{\tan^2(i-i')}{\tan^2(i+i')}\right)\right)\left(1-2\frac{(\cos(i-i'))^2}{1+(\cos(i-i'))^2}.\right)$$

This formula is applicable to common light in which $\cot x=1$ disappears from the equation; but on the same principles which we have explained in a preceding paper, it becomes for partially polarized rays and for polarized light,

$$Q'=\left(1-\tfrac{1}{2}\left(\frac{\sin^2(i-i')}{\sin^2(i+i')}\cos^2 x+\frac{\tan^2(i-i')}{\tan^2(i+i')}\sin^2 x\right)\right)$$
$$\left(1-2\frac{(\cot x\cos(i-i'))^2}{1+(\cot x\cos(i-i'))^2}.\right)$$

In all these cases the formula expresses the quantity of light really or apparently polarized in the plane of refraction.

As the planes of polarization of a pencil polarized $+45^\circ$ and -45° cannot be brought into a state of coincidence by refraction, the quantity of light polarized by refraction can never be mathematically equal to the whole of the transmitted pencil, however numerous be the refractions which it undergoes; or, what is the same thing, refraction cannot produce rays truly polarized, that is, with their planes of polarization parallel.

The preceding analysis of the changes produced on common light, considered as represented by two oppositely polarized pencils, furnishes us with the same conclusions respecting the partial polarization of light by refraction, which we deduced in a preceding paper respecting the partial polarization of light by reflexion. Each refracting surface produces a change in the position of the planes of polarization, and consequently a physical change upon the transmitted pencil by which it has approached to the state of complete polarization.

This position I shall illustrate by applying the formula to the experiments which I have published in the Philosophical Transactions for 1814.

According to the first of these experiments, the light of a wax candle at the distance of ten or twelve feet is wholly polarized by eight plates, or sixteen surfaces of parallel plate glass at an angle of $78° 52'$. Now I have ascertained that a pencil of light of this intensity, will disappear from the extraordinary image, or appear to be completely polarized, provided its planes of polarization do not form an angle of less than $88\frac{3}{4}°$ with the plane of refraction for a moderate number of plates, or $88\frac{1}{2}°$ for a considerable number of plates, the difference arising from the great diminution of the light in passing through the substance of the glass. In the present case the formula gives

$$\text{Cot}\ \theta=(\cos(i-i'))^{16} \text{ and } \theta=88°\ 50';$$

so that the light should appear to be completely polarized, as it was found to be.

At an angle of $61°\ 0'$ the pencil was polarized by twenty four plates or forty eight surfaces. Here

$$\text{Cot}\ \theta=(\cos\ (i-i'))^{48}=89°\ 36'.$$

At an angle of $43°\ 34'$ the light was polarized by forty seven plates or ninety four surfaces. Here

$$\text{Cot}\ \theta=(\cos\ (i-i'))^{94} \text{ and } \theta=88°\ 27'.$$

It is needless to carry this comparison any further; but it may be interesting to ascertain by the formula the smallest number of refractions which will produce complete polarization. In this case the angle of incidence must be $90°$.

Hence $\varphi=56°\ 29'$ and $(\cos\ (i-i'))^{9}$ gives $88°\ 36'$, and $(\cos\ (i-i'))^{10}$ $89°\ 4'$; that is, the polarization will be nearly complete by the most oblique transmission through four and half plates or nine surfaces, and will be perfectly complete through five plates or ten surfaces.

Having thus obtained formulæ for the quantity of light polarized by refraction and reflexion, it becomes a point of great importance to compare the results which they furnish. Calling R the reflected light, these formulæ become

$$Q=R\left(1-2\frac{\left(\frac{\cos\ (i+i')}{\cos\ (i-i')}\right)^2}{1+\left(\frac{\cos\ (i+i)}{\cos\ (i-i')}\right)^2}\right) \text{ and}$$

$$Q'=1-R\left(1-2\frac{(\cos\ (i-i'))^2}{\varphi+(\cos\ (i-i'))^2}\right).$$

But these two quantities are exactly equal, and hence we obtain the important general law, that,—At the first surface of all bodies, and at all angles of incidence, the quantity of light polarized by refraction is equal to the quantity polarized by reflection. I have said 'of all bodies,' because the law is equally applicable to the surfaces of crystallized and metallic bodies, though the action of their first surface is masked or modified by other causes.

It is obvious from the formula that there must be some angle of incidence where $R=1-R$, that is, where the reflected is equal to the transmitted light. When this takes place, we have $\sin^2 \varphi = \cos^2 \varphi'$, that is,

The reflected is equal to the transmitted light, when the inclination of the planes of polarization of the reflected pencil to the plane of reflection, is the complement of the inclination of the planes of polarization of the refracted pencil to the same plane;—or if we refer the inclination of the planes to the two rectangular planes into which the planes of polarization are brought,—The reflected will be equal to the transmitted light when the inclination of the planes of polarization of the reflected pencil to the plane of reflection, is equal to the inclination of the plane of polarization of the refracted pencil to a plane perpendicular to the plane of reflection.

In order to show the connection between the phænomena of the reflected and those of the transmitted light, I have given the following Table, which shows the inclination of the planes of polarization of the reflected and the refracted pencil, and the quantities of light reflected, transmitted, and polarized, at all angles of incidence upon glass, m being equal to 1.525, and the incident light $=1000$.

Angles of Incidence, *i*.		Angles of Refraction, *i'*.		Inclination of Plane of Polarization of the Reflected Light, φ'.		Inclination of Plane of Polarization of the Refracted Light, φ.		Quantity of Light Reflected, R.	Quantity of Light Transmitted, 1—R.	Quantity of Light Polarized, Q.
°	′	°	′	°	′	°	′			
0	0	0	0	45	0	45	0	43.23	956.77	0.
2	0	1	18⅔	44	57	45	0.7	43.26	956.74	0.07
10	0	6	32	43	51	45	3	43.39	956.61	1.73
20	0	12	58	40	13	45	13	43.41	956.59	7.22
25	0	16	5	37	21	45	21	43.64	956.36	11.6
30	0	19	8½	33	40	45	31	44.78	955.22	17.24
35	0	22	6	29	8	45	44	46.33	953.67	24.4
40	0	24	56	23	41	46	0	49.10	950.90	32.2
45	0	27	37½	17	22½	46	20	53.66	946.33	44.0
50	0	30	9	10	18	46	45	61.36	938.64	57.4
56	45	33	15	0	0	47	29	79.5	920.5	79.5
60	0	34	36	5	4½	47	54½	93.31	906.69	91.6
65	0	36	28	12	45	48	42	124.86	875.14	112.7
70	0	38	2	18	32	49	28	162.67	837.33	129.8
75	0	39	18	26	52	50	55	257.56	742.44	152.3
78	0	39	54	30	44	51	48	329.95	670.05	157.6
78	7	39	55	30	53	51	50	333.20	666.80	157.65
79	0	40	4	31	59	52	7	359.27	640.73	157.6
80	40	40	13	33	13	52	27½	391.7	608.3	156.7
82	4	40	35	36	22	53	26⅓	499.44	500.56	145.4
84	0	40	42	38	2	53	57	560.32	439.68	134.93
85	0	40	47	39	12	54	22	616.28	383.72	123.7
85	50⅔	40	50⅔	40	12	54	44	666.44	333.56	111.11
86	0	40	51	40	22$\frac{7}{10}$	54	48	676.26	323.74	108.67
87	0	40	54	41	32	55	16	744.11	255.89	89.8
88	0	40	57½	41	23	55	43	819.9	180.1	65.9
89	0	40	58	43	51	56	14	904.81	95.19	36.3
90	0	40	58	45	0	56	29	1000.	0.	0.

It is obvious from a consideration of the principle of the formula for reflected light, that the quantity of polarized light is nothing at 0° because the force which polarizes it is there a minimum. At the maximum polarizing angle, Q is only 79° because the glass is incapable of reflecting more light at that angle, otherwise more would have been polarized. The value of Q then rises to its maximum at 78° 7′, and descends to its minimum at 90°; but the polarizing force has not increased from 56° 45′ to 78° 7′ as the value of φ' shows. It is only the quantity of reflected light that has increased, which occasions a greater quantity of light to disappear from the extraordinary image of the analysing rhomb.

The case, however, is different with the refracted light. The value of Q' has one minimum at 0° and another at 90°, while its maximum is at $78^\circ\ 7'$, while the force has its minimum at 0° and its maximum at 90°, where its effect is a minimum only because there is no light to polarize. At the incidence of $78^\circ\ 7'$, where the quantities Q, Q', reach their maxima, the reflected light is exactly one half of the transmitted light; $\sin^2\varphi = \cos^2\varphi$ and $\tan\varphi' = \cos\varphi$.

At $85^\circ\ 50'\ 40''$, where the transmitted light is one half of the reflected light, the deviation $(i-i')=45^\circ$, and the quantity of polarized light is one third of the transmitted light, one sixth of the reflected light, and one ninth of the incident light. $\sin^2\varphi' : \cos^2\varphi =$ reflected light : transmitted light, and $\cot\varphi' = \sin(i-i')$.

At 45° we have $(i+i')+(i-i')=90^\circ$ and $\varphi'=(i-i')$,

$$\operatorname{Tan}(i-i') = \frac{\cos(i+i')}{\cos(i-i')}, \text{ and } \tan(i-i')^2 = \frac{(\sin(i-i'))^2}{(\sin(i+i'))^2}$$

At $56^\circ\ 45'$, the polarizing angle, the formula for reflected light becomes $R=\frac{1}{2}(\sin^2(i-i'))^2$; but at this angle we have $i'=90^\circ-i$. Hence we obtain the following simple expression in terms of the angle of incidence, for the quantity of light reflected by all bodies at the polarizing angle.

$$R=\tfrac{1}{2}(\cos 2i)^2.$$

I have already mentioned the experiment of M. Arago with plates of glass, in which he found that "at every possible inclination" the quantity of light polarized by transmission was equal to the quantity polarized by reflexion. This conclusion he extends to single surfaces; but it is remarkable that the law is true of single surfaces in which he did not ascertain it to be true, while it is incorrect with regard to plates in which he believes that he has ascertained it to be true. As the consideration of this point does not strictly belong to the present branch of the inquiry, I shall reserve it for a separate communication, "on the action of the second surfaces of transparent plates upon light."*

Allerly, December 29, 1829.

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* Inserted in the last number of this Journal.

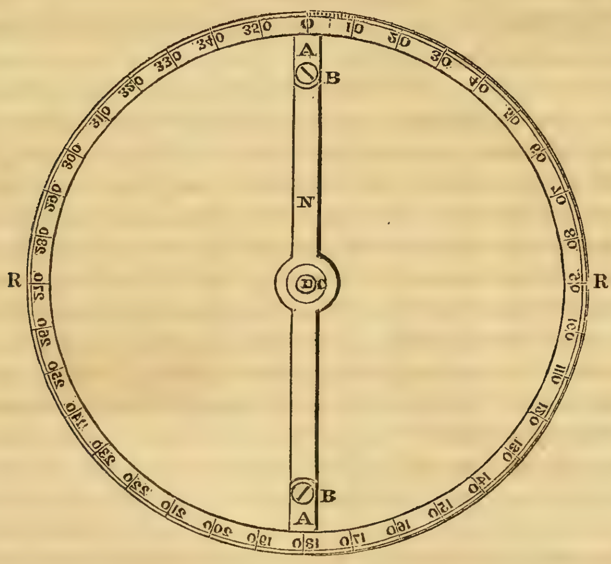
Art. IV.—*The Microscopic Compass; invented by* John Locke, M. D., Principal of Cincinnati Female Academy.

TO THE EDITOR.

Dear Sir—For several years I have been procuring a variety of miniature or pocket instruments for mathematical and philosophical purposes. To the pocket sextant, telescope, level, &c. I have been desirous to add a compass, which should have nearly the accuracy of a surveyor's large compass of the best construction.

After several fruitless attempts to procure one already made, I attempted to invent one and have succeeded so much to my satisfaction that it has seemed to me that an account of my invention would not be useless or uninteresting to the public.* My compass has the graduated rim attached to the needle and revolving with it in the manner of the card of the mariner's compass Fig. 1. This rim is made

Fig. 1.



* I commenced my experiments on this instrument in Feb. 1832. I presently had one constructed for myself by a very ingenious young artisan of this city Mr. T. Wells. Another has been constructed under my direction by Mr. Cox, for Mr. Bonney.

of brass, three inches in diameter and very light, weighing fifty grains. Although the word "card" is inappropriate, yet as it has been "coined" by use for that part of a compass when it moves with the needle, I shall use it in the subsequent part of this paper.

Fig. 2.

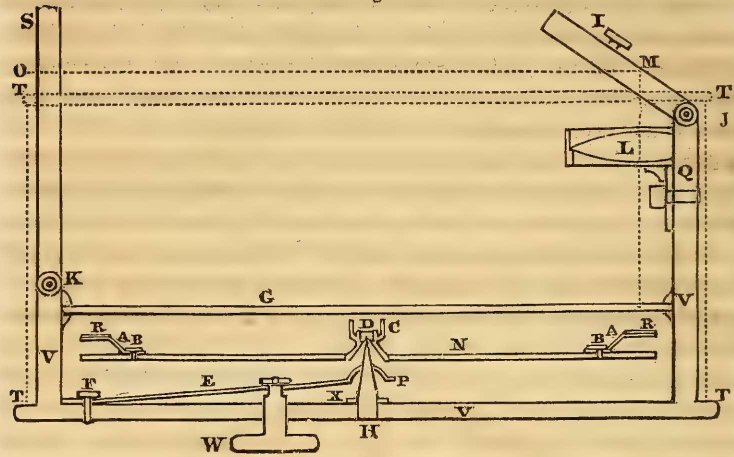


Fig. 3.

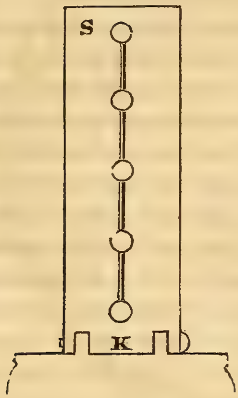
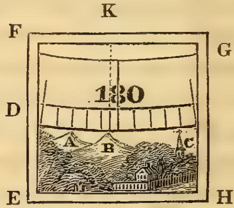


Fig. 4.



This card is suspended in a brass box three and a quarter inches in the inside diameter and half an inch deep, (T V Fig. 2.) The sights (K S and V J Fig. 2.) arise from opposite sides of the box as in the surveyor's compass, but are not carried out on arms, the distance between them being the exact diameter of the box. Indeed these sights may be considered as a part of the cylinder of which the box is made. The sight K S which is to be used next to the eye, is made precisely as in the common compass, having several holes placed vertically, and these connected by a slit one-thirtieth of an inch wide. (Fig. 3.) The opposite sight V J is slitted and perforated in a similar manner from V to Q chiefly for the purpose of reversing for adjustment. Its main use however is independent of these slits, it is intended to support at its top an inclinable reflector (M), the inclination being directly towards the first sight K S; and immediately below the reflector, a single lens or microscope (L), placed horizontally one inch above the card and having an inch focus. In these two parts, the lens and the reflector, lies the peculiarity of the instrument.

Every philosophical reader is now enabled to understand the use of the instrument. The rays of light passing divergingly upward from any point of the card to the lens, pass through it and emerge parallel above it, where meeting with the reflector (M) inclined to an angle of forty-five degrees, they are reflected horizontally through the opposite sight at (O). The eye at the sight (O) would of course see the card in the direction in which the rays were last received; that is, in a horizontal direction. As the rays would be rendered parallel, the card would appear at a great distance and magnified.

The card thus reflected would appear in a vertical position, in the position of a full moon just risen, with that point which is really farthest from the eye as the lowest point in the reflected image. It should be remarked that the whole of the card is not seen at once in the reflector, but only about ten degrees of the lowest part of it. (Fig. 4.) The silvering of the reflector being removed from the lower half, (from M towards J) any distant object can be seen through the opening while the card is reflected from the upper part, and by inclining the reflector on the hinge (J) the graduated edge of the reflected card can always be brought to visual contact with the object whose bearing is at once read, as it were, on itself. The rays of light coming from a distant point are nearly parallel, and those coming from the card are made so by passing through the convex lens; the consequence is that both the degrees on the card, and the object are seen perfectly clear as if equally distant. This would not be the case if the card were reflected without the interposition of the lens. The degrees on the card and the object would then be in the condition of one object within three inches of the eye and another at an indefinitely great distance. On account of the focal adjustment of the eye both cannot be clearly seen at once.

Any person may be satisfied of this by making several marks the twentieth of an inch apart on the edge of a piece of paper, holding it up at the distance of three inches, and looking over the graduated edge at a distant object; the lines will appear entirely blended; if the attention be then directed to the lens the object disappears or is seen very indistinctly. I mention this principle more especially, because I once saw a French compass of this defective construction, in which the sight and the reflector were close to the card. It could not of course be used for objects either above or below the horizon and even for horizontal objects it could not, for the above defect, be read with accuracy. It was the inspection of this however which led me to attempt the present improved invention.

The degrees in my compass are magnified so much that each degree becomes a true measure of a degree of the horizon, as the degrees of a horizontal circle would be if they were seen from the centre. When a degree of a circle is viewed from the circumference, it measures one-half a degree; Euc. III. 20. If under these circumstances the degrees were magnified twice, then a degree of the circle seen at the distance of the diameter, would be the true measure of a degree. If the degrees are seen at a greater distance than a diameter, they become proper measures of degrees by being proportionally magnified. This is true only of a few degrees on each side of the diameter; so far only as the arc, chord, sine and tangent have no sensible difference. The degrees of the card in my compass are magnified very nearly to that proportion, so that the bearing of all the objects in the field of view, which takes in ten degrees, can be read at once without moving the instrument: Fig. 4 exhibits the appearance of the field of view as seen in the reflector. The space D G includes ten degrees of the card seen in the silvered part; D H is the part of the horizon seen through the unsilvered part. The bearings of the objects A, B, C, would be read as follows, A 177°, B 179° 25′, C 184°. It will be seen from this reading that the circle is numbered quite round from 0 to 360. Zero or 0 is placed North and the reading continued eastward. East is 90°, South 180° and West 270°. Reading at several points in the field of view as above is liable to error from the vibrations of the card up and down and from "aberration" of the lens, the degrees being seen out of its axis. A principal reading point or sight is therefore made by a scratch or line on the glass cover directly underneath the lens. This mark (B K Fig. 4) appears in the field of view crossing the card vertically. It has nearly the distinctness of the degrees because it is so near the card that the rays from it pass through the lens and are rendered nearly parallel.

Manner of using the Microscopic compass.—As it is contained in a box, three and a half inches in diameter and one inch and nine-tenths deep, it may be carried in the waistcoat pocket.

When the bearing of an object is to be taken, remove the cover, raise the sights, and holding the compass horizontally, by grasping the milled edge of the bottom by the thumb and fingers of one hand, move the eye up or down along the slitted sight till the object appears in the unsilvered part of the reflector. With the other hand incline the reflector backwards or forwards on its hinge till the graduated edge of the card is brought to the lower edge of the silvered part of the reflector and in apparent contact with the object. Turn the compass round till the vertical sight line crosses the object. The degree or degree and part which appears behind this line is the bearing. Some advantages might be obtained by using the instrument on a stand, but by a little practice the bearings may be taken very accurately by hand. I do not propose this as a substitute for the surveyor's compass; but merely as an instrument exactly suited to amateurs and scientific travellers, to whom it is inconvenient or unpleasant to carry a back load of machinery, to take the bearing of an object. I have, for several years, been carrying on a trigonometrical survey of the beautiful valley of Cincinnati in which I reside. This I have done for the recreation both physical and intellectual which it affords. It invites me to exercise in the open air and is the best antidyspeptic I have tried. I have managed the several points of the valley very much to my satisfaction with the sextant; but nothing answers so well for "meandering" the ravines, rivulets, and ridges of the hills as the microscopic compass. I can take the angles with equal accuracy as with the surveyor's and with ten times the convenience. It remains to explain the figures, and make some remarks on the construction. Fig. 1. represents the needle and graduated rim, a vertical section of which is shown in Fig. 2. N is the needle, which is one twenty fifth of an inch thick, one eighth of an inch wide, and three inches long. AA are two pieces of brass, by means of which, the rim is fastened to the needle by screws at BB. The pieces AA have holes at BB a little larger than the screws which pass through them, to allow the rim to be adjusted both to the center and to the magnetic axis of the needle. The pieces AA are bent as in Fig. 2. so as to raise the rim even with the point of suspension in the cap. C is the brass cap riveted through the needle, and D an agate cap fastened into its socket, by burnishing the brass over its edge in the lathe. The rim is on fiftieth of an inch thick, and divided very accurately into degrees. The figures numbering the degrees, must be reversed in the manner of types, because they are to be read in the reflector which will rectify them. Fig. 2. This is in general a vertical section of the whole instrument in the plane of the sights. VVV is the box turned out of cast brass or soldered out of thick sheet brass. G is the glass resting on a projection below and held in by a ring above. The sight KS has a joint at K by which it can be turned down on the glass G. M is the reflector previously described. I is a screw passing through the brass back which protects the silvered part, and screws against a thin plate interposed between it and the glass, to keep the latter firmly in its place. L is the lens set in brass and fastened to the sight by two screws below, each near the outer edge of the sight. The brass is slitted on the screws so as to allow of an adjustment of the microscope. The lens should be seven tenths of an inch in diameter, and if necessary should be ground off on the side next the sight so as to bring the axis over the rim R, or the axis may be a little inclined so that the ray RM shall not be perpendicular, but shall strike the reflector, say, at the screen I. H is a steel pivot screwed into the bottom of the box with a 'flange' at X squared for unscrewing. PHP is a spring to raise the needle against the glass from the point. W is the screw by which it is raised. The dotted line TTTT represents a brass cover which closes the whole instrument, the sight KS and the reflector M being shut down by means of their joints KJ. The compass thus closed has the appearance of a pocket sextant. At the top and bottom of this box is the milled projection, which is of use in opening and holding it. Fig. 4. has already been described. In making the instrument the artisan should be careful so to construct it, that the plane of the sights may pass through the point of the pivot and that the hinge of the reflector may have its axis exactly perpendicular to that plane. The ends of the needle should not come within the eighth of an inch of the box, as it may otherwise be influenced by the magnetism of the brass. I have not found a specimen of hammered brass which was not magnetic when tried by a delicate test needle. Its magnetism is however destroyed by heating it to a bright red. So great was the magnetism of some of the brass of my compass, that it would attract the test needle more than one eighth of an inch, and by contact would carry it 70° out of the meridian. I was obliged to anneal the whole box. I did not find it to possess polarity, but it acted like soft iron.

That the brass was not magnetic by actually containing iron, was evident by its magnetism being destroyed by annealing. It might be well to make the spring of silver. It is possible that this application of the lens and reflector to the compass is not new; but so far, I have not been able to find an account of any thing similar. Notice of the invention has been communicated to the Patent Office of the United States. A patent will be applied for as soon as the best modification of the instrument shall be obtained.

Cincinnati Female Academy, Oct. 20th. 1832.

Art. V.—*Facts relating to Diluvial Action;* by the Hon. Wm. A. Thompson.

TO PROFESSOR SILLIMAN.

Dear Sir.—When I had the pleasure of seeing you at New Haven, last autumn, I intimated my intention of sending you my views of the geological features of Sullivan County, New York, and likewise the traces of diluvial action on the solid strata, with some of the proofs that present themselves, in every part of the country where the earth has been removed, so deep as to come to firm rock, below the effects of frost and other decomposing agents; but, the snow came on so early in the fall and my health has been so indifferent, this spring, that I have been obliged to defer it until the present time. Perhaps I shall not even now be able to write any thing new or interesting on this subject, especially as I find that Sir James Hall, many years since, described traces of diluvial action in Scotland, and Mr. David Thomas of Cayuga has made similar observations in the western part of this State as appears in Vol. xvii, p. 408 of your Journal. I have examined this part of the State with considerable care, and have found that in more than fifty different places where I have seen the solid strata, the grooves and furrows appear from an inch to one fourth of an inch deep, and from one fourth of an inch, to three and four inches wide; and in some cases they run due north, and in every direction from north to twenty five degrees south of east. I have found them also in the bottoms of cellars, of excavations made in digging wells, and where the earth has been removed by making roads, and in many instances where I have uncovered the solid rock for the purpose of observing the effects of the diluvial action. I have paid some attention to this subject while travelling in the Eastern States, and I could find none of the furrows;* but the solid strata appears to be worn very smooth by attrition, by the motion of some bodies smaller and less solid than those which have produced the distinct traces, in this part of the State of New York.

It may be proper to remark first, that Sullivan County is bounded south and west by the Delaware river; north by Delaware and Ulster Counties, and east by Orange: that the county lies on the easterly part of the Alleghany range of mountains, and that the mean altitude of the county, is on a level with the highlands below Newburgh,—about one thousand five hundred feet above the tide water; that this level is continued westerly through Sullivan County and the state of Pennsylvania, from the Shongham mountain to the Susquehannah River; that a space of above fifty miles wide of this level lies continuously, in the Alleghany range, until you come to mountains of a greater height, on the west side of the Susquehannah; that the depth of the earth above the solid rock, gradually and regularly increases from Shongham mountain to the Susquehannah; that the average depth of earth in Sullivan County is not more than twenty five feet, nor more than thirty five through the state of Pennsylvania: that the range of the Kattskill mountain, bounds the north part of Sullivan; that south of this space of fifty miles, the altitude of the mountains considerably increases; in this intermediate space it appears that tops of the ridges had been dilapidated by mighty force, and that the current had pressed easterly, and often times carried large pieces of rock to a considerable distance, say from fifty to two hundred rods, and if the fragments are of very considerable size they always rest on the solid strata. In many instances, sections of the strata were broken out and raised by the violence of the current and left on the tops of the highest hills; I have seen an instance where a rock twenty feet square has been carried half a mile on the level surface of the strata that are covered about three feet with earth, and there left in that position;

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* The author will find notices of such appearances in Massachusetts by Mr. Appleton, Vol. XI. p. 100 of this Journal.

the violence of the current having ceased to effect its farther removal from its original position.

The upper strata of the whole section of the country before the deluge, appear to have been composed of a common grey sandstone covering the surface of the rock from twelve to twenty four inches thick. This seems to have been the last marine formation; it is full of fissures and cracks, being broken into small angular pieces by the first violent surges of the deluge, and now scattered on the surface of the ground.

The next lower strata are puddingstone, filled with quartz and feldspar and other primitive minerals; its parts are generally water worn and are from the size of a robin's to that of a hen's egg. The next rock underneath is the old red sandstone, which is universally found in the bottoms of the vallies; on the tops however of the highest hills the red clay slate is universally found, and for eighty or ninety miles west, gives a reddish color to all the soils of the country, and passes southerly through New Jersey and Pennsylvania.

The vallies in this section of country uniformly run from north to south, are in many instances from ten to twelve hundred feet deep, and are the beds of the large streams. The lesser vallies are covered with pieces of red and grey sandstone of a convenient size for making fences. The most free and feasible land is always found on the tops, and on the eastern sides of the hills, the western sides being uniformly steep and broken. The whole of the earth or soil appears to have been removed from the solid strata at the deluge, and most, if not all the upper strata of sandstone, were then broken up. A small portion of the puddingstone was also broken up in large square blocks and occasionally pieces of the old red sandstone were detached from the bottom of the vallies. It is probable that previous to the deluge there was little or no soil on this section of the country, that the hills, vallies and streams were the same previous to the deluge that they are at this time, excepting that the hills were dilapidated and lowered, and the deep vallies were made still deeper by the tremendous cataracts and surges, the water being carried violently over the high ledges and hills and then, in crossing the ridges from west to east, falling ten or twelve hundred feet into the vallies. While contemplating such a scene, our imaginations must fall infinitely short of the reality. The single wave that totally destroyed the port town of Lima, or the surge that overwhelmed the Turkish fleet in Candia comes nearer to the terrific scene than any similar events that are recorded.

That these large masses of rocks should be broken up and thrown upon the the tops of high hills will appear in no way surprizing when we consider what must be the effect of the precipitation of the cataracts into deep vallies and of their subsequent violent reflux over the high hills; a power more than sufficient to raise the large masses of rock that were left on the high grounds in the country.

That water has the power to carry rocks and other heavy bodies over the tops of mountains, is evinced by the simple fact, that the only place where the millstone is found within two hundred miles, is at Kizerack, on the west side of Shongham mountain, fifteen to twenty miles from Esopus or Kingston, up the Roundout Hill. At this place, all the country or Esopus millstones are sold. Now, over a great part of the west side of Shongham mountain, which is composed of the millstone grit, this rock has been carried to the height of ten or twelve hundred feet, so as to pass over the top of the mountain, and it lies scattered through the country for many miles east, between Newburgh and the Shongham mountain, and as there is no other similar stone within two hundred miles, this is conclusive evidence that the violence of the surge carried the rock over the top of the mountain and left them in the position in which we now see them; some of the stones weigh from three to four tons.

Professor Eaton, in his geological survey of the Kattskill or Alleghany, says, that all the eastern slope of the Alleghany is capped or protected by the millstone grit, but what he called the millstone grit, I call the conglomerate, or puddingstone; both are formed in part of quartz, but in the true millstone grit, the fine parts are formed by abrasion of the quartz only, while common sand mixed with globular pieces of quartz, forms what he calls the millstone grit of the Alleghany range.

I have never been able to find any grooves or furrows, on the west side of the hills and ridges in the County; nothing appears but the traces and breaches where the rocks have been torn up by some violent agent. It very rarely happens that any traces can be found on the red argillaceous sandstone; it is not sufficiently solid to sustain the force of heavy bodies moving in contact with it, although in some instances the grooves appear for fifteen or twenty feet, and then the strata are rough and broken, but the traces are mostly on the solid puddingstone, and the common grey sandstone which remained solid and unbroken at the deluge. In those cases where the old red sandstone appears, if the slope or side of the hill faces the north, I have seen three or four instances in which the furrows run in that direction for half a mile, and on meeting a ridge of rocks in the low grounds, the furrows turned due east, and after passing the obstruction, again turned north east, or east. Not a mile from the same place, on descending from the same high ground, the furrows run east, tallying with the face of the hill. On the high lands west of the Shongham and where there could be no obstruction for seventy or eighty miles, I examined ten or twelve different places in which the furrows were deep and distinct, and found them to run from ten to twelve degrees north of east, and they continued in the same direction for a considerable distance down the mountain; at no great distance to the south, the furrows tended twenty-five degrees south of east, leading to a low opening in Shongham mountain, through which the currents of water naturally run. I have rarely examined the strata below the decomposing effects of frost, without discovering distinct traces of diluvial action. Near the banks of streams, I hardly ever found any such marks, but the solid strata appeared broken and very little altered by attrition. In one place where the earth was removed and where there was no visible obstacle to alter the current of water, the furrows crossed each other, shewing that the current took a new direction, after the first furrows were made. About twelve or fourteen miles west of Newburgh, I found the marks on the solid graywacke to run nearly north and south. At Coxakie, in Green County, in digging a well and coming to the solid strata, the furrows ran northerly and southerly about in the direction of the mountain. I found that in different places, between thirty and forty miles apart, the furrows ran about ten degrees north of east, especially where the current had a free course for any considerable distance without any obstacle. Where the solid strata remained, but a part has been removed by some powerful agent.

On examination, I have found, that the corners of rock have been worn off by abrasion from eighteen to twenty four inches, and that the furrows made on the rocks by the abrasion of hard substances, were very distinct, although the edges of rock were rounded. This fact is of frequent occurrence. On the high land, as well as on the low, the furrows appear near small streams, in every possible situation, showing, without a doubt, that the rivers and hills remain now as they were before the flood. Pieces of the solid strata with the furrows on them, are often found where part of the strata was broken up after the furrows were made, but more of the argillite than of any other rock appears in fragments. It was supposed that these grooves were made by the Indians, before the settlement of the country by the white people. Large fragments of rocks or boulders are found in every part of country, which fragments, in passing over the surface of the strata, have doubtless made these furrows. Most of them have the corners worn off. There are but few instances in which other stones are found besides the natural strata of the country. In some instances, the stones are composed altogether of sea shells; in two instances, I have found palm leaves and ferns incorporated in the soft gray slate. The soil is much fuller of the small particles of quartz and feldspar than in Orange county, or in the New England states. The disintegration produces a fine sand, upon which there rises an abundant growth of pine and hemlock. For three hundred miles to the westward, it is evident that the soil or earth was raised and increased very much by the deluge, and the mountains and ridges were lowered and robbed of their loose stones, by the same cause. The opening of about fifty miles wide through this part of the Alleghany ridge has probably tended in some measure to control and direct the course of the current of water. The mastodon appears not to have been a native of this section of the country, but was probably an inhabitant of the champaign countries to the west, and the bodies may have been borne, on this mighty current, through falls and cataracts to the low, basin-like counties of Ulster and Orange, where they were finally deposited. Before the deluge, the counties of Orange and Ulster were probably formed of low sharp ridges of graywacke and limestone, and narrow short vallies running in different directions, with little or scarcely any soil or earth either in the vallies, or on the low sharp ridges, and of course such countries would not be the natural residence of the unwieldy mastodon. The carcases of these animals were probably in some cases brought whole, in others they were lacerated and torn assunder, or bruised, and the bones broken, before the flesh had decayed and dropped from them. This appears from the place and the condition in which the bones are found. The first skeleton found in Orange was taken out of a swamp near Crawford on the Newburgh turnpike. This carcase was deposited entire and unbroken in a pond or basin of water, and after the flesh was decayed from the bones, they were spread over an area of about thirty feet square; the outlet of this pond is a firm rock; the pond has been filled up by decayed vegetable substances, and now forms a swamp of about ten acres covered with maple and black ash. In the north part of this swamp, about two years ago, on digging a deep ditch to drain the ground, a skeleton of the mammoth was found; this skeleton I immediately examined very minutely, and found, that the carcase had been deposited whole, but that the jaw-bone, two of the ribs, and a thigh bone had been broken by some violent force while the carcase was whole; on taking up the bones, this was evident, from every circumstance. Two other parts of skeletons were, some years since, disinterred, one near Ward's Bridge, and the other at Masten's meadow, in Shongham; in both instances, the carcases had been torn asunder, and the bones had been deposited with the flesh on, and in two or three instances, the bones were fractured. That the bones were deposited with the flesh attached to them, appears from the fact that they were found closely attached to each other, and evidently belonged only to one part of the carcase, and on a diligent search, no part of the other bones could be found within a moderate distance of the spot. If the animal had died where the bones were found, the whole skeleton would have been found at or near the place. Great violence would be necessary to break the bones of such large animals; in the ordinary course of things, no force adequate to that effect, would be exerted; I think it therefore fair reasoning, to say, that at the deluge, they were brought by the westerly currents, to the place where they were found; that the carcases were brought in the first violent surges, and bruised, broken, and torn asunder by the tremendous cataracts, created when the currents crossed the high mountains and ridges, and fell into the deep vallies between Shongham mountain, and the level countries at the west; that those carcases that came whole to the place where they finally rested, arrived after the waters had attained a greater height, and were probably less violent, and of course the bodies were less liable to be beaten and bruised by coming into contact with the rocks. This view of the facts appears to me fairly to account for the condition in which the bones of the mammoth are found.

I have thus given a desultory sketch of a number of facts relating to the currents of water at the deluge, and their effects on the face of the country; if they should not appear to be new, they may still be received as evidences of diluvial effect in different parts of our country. I have a number of specimens, which I can send you, of rocks containing the traces left on the different strata, and should any additional information be desired, I will cheerfully furnish it.

Thompson, Sullivan County, Aug. 20, 1832.

Art. VI.—*List of the Plants of Chile; translated from the "Mercurio Chileno," by* W. S. W. Ruschenberger, M.D. U.S. Navy.

(Concluded from p. 96.)

Lycogala argenteum and *L. miniatum.* Pers. These two small mosses are seen on rotten wood towards the close of the autumn after rains. They are not distinguishable from those of Europe.

Lycopersicum esculentum. Dun. The tomato is a well known plant. It is generally cultivated and its fruit forms one of the great resources of the kitchen. It may be perfectly preserved during the winter by the method pointed out by Mr. Appert.

Lysimachia Linum stellatum. L. Common in fields and in shady places on the highlands, in the Punta de Cortes and Taguatagua. It does not appear that it came from Europe as it is found growing far from inhabited places. If it was desirable to introduce some species of this genus into gardens the *L. thyrsiflora, L. verticillata,* Pall, and the L. *punctata,* might be selected.

Lythrum thymifolium and L. *hyssopifolium,* L. Frequent in humid situations, in drains near habitations and torrents. I have met with a third species, which I think new, near the Powder House* and at the foot of San Cristoval. It differs from the preceding by its flowers being three times as large, and its stalks much more prolonged and white. I have called it *L. albicaule,* and it should be placed at the side of the *L. maritimum,* H. B. and Kunth.

Macrea parvifolia. Lindl. A very branching shrub which grows on the barren hills of Punta de Cortes and of Leona. The whitish appearance of its leaves is very beautiful. I do not think it easy to cultivate.

Macrocystis Pyrifera. Agardh. A beautiful marine plant which is met with in the bay of Valparaiso, and along the whole coast, and even before arriving at Cape Horn. i. e. to the southward of it. I believe that the *M. Humboldtii,* Ag., is but a variety of the former, as I have had occasion to observe all the difference relative to the figure of the leaves and the vesicles which sustain them. The name *cochayuyo* is given to an infinity of species which belong to this family and particularly to those which grow in the sea. That which is most generally known under this appellation, and of which

* Santiago.

most use is made, is to me as yet quite uncertain, having only seen some stalks of it which were without leaves and fructification. It serves as an aliment, and when well prepared is not a disagreeable dish.

Madia sativa. Molina. *Melosa.* It is found every where both in cultivated and uncultivated situations. A variety is found upon the arid highlands which might be separated from the soil but it would first be necessary to ascertain whether its characters are not changed by cultivation. Molina recommends this plant strongly on account of the quantity and quality of the oil produced from its seeds. Nevertheless it is at present neglected and looked on as a weed.

Malesherbia paniculata. Don. Common in the stony and arid situations both on the highlands and in the plains, in Santiago, Rancagua, and S. Fernando. Its numerous violet flowers recommend it for cultivation. De Candolle is mistaken in attributing yellow flowers to this genus; I have always seen them of the color named above, or rose or white. The *Gynopleura dentata* and *laciniata*, Miers, are in my opinion only varieties of the same species the leaves of which present many anomalies, and sometimes even in the same individual. I possess another species which appears to differ from the *M. thyrsiflora*, Ruiz and Pavon, in its leaves, which are constantly entire. In other respects they are similar. It grows in the stony situations in the highlands and particularly in the vicinity of the copper mines of Porpaico. Its flowers are small and white. I am indebted for it to Claudius Gay, Professor of Physics and Chemistry in the college of Santiago. This gentleman has very kindly informed me of other plants which I have not yet met with.

Malva. L. The most common species met with in the country resembles the *M. Brasiliensis,* Desrouss. It grows every where: its stalk is generally prostrate; sometimes erect. Its common name is *Malva.* The *M. prostrata,* Cav. *pilapila,* grows in fields and on the margins of drains. Its flowers are of a bright red. The *M. Caroliniana,* L. *Malvaloca,* is not uncommon in the plains and near roads. Its figured leaves (*hojas recortadas*) and large sky-blue flowers, disposed in clusters, render it agreeable to the eye. The *M. umbellata,* Cav. *Malvavizco,* is frequent in gardens and likewise on the sides of roads, near Quinta and Santiago. If it is not new I think it is the *M. leprosa,* Ortega. The first is most used. It is employed in cataplasms. The decoction of its roots and leaves and the infusion of its flowers are prescribed in many diseases. Virtues eminently pectoral are attributed to the *malvavizco*, and to the *pilapila*, properties which are specific in diseases of the throat.

Marchantia Chenopoda and *polymorpha*, L. These two Hepaticæ are found in shady and humid situations, near drains and walls, and among rocks and in woods on the mountains and plains.

Margyricarpus setosus. Ruiz and Pavon. This under-shrub is seen in the woods and ravines near the *Cachapual* running to Canguenes. I have seen in these same places a shrub of the same family precisely similar in size. It differs only in the number of stamina which are six; in the fruit which is not drupaceous *(drupaceo)*, and is provided with four wings; and finally, in the leaves which are obtuse. It may form a new genus.

Matricaria Chamomilla. L. Vulgarly *Manzanilla de Castilla*. It grows in olitories and cultivated places, and near houses. This plant is generally employed as a medicine. The aromatic odor of the whole plant and particularly of its flowers, and the bitter principle declare its virtues, which are confirmed by experience: particularly with persons of a nervous temperament. Its infusion is prescribed as a drink and as an injection. Fumigations of it are also used.

Maytenus Chilensis. DC. A pretty tree with light foliage and hanging branches. It sometimes acquires a considerable elevation; its wood serves for many works in carpentry. It might be employed in forming woods and groves about country seats. Cattle eat its leaves and even its bark in the winter season when fodder is scarce. The *M. Boaria*, Molina, is the same badly described. It appears that this author has examined the flower after the fall of the petals, and calycine teeth, and he thought that the fleshy disk which surrounds the ovary was the corolla. I have observed three very marked varieties which merit the attention of botanists; the first, in the woods of Leona. Its branches are straight, the leaves are twice as large but less pointed. The other two resemble it in size; but the first has the anthers sessile, the ovary more distinct, and the stigma bifid. The stamens of the other have quite long filaments, the ovary much shorter, and the stigma scarcely bilobate. Not having seen its fruit, when ripe, I cannot at present say whether it belongs to a different species. The variety *angustifolia* is met with near Quinta and in Rio Claro.

Medicago, L. Of all the species of this genus the most common is the *M. sativa*, L.; *alfalfa*. It is the general aliment of cattle, but its advantages though great do not appear to me proportioned to the expense and the extent of surface which its cultivation requires, particularly as respects certain localities and quality of soil. But the method of cultivating the *Alfalfa* might in my opinion undergo some useful and important changes; but as my plan does not allow me to enter into long disquisitions relative to agriculture, this subject as well as others of the same nature will occupy a separate communication. There are many other species of *Medicago* quite common in meadows and fields; they come from Europe and are generally confounded under the name of *gualputa*: such are the *M. lupulina*, L., *maculata*, *tuberculata*, *denticulata*, Willdn. *minima*, Lamk, and *muricata*, All.

Melia Azedarach. L. I have seen only one of prodigious dimensions on the farm of Licèo, which was planted, I have no doubt by the Jesuits. This tree should be cultivated with care; for the elegance of its leaves and the delicate color of its numerous flowers, recommend it as an ornament of the garden.

Melica violacea and *laxiflora.* Cav. Two pretty grasses common in thickets and stony places on the highland near Cachapual. Another of the size of the last, but of a different appearance is found in the same situations.

Melilotus officinalis. W. *Trebol*;—common in fields on the plain near drains and humid places. It doubtless came from Europe: it is not applicable to any purpose.

Melissa officinalis. L. There is scarcely a garden which has not a corner appropriated to the *toronjil.* It is a fashionable remedy for soothing pain. As its efficacy depends chiefly on the odor of its leaves, I am far from condemning its occasional use, and it can be injurious only in cases of special aversion.

Menonvillea linearis. DC. Common in fields near Leona and Cachapual. I have met with a variety of this plant in the sandy fields near this river towards Canguenes. All its leaves are cylindrical and fleshy, but I have not observed any difference in the flower. As the flowers of this genus vary much, I do not think that it should form a distinct species; I have seen the flowers sometimes entire, sometimes figured, (*recortadas*) and again pinnate. The flowers are whitish inclining to yellow. De Candolle must have had a bad specimen when he said: *Petala....sordide in disco rufa, verosimiliter Hesperidis tristis colorem referentia.* (Regn. Veg. Syst. Nat. vol. 2. pag. 420.)

Mentha. L. The *yerba buena*, the *bergamota* and the *poleo* very common near drains, along the fences of olitories, and the last in marshy fields in the plain, are plants brought from Europe. They belong to the *M. Piperita*, L. *Citrata*, Ehrh. and *Pulegium*, L. and serve for various domestic and pharmaceutic purposes.

Merisma. Pers. I have found only one species of this genus on pieces of wood and branches of trees which have been buried and are half rotten. This moss is blackish, its branches are caked, coriaceous, and *figured* at the extremity.

Merulius Morchellicephalus. Bertero. A small pretty moss which I have only seen once in a heap of rotten branches in a garden. The superior part of the *Pileus* shows some cuts analogous to those of the *Morchella*, Pers. and on the inferior part the generic character was very decided.

Meum Fœniculum. Spr. *Hinojo*—Fennel. Very common on farms. This plant is much used as a condiment and as a remedy. The seeds are used to flavor spirits (aguardiente). Sown in good soil the fennel yields very tender sprouts of good flavor which may be served at table as is the custom in Italy.

Micropus. L. Two species; the first resembles the *M. supinus*, L.; it grows in the pastures on the highlands and plains. The other is found in barren situations and in the fields of Rancagua and Quinta. The particular form of its flowers almost sticking to the earth, has obtained for it the name of *M. globiferus* which I have given it.

Miersia Chilensis. Lindl. A precious little plant which grows in the woods, in stony and humid situations on the hills near Leona and Punta de Cortés. Its flowers incline to a greenish yellow. Another species is met with in the same situations which, although similar in appearance to the first, differs from it in the following particulars. Its leaves are narrower, its flowers less numerous and only of half the size, the exterior bracts are linear, lanceolate, greenish with violet rays, and the two inferior declinate. I have called it *M. Myodes*, from its figure's being analogous to the *Ophrys* of this name.

Mimulus luteus. L. In drains and inundated places both on the highlands and plains. A variety or species with large yellow flowers with red spots is also met with and is that perhaps which Miers has called *M. punctatus*. Another species grows amongst rocks, near torrents on the mountains, and is sometimes seen on the plains. It is the *M. Andicola*, Kunth; at least it cannot be classed with any other which is known. These three plants are vulgarly called *placa*. The leaves and particularly of the last are succulent and of an agreeable taste. They are eaten in salad.

Mirabilis Jalapa. L. *Dengue;* a plant cultivated in gardens. Its flowers vary in color and succeed each other for a long period of time.

Mollugo radiata. Ruiz and Pavon. Common in sand along torrents in Taguatagua. It possesses no interest whatever.

Moluccella lævis. L. Cultivated in small gardens. It is remarkable solely on account of the large size, and extraordinary form of its calyces. In other respects it is not worthy of note.

Morus alba. L. There are some shoots of this tree in Santiago, which proves that attempts were formerly made to introduce the silk worm. I am ignorant why the undertaking has been abandoned. The difficulties which oppose it do not appear to me serious, and at any rate they cannot be greater than in other countries where this branch of industry is the only resource of the inhabitants. Piedmont, near the Alps, with a less favorable climate, with more rigorous winters and more stormy and variable springs, is covered with mulberry trees, and the money which the exportation of silk produces is a great cause of the prosperity enjoyed by the agricultural class of the people. Besides, the great number of these trees which surround the fields, planted in rows, are grateful to the sight, temper the heat of the sun in summer, offer a shade to cattle, and possess many other uses an enumeration of which is not necessary at present. The wood is durable; it is used in carpentry and for domestic purposes. The fruit is sweet and agreeable; poultry eat it and it makes a good syrup.

Mucor aquosus. Mart. *Mucedo violaceus.* Spr. and *Stilbospora.* Bertero. A species of mould which covers various substances, in the state of putrefaction, during the autumn and after rains.

Musa Paradisiaca. L. The banana and plantain, originally from India, are extensively cultivated in the Antilles and the equatorial regions of South America. It may be said that it forms the principal food of the poorer classes in those regions. There are some trees of this interesting plant in the gardens in Santiago, and amateurs are desirous of propagating them. I will only observe here that the climate will never permit this branch of agriculture to flourish to any extent. Its cultivation will always be an object of luxury, and cannot be of any public utility. We are accustomed to receive plantains from Lima, but they suffer on the voyage, and do not preserve that exquisite taste which is proper to them.

Mutisia. L. The species which I have seen are not well determined. Two of them approach the *M. inflexa*, Cav., and *M. sagittata*, W. They grow in the woods. The third grows on the rocks in the highlands, and appears to me new. It is called *yerba negra*, though this appellation is more commonly given to another, *Synanthera*, which I have not seen in flower, and which is common in the mountains.

Mycogone rosea. Link. It grows on rotten mosses, and particularly on the *Boletus cervinus*, Schwein.

Myosotis corymbosa. Ruiz and Pavon. In the fields on the highlands. I have in my possession three other species, one of which resembles the *M. humilis*, Ruiz and Pavon, and the others are worthy of being again studied. These plants delight in the stony situations of the highlands and near torrents. They present nothing remarkable.

Myriophyllum verticillatum. L. *Yerba del pato:* common in drains and marshes. It does not differ from the European plant.

Myrtus. L. The common name, *arrayan—myrtle*, is given to many species. The most common, which is thus called, is a very elegant tree. It usually grows seven or eight yards high and I have seen it higher and of an extraordinary size, at a country seat near Corcolen. It has a fine effect in gardens from the thickness of its foliage and the whiteness of its flowers. Although its wood is hard, it is not worked, from the difficulty in meeting with large pieces of it. The leaves are employed as a medicine. Its blackish berries filled with white pulp, although but slightly juicy, are much sought after by some species of birds. The country people make an agreeable drink of them. The *M. Arayan*, H. B. and Kunth, approximates to the preceding, but differs from it in the red and binocular berries. Is our species the true *Mugni*, Molina? The *M. triflora*, Spr., *pitra* is frequent in the woods near Santiago, Doñigue and Taguatagua. Its height varies from eight to ten yards. The green wood is fragile; when dry, it is stronger, but rots when humid or in the ground, and therefore is employed only as a fuel. The use of its leaves is recommended in rheumatic pains. Many other species mentioned by Molina are known only by his descriptions of them.

Narcissus. L. The names *junca*, *tulipan* and *junquillo* are generally given to the *N. Tazetta*, *N. odorus*, L., *N. incomparabilis*, Curt., and *N. Jonquilla*, L. These plants, originally from Europe, are cultivated in gardens, and are esteemed for the beauty of their flowers. The double varieties are most appreciated.

Nardus. L. Two grasses approach this genus, but I believe they do not belong to it. One is found in the dry pastures on the mountains which are made very slippery by its remains; the other grows much higher in the woods on the highland near Cachapual.

Nasturtium officinale, var. *Chilense*, DC., *berro*—water-cress. Common in the brooks on the mountains, and in the plains. It is eaten as a salad, and is both wholesome and agreeable. There are persons who believe that the water-cress possesses eminent virtues for the cure of pulmonary phthisis.* Wonderful stories are related of it. I have been told that a victim of this disease, who was given over by the most skillful physicians of the capital, retired to the country to die in tranquillity, and, when there, lived exclusively on this plant, in pursuance of advice which had been given him, and that in two months he was restored to perfect health. He died, however, as was thought, of another disease, and on examination of the body a large quantity of cresses was found in a sack which they had formed for themselves. With this tale in view, we may form some idea of the degree of credulity of the very many unhappy creatures, who are sacrificed to ignorance and charlatanism.

Nescæa. Kunth. This genus has been reformed by De Candolle in his *Prodromus*. The three species with which I have met in the sandy pastures and among the rocks, near Cachapual, do not belong to it and perhaps will form a part of the *Cuphea*, L., or of the other intermediate genus. However, I have not seen them described. Their flowers, although small, are pretty, and particularly in the spring.

Nicotiana angustifolia. Ruiz and Pavon. *Tabaco del Diablo.* In inclosures near roads and torrents. This plant is of but little importance. The *N. minima*, Molina, which some botanists have retained, does not differ from the first, and ought to be considered as a synonym. I have seen in some gardens the *N. fruticosa*, L. Its leaves are large and do not possess the fragrance of the *N. Tabacum;* so that no use is made of them. The leaves of all the species of tobacco are employed in certain diseases, sometimes externally, sometimes in decoction, and are the vehicle of an immensity of drugs which ignorance alone can tolerate.

Ocimum basilicum, minimum and *monachorum.* L. *Albahaca*—Sweet basil. Plants very common in gardens. It is highly appre-

* It is also used in hepatic affections.

ciated for its odor. It is quite necessary amongst the constituents of a nosegay, and sometimes required for the table.

Œnothera mollissima. L. *Metron, flor de la noche.* It grows in sandy situations near rivers. It is cultivated in gardens, and is considered valuable as a vulnerary. A decoction of its leaves is employed to wash ulcers, and particularly those of the legs. The *radalau*—*Œ. acaulis*, Cav., is frequent in the humid pastures of the plain, near Taguatagua. Its variety β. Ser. in DC. *prodr.*, is found in Valparaiso, in shaded spots. This plant and its roots are considered efficacious remedies in boils. The *Œ. tenuifolia*, Cav., grows in sandy situations, and among stones, along torrents and rivers. A variety with flowers, three times as large, is found in the same situations, and on mountains; perhaps it is a different species. The *Sangre de toro*, the *Œ. tenella*, Cav., is very common in pastures. Its flowers are either violet, or purple. I have gathered another species in the dry pastures near San Fernando. It approaches to the *Œ. rosea*, Ait., but appears to be different.

Ogiera triplinervia. Cassin. A shrub very frequent in the woods on the highlands, known by the name of *mitriu.* Its flowers are of the size of a *Spilanthus.* Like the leaves, they are somewhat aromatic. The wood is fragile and only useful as a combustible.

Olea Europæa. L. Aceiturro—Olive. Cultivated near habitations. Its wood is employed in white work. Its prepared fruit is excellent. The oil made in this country is far from being good. Considering the facility with which the tree yields its fruit, and the great quantities which might be obtained, we wonder at the negligence with which it is cultivated, and the small extent of its plantations. It is said that to sow and to reap is not the work of a day—a selfish maxim which is gainsaid by the father who is not indifferent to the prospects of his children. The introduction of foreign oils which is daily becoming more necessary, is no eulogy upon native industry.

Onoseris. W. There are many species, some of which perhaps belong to the genus *Chætanthera.* The most common is called *yezquilla.* It grows in dry pastures on the plain, near rivers, and on the mountains, and differs very little from the *O. Hieracioides*, Kunth. The down, which covers the plant when it is in flower, is used by the country people for spunk. Another grows among the stones along the Cachapual. I have called it *O. linifolia* from the form of its leaves.

Ophioglossum. L. The plant which I have seen in the humid plains at the foot of mountains is perhaps the *O. lingulatum*, Miers. It is of no use.

Orbignya trifolia. Bertero. A shrub of the family of the Euphorbiaceæ *(tricoccæ)*, notable for its compound leaves, a rare example in this group. It is met with on the heights near the Punta de Cortes. Professor Gay has also seen it on the summit of Mount San Cristoval. It is not lactescent, nor does it resemble, in any particular, the *Colliguaya*, which inhabits the same places. The fruit is of the same figure, with the exception of the capsule's being ligneous. Its seeds are used for rosary beads. It appears that Molina in characterising his genus, *Colliguaya*, has described the staminate flower of this, since he attributes to it eight stamina. I have dedicated this beautiful genus to M. D' Orbigny, a learned and zealous naturalist, who is at present exploring the banks of the Rio de la Plata, and who will soon visit Patagonia with the view of enriching those sciences which he professes.

Origanum Maru. L. *Oregano*—Wild Marjoram. Cultivated in gardens; an aromatic plant used as a condiment. It might serve to garnish parterres, being advantageously substituted for the brick which is here employed for that purpose. Many other plants might be introduced for the purpose, as the *Armeria vulgaris.* W., *Bellis perennis, fl. pleno, Primula veris.* W. *P. elatior*, Jacq.

Ornithogalum. L. There are many species in almost every garden. The *Flor de la cuenta* of gardens appears to be the *O. Arabicum*, L. The *Lágrima de la Virjen*, also cultivated, does not agree entirely with the *O. corymbosum*, Ruiz and Pavon, according to the phrase of Sprengel, in his *Species Plantarum*, (*vol.* 4, *part.* 2, *p.* 132.) The *cebolleta, O. æquipetalum*, Bertero, in the dry pastures of the high land, and the *O. striatellum*, Miers, (*guilli de perro o' de zorro*,) common in meadows and cultivated places. This last appears to differ from the genus, and in fact, I have just seen in the Transactions of the Horticultural Society of London, vol. vi, part. 1, that Lindley has called it *Allium striatellum.*

Orthopogon Crus-Galli. Spr. A grass frequent in drains and humid places. Some call it *carrizo*, a name by which a species of cane is designated, which frequently grows in wet situations, near Santiago and other places. This last is of the size of the *Arundo Phragmites*, L. although in my opinion it is different. It is used for various domestic purposes, and large quantities of it are consumed.

Orthotrichum affine, Schrad., *O. anomalum*, Hedw., and *O. diaphanum*, Schrad. Small mosses which grow upon stones and the barks of trees. They are not interesting except in a botanical point of view. They are all confounded under the name of *pastito*.

Oscillatoria nigra. Vauch. and *O. muralis*, Ag. *Syn.* Two algæ very frequent in winter. The first on the surface of stagnant waters, and the second on walls which are damp and in the shade. There are other species which grow in similar situations, but whose characters, being for the most part microscopic, require time, instruments, and books which are not always within reach of the traveller to determine them. They are only interesting in a scientific point of view.

Oxalis. L. This genus offers many species proper to this country; some are not well known, and others are new. The name *vinagrillo* is generally applied to those with yellow flowers, and *vinagrillo colorado* to the species with a reddish flower. The most remarkable are the following. The most common of the species is that which is called *flor de las perdices*. It begins to appear in April, and continues flowering till the close of May. It covers the fields and lawns of the plain. I am told that the Indians call this plant *rimu*, and make use of its tincture. The word *rimu*, according to Father Andres Hebres, signifies partridge. Keeping in sight what we have just said, and what Molina says, there is room for supposing that the *Sassia perdicaria* of this author, is the plant mentioned; save the leaves, the disposition of which he may not have had occasion to observe, and particularly examining the plant from imperfect specimens, which most probably has been the case. We have called it *O. perdicaria*, not being able to refer it to any known species. About the same time, and in the spring, another *Oxalis* is found, with purple and sometimes violet flowers, in the sandy plains, near rivers, and on the highlands. This, with the same exception, resembles the *Sassia tinctoria*, Molina. I therefore think that this genus should be expunged from the books, and I invite all botanists who possess specimens of these two plants, to subject them to a careful examination, in order to decide the question. I have called the last *O. arenaria*. It closely resembles the *O. tetraphylla*, Cav. Gardens are overrun by another species which is of the size of the *O. corniculata*, L. The *O. rosea*, Jacq. is met with in abundance in shady woods, both on the highland and on the plain. The *O. megalorhiza*, Jacq. grows upon heights, and in the clefts of rocks. It does not differ from the *O. tuberosa*, Molina. The *O. pubescens*,

H. B. and Kunth. is frequent in olitories, on mud-walls, in cool and shady situations. In fine, I have found two other species which I believe to be new. One on the edges of roads and level plains; the other in the woods of Punta de Cortés. I have called the first *O. gyrorhiza*, from the direction of its root; and the second *O. micrantha*, from its very small and frequently apetalous flowers. There are many others which I have not had time to examine minutely. All the *vinagrillos* possess more or less the same acid property.

Oxybaphus viscosus. Herit. Among the stones on the margin of brooks, on the plain in the neighborhood of Quinta. Though closely resembling it, I think this plant should be separated from that described by L'Heritier, which is originally from Peru.

Papaver somniferum. L. Vulgarly *Amapola—Adormidera.* Cultivated in gardens. The flowers are commonly double, large, variously colored and have a rich appearance. The capsule is very useful in medicine; its decoction is employed either as a fomentation or enema in colics and in nervous diseases. Opium, a heroic remedy so much used throughout Asia, is obtained from the juice of this species, by incision and exudation from its capsule. The *P. Rhœas*, L., is scarcely known in Chile. Its varieties with double flowers and variously combined colors merit preference. Its juice possesses the same properties, though in a less degree. The infusion of its petals is said to be sudorific.

Parmelia. Ach. There are a great many species here; they grow upon stones and on the bark of trees. All are known under the name of *calchacura.* Some possess a gelatinous principle in abundance, similar in properties to that of the Lichen Islandicus. The most common are the following: *P. aquila*, *atra*, *caperata*, *chrysophthalma*, *cycloselis*, *murorum*, *parietina*, *saturnina*, *saxicola*, *stellaris*, *subfusca*, *varia*, Ach. and many others, two of which, in my opinion, are new. I will call the first, *P. Chilensis;* it resembles the *P. scopulorum*, Ach.; and I will name the second, *P. discolor.*

Paronychia Chilensis. DC. On the dry and stony plain of Cachapual and San Fernando. *P. ramosissima*, DC. upon the arid pastures of the highlands and mountains. It is known by the name of *dicha.* It is a troublesome plant, when dry, from its numerous thorns. It resembles the *Polycnemum arvense*, L.

Paspalum. L. The plant called *chepica* is of this genus. It approaches, though it differs from the *P. conjugatum*, Bery. A ptisan made of its roots is daily prescribed as a cooling specific in urinary complaints. The *chepica blanca* is preferred to the *colorada.* We regret that it is not in our power to decide this question, as well as many others of a similar nature, and which are so interesting to the country people.

Passiflora cœrulea. L. *Flor de Pasion.* An ornamental plant much cultivated in gardens.

Pastinaca sativa. L. It grows in cultivated situations. It is called vulgarly *chirivia.* Formerly it was attended to, and its root eaten, but at present, other plants more nutritive and pleasant are substituted for it.

Patellaria æruginosa. Spr. A Lichen which commonly grows upon old mud walls. I have met with other species which are not yet determined.

Pelargonium. Herit. The *Malva de olor* and the *Malva rosa,* are the only species of this genus which I have seen in the gardens of Chile. The first is the *P. odoratissimum,* and the second the *P. Radula,* Ait. var. *roseum,* W. The fragrance of their leaves, as well as the facility of preserving them in the open air, makes them valued. It is strange that other *Geraniaceæ* have not been introduced, their flowers being so much sought by lovers of the garden. Many species would flourish in Chile, and would decorate gardens with elegant flowers of an infinite variety, in form, color, and size.

Peltigera canina. Hoffm. In woods, at the foot of trees, and among the stones on the 'Montaña de la Leona.' It is also a *calchacura* of which no use is made.

Peumus fragrans. Pers. Vulgarly *boldu,* a tree common on the plains, on the declivities of mountains, and in vallies. The trunk acquires a height of six or eight yards. Its wood is applied to no use, and even as fuel, it is not valued. The charcoal made from it is easily extinguished. The leaves, par-boiled and moistened with wine, are employed as a remedy in colds and defluxions from the head. Baths of its decoction are said to be antisyphilitic, and are used in rheumatic diseases and dropsies. It is also said that the juice is efficacious in the ear-ach. The fruit, when ripe, is of the size of a small apricot. It is sweet, but has very little meat. The *stones* are used for rosary beads.

Peziza. L. Mosses, the greater part of which are on trunks and rotten branches; some of them are scarcely visible. To the species, the names of which I have already published, I will add the following. *P. ascoboloides,* Bertero, in a large quantity on the skins of half decayed grapes, *P. badia*, Pers. on the banks of drains. *P. vesiculosa*, Bull. on mud-walls in winter after rains. *P. caulicola*, Fries. upon the dry stalks of plants. *P. cinnabarina*, Bertero, on old posts and forks in vineyards. *P. Valenzueliana*, Bertero, on the damp walls of the orchards of Rancagua. In testimony of gratitude to Don Manuel Valenzuela, for the assistance he has afforded me in my botanical pursuits, I have given his name to this last plant.

Phacelia circinata. Jacq. Common on heights, in the clefts of rocks; it has no common name. There is another species, (which I believe to be new,) that grows in shady situations in Punta de Cortés and Leona. I have called it *P. clinopodioides*, from its resemblance to a Clinopodium. Its flowers are reddish.

Phalaris. L. I have met with two plants which I think belong to this genus. One is rare on the plain of Leona: the other in Cachapual. The glumes of the first are almost violet.

Phascum. L. A small moss common in the pastures of the mountains, on declivities, and in humid places. I believe it is not described.

Phaseolus vulgaris. L. *Porotos—Frijoles*. An extensively cultivated vegetable, of which great consumption is made by country people. There are many varieties to which different names are given, according to the color, form or taste of the fruit. Some of them are delightful. Larger crops might be obtained, if cultivators would leave their blind routine and adopt the plans pointed out by agriculturists and experience. In some gardens, is cultivated the *P. multiflorus*, W. *poroto de España:* its flowers are of a cochineal color, and are very pretty. The *P. Caracalla*, *caracol*, universally cultivated, is not however indigenous to Chile. The size, peculiar form, and sweetness of its flowers have acquired for it some distinction. A sweetmeat is made of its petals, which is said to be excellent.

Phlox unidentata. Bertero. A precious species which grows in the skirts of woods on the sandy plain near Cachapual. The flowers disposed in clusters and of a magnificent orange color, make it worthy of a place in gardens. The specific name which I have given it, is not strictly correct, since the number of its teeth varies from one to three, and sometimes the leaves are entire.

Phœnix Dactylifera. L. *Palma datil*. We see some stalks cultivated, but they do not flourish nor yield fruit. In Coquimbo, this palm might be propagated: its fruit imported from Lima, is much esteemed.

Physalis pubescens. L. A plant cultivated for its yellow, aromatic, pleasantly acid fruit. The stalk is fructicose, and lives through winter in the open air.

Physarum Muscicola, P. farinaceum, Pers., *mycophilum et areolatum,* Bertero, on rotten plants and wood at the close of autumn, and in winter after rain.

Phytolacca Chilensis. Miers. A cultivated plant which I do not think indigenous. It resembles the *P. dioica,* L., but its flowers are hermaphrodite; the styles vary from fourteen to eighteen. It is called *carmin.* Its ripe berries are used to dye yarn.

Pilobolus roridus. Pers. Upon compost and excrement of cattle.

Pinus. L. A tree resembling the *P. Laricio,* Poir., is seen in some places. It is from Europe, and is commonly called *pino*—pine. This tree should be propagated.

Piper inæqualifolium. Vahl. The *congona* is cultivated in some gardens, but its young shoots do not resist the winter. Its aromatic leaves, of a slightly pungent taste, are said to be useful in some diseases. It is administered in infusion, in atonic affections of the stomach.

Pircunia drastica. Bertero. A small under-shrub, common on the declivities of mountains, among stones in Cauquenes, Taguatagua, and other places. Its root, resembling a large wooden pin, (fusiform ?) almost always divided at the extremity, possesses emetic and purgative virtues in a very high degree. The country people frequently employ it, and even in small doses its exhibition is sometimes attended with unhappy results. It should only be given by the prescription of a physician. A careful chemical analysis and experiments made with it, would no doubt afford us an exact knowledge of this medicine, which, in my opinion, is highly useful in certain cases. I have thought proper to preserve the vulgar name *pircun,* and would propose it to botanists as a new genus. Don Vicente Bustillos has given me some specimens in seed.

Pisum sativum. L. *Aberja.* Generally cultivated and is a grand resource in domestic economy. The tender seeds may be preserved throughout the winter in brine, and thus afford a delicacy. The variety *macrocarpum.* Ser. in the *prodr.,* DC., is not sufficiently propagated. The tender thick pods are excellent, and are called by the French, *pois gaulu, pois mangetout.*

Plantago. L. The *Llanten* (*P. major. L.*) is the most common species. Its leaves are employed for the cure of vesicatories, and their decoction passes for a vulnerary. I have met with other species which are not determined. The *P. lanceolata*, L., on the banks of rivers; the *P. hispidula*, Ruiz and Pavon, in sandy spots upon the plains and highland. The *P. Patagonica*. Jacq., on the mountains of Leona. The L. *truncata* and *tumida*, Chamiss, are met with in bananeos—the dry beds of mountain torrents, and in the pastures on the highland.

Poa annua, *P. pratensis* and *P. pilosa*. L. Grasses frequent in cultivated situations, in fields, and near drains. The last is very common on farms, and does not differ from the European species, all the characters of which it possesses, except that it is larger. They have all been introduced.

Polianthes tuberosa. L. *Margarita*. Cultivated in gardens. The variety with double flowers is less known. The odor of the flowers is pleasant, though rather strong.

Polygala Thesioides. W. A shrub met with in the mountains, vulgarly called *Quelenquelen*. The root is used in decoction in many diseases which are called internal. The *P. Gnidioides*, W. does not differ from the preceding, except in its herbaceous stalk. It is found in fields and along the skirts of woods in the highland.

Polygonum aviculare. L. *Sanguinaria*. It is found in all dry, stony situations along roads. The variety with straight stalks grows in humid meadows and about marshes. Its decoction is prescribed in certain female complaints. The *P. Persicaria* and *lapathifolium*, L., *duraznillo*, frequent in drains and pools. They are employed for the same purposes, and if we may believe what we hear respecting them, possess great virtues. The *P. orientale*, L., should be cultivated for the beauty of its flowers; and the *P. Fagopyrum*, L., for its farinaceous grain which might form a substitute for wheat.

Polypodium. L. Ferns which grow in woods, on the mountains, and among stones. The *doradilla*, a species of this genus not determined, is considered a great remedy in certain diseases. The *yerba del lagarto* which I take to be the *Polypodium radice squamosa*, Feuill., appears to be a new species which I will name, *P. Feuillei*, and another which is called *palmilla*. This approaches the *P. resiniferum*, Desv: I believe it however to be different. The last two were found and communicated to me by Don Vicente Bustillos.

Polypogon. Desv. The name *rabo de zorro*, is also given to two species of this genus, one of which is the *P. maritimus*, W.; the other does not agree with any yet described. It is found in drains and in fields on the plain.

Polytrichum commune. L. Frequent in meadows and shady places on the mountains. Another resembling the *P. hyperboreum,* R. Br., grows in similar situations, and particularly in Leona.

Populus dilatata. Ait. *Alamo.* This tree was long since introduced but is just beginning to draw the attention of land holders. It ought to be planted almost without limit. It grows rapidly—forms good plank for many kinds of work, and its branches make good fuel.

Porliera hygrometrica. Ruiz and Pavon. The tree which is designated here by the name of *guayacan* is called in Peru *turucasa.* Its wood is very hard and veined blue and yellow. It serves for making combs, balls, and many utensils. Its decoction is antisyphilitic, particularly when united with sarsaparilla. It is met with on the mountains, and on the banks of large rivers on the plain. The true guaiacum (*Guaiacum,* L.) cannot grow in these latitudes. It is indigenous to the Antilles.

Portulaca oleracea. L. *Verdolaga.* It is found in cultivated situations, in fields and in gardens. Sown in good soil properly irrigated, it would yield its leaves three times as large, and of a higher flavor, which could be used as nutriment as is the fact in other countries. Its decoction is said to be a vermifuge, and it is employed as such in the form of a ptisan.

Potamogeton striatus. Ruiz and Pavon. In the brooks and running waters of Taguatagua. It is called *luchi,* and is of no use.

Pourretia coarctata. Ruiz and Pavon. *Phagnal, Maguey, Pardon, Paya.* A beautiful plant of the family of the Bromeliaceæ, common on heights and craggy points. Its leaves are armed with strong thorns. Its scape, quite high and tolerably thick, supports flowers which yield a honey like juice, which is sought with avidity by birds and particularly by the humming bird. The stalk when dry is used for corks and for razor straps. Cut into boards it makes excellent boxes for preserving insects, an advantage to entomologists in a country where there is no cork. From openings and incisions made in the stalk exudes a gum which merits examination, and might perhaps form a substitute for that imported.

Pozoa coriacea. Lag. On arid heights among broken rocks and craggy places. Sprengel joins this species with the *Asteriscium Chilense,* Chamiss. I do not know whether he is correct.

Prosopis Siliquastrum. DC. *Algorrobo.* Quite a common tree in stony soils, near rivers in the plain. Its elevation is from four to five yards, the thorns are commonly very long though sometimes short or scarcely visible. The fruit is used to feed cattle, though it is indigestible for them. The wood is incorruptible in water and is employed for sills, door posts, and mills. The *Ceratonia Chilensis*, Molina belongs to this species as well as the *P. flexuosa.*

Prunus domestica. L. The *ciruelo*—the plum tree, is widely spread over the country. Many varieties are enumerated; the fruit of some of them is made into sweetmeats. Dried plums (prunes) are purgative and may be substituted for tamarinds particularly if used with cream of tartar. Plum trees planted at a short distance from each other, form an impenetrable inclosure, if care is taken to cut them at about the height of a man. I have seen some beautiful inclosures in this style in the neighborhood of San Fernando.

Psorealea glandulosa. L. The *culen* is very common in woods near rivers, and in the vallies. The bark and leaves of this little tree are used as a medicine. It is said that the infusion is a specific in abdominal pains, 'empachos,' (surfeits) indigestions, &c. The same virtue is attributed to the ashes. The dry leaves powdered, and the green ones wilted, are applied to wounds in the form of a cataplasm. Ulcers are washed with its decoction. It is made into a ptisan with the heart of lettuce; it has a pleasant taste and is said to be salutary. From the bark of this tree a resin exudes which is used by shoemakers to wax their thread. The *P. lutea*, Molina is a monstrosity of this species.

Pteris. L. Two species of this genus grow on mountains, in woods and on rocks. The first resembles the *P. Chilensis*, Desv., the other may be new. I will call it, *P. triphylla.* It is different from the *Adiantum triphyllum.* Smith, which Kaulfuss places with his *Passebeeria.*

Puccinia. Pers. The name *polvillo* is given to the species of this genus, as also to the *Æcidium*, and *Uredo.* They all grow upon the living leaves of plants, the specific name of which they generally take. I have found the *P. Rosæ*, DC., *P. graminis*, Pers. *P. compositarum*, *P. Poligonorum*, Schlecht. and *P. Lycii*, Bertero.

Punica Granatum, L. *Granada.* A common shrub. Its leaves, flowers, and particularly its fruit render it interesting. The bark of the fruit is an excellent astringent adapted to various abdominal diseases which are kept up by a want of tone in the absorbent vessels. A saturated decoction is the base of a tincture black as ink. This quality depends upon the gallic acid in which it abounds.

Pyrethrum Parthenium. W. Frequent in vallies in sandy soil, near torrents. It is so common that it appears indigenous. The *artemisa* is a medicinal plant. Its virtues are analogous to the *manzanilla* and might be substituted for it.

Pyrus communis and *Malus.* L. *Peral y Manzano.* Fruit trees which are so abundant in the country that the inhabitants cannot believe they have been introduced. It is usual to have apples and pears of good quality, but in general, this fruit does not attain the same perfection as in Europe. The wood is used in carpentry.

Quillaja Saponaria. Molina. In woods at the foot of hills, and in mountain vallies. It trunk usually attains ten yards in height, and about two in circumference. The wood soon perishes if exposed to the air; but lasts a long time in damp situations under ground. It is used in mines and in mills. The bark of the *quillay* is excellent for washing woollen textures. Its decoction makes a suds the same as soap. It is administered in certain cases in the form of an enema.* Botanists differ as to the synonym of this species. De Candolle forms two of it which he names, *Q. Molina*, and *Q. Smegmadermis.* Sprengel places the last with the *Smegmaria emarginata* of Willdenow: and he confounds the *Quillaja* of Molina, with the *Smegmadermos*, Ruiz and Pavon. Though I have not yet examined this tree in the different and remote parts of Chile, I think it forms but one species which varies considerably in the form of its leaves, and that the name given by Molina ought to be preferred.

Quinchamalium Chilense. Molina. Common in pastures, on the highland, and in stony situations near rivers. It is sometimes woody, at others, herbaceous, though the species is always the same. This plant is considered a most energetic vulnerary. The juice and de-

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* I am disposed to think that this bark may be made very useful, not only in medicine, but for domestic purposes. A small quantity of it broken into pieces, and infused in a basin of cold water, will yield a strong suds when agitated. This will remove grease spots from cloth, and the oily matter which collects upon the collar of the coat from the hair, without injury to the garment. The same remark applies to silks and crapes. I have used it with advantage as a lotion in certain diseases of the skin, and for ulcers; and it has proved in my hands a very appropriate stimulus to the scalp in cases where the hair was falling. In several instances it arrested it at once. The ladies of Chile, I am told, are in the habit of washing the head with it, about once in ten days, and they say it preserves the scalp from dandruff, and it certainly gives the hair a very clean, glossy appearance.

It may be considered a vegetable soap with a super-quantum of alkali. Might it not become a useful article in the hands of dyers and scourers? W. S. W. R.

coction are administered in what are termed internal complaints, or in extravasations of blood, boils, &c. Though I do not deny altogether its astringent property, I would advise patients to recur to more certain and efficient medicines.

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A letter from Dr. R. to the Editor, dated Callao Roads, April 15, 1832.

The revolution, which occurred in Chile in June 1829, interrupted, and finally stopped the publication of the 'Mercurio Chileno.' At different times that periodical work contained communications of a political nature which were highly offensive to one of the parties of the day, and soon after the present administration assumed the direction of public affairs, the Editors were forced to leave the country. About the same time, Dr. Bertero, the industrious and able author of the 'list', embarked, at Valparaiso, for the Sandwich Islands, to pursue his botanical researches there, until he might resume without fear of interruption, and complete the catalogue of plants which he had commenced. While at the Islands, he collected a large herbarium, and sailed for Chile. More than a year has now elapsed, since the vessel, in which he was passenger, sailed, and no news having been heard from her, it is presumed that she perished at sea!

Besides Dr. Bertero, several other scientific men have been lately in that country studying its natural history. Professor Gay, who is still there, has been for some time travelling in different provinces, collecting plants and specimens in natural history, and although the result of his labors has not yet been published, a few letters which have appeared in 'El Araucano'—a gazette of Chile—prove that he has not been idle. These letters are dated at San Fernando, and are addressed to Don José Alejo Bezanilla, Don Francisco Huidobro and Don Vicente Bustillos, members of a scientific commission in Santiago.

In the first letter he gives a detailed account of a visit to the lake of Taguatagua. He says that he saw there for the first time, a curious natural phenomenon celebrated by the old Scotish bards—the floating island. Almost half of the lake is covered by these islands which float from north to south, and from east to west, according to the direction of the wind. They consist of vegetable remains of many species of plants——*Convolvuli*, *Potamogeton*, *Ranunculi*, *Gramineæ*, &c.—interlaced with each other in a thousand ways, and upon which other floating plants perish, affording by their decomposition, an extremely fertile soil, increased from time to time by the constant decay of other plants that spring up and grow in it; so that in the course of time, these islands, by a gradual augmentation in extent and thickness, will in all probability, fill up and cover the whole superficies of the lake with their artificial soil, and yield to future ages a mine of inflammable turf which may supply an excellent fuel for domestic uses.

Upon these islands, which are called *chivinas* by the inhabitants, great numbers of birds of many species deposit their eggs. Amongst them are Swans, Flamingos, Herons and an infinity of others, many of which are unknown to science.

The geological formation to the north of the lake is basaltic, and of the south granitic; these are separated from each other by great banks of phonolite, of arkose, and of a very fine stone suitable for whet-stones. The hill which contains it is called "el cerro de la piedra de afilar," whet-stone hill.

There is a great number of new and interesting specimens surrounding the lake. Amongst the new ones M. Gay enumerates two species of *Poranthus*, one *Ranunculus*, an *Utricularia*, a beautiful *Galvezia*, *Chotanthera*, and a number of arborescent *Gyneteriæ*.

The next visit of the Professor was to that part of the Cordilleras called Cauquenes. On this route along the river Cachapual and the "rio de los cipreses," he met with more than a hundred species of plants which were unknown to him. Along the Cauquenes he followed for more than ten leagues a basaltic formation running in a horizontal direction, and alternating with wacke, dolerite and a resinous quartz. He made a chemical analysis of the waters of the hot baths of Cauquenes which are visited annually by great numbers of invalids from every part of Peru and Chile. The base of these waters he found to be a hydrochlorate of soda, although it has been generally supposed heretofore, that they were indebted for their virtues to sulphur, of which substance, M. Gay declares, they do not contain a single atom. There are however sulphur baths in the neighborhood.

In another letter M. Gay describes his visit to the gold mines of Yaquil, (the ore of which is simply auriferous pyrites,) and to the plain of Colchagua. "Passing by the plain," says he, "we enjoyed the curious spectacle which so often disappointed the hopes of the French troops in Egypt, when suffering from thirst in a dry and burning atmosphere. I allude to the phenomenon denominated *mirage*, which is seen here in perfection. At a distance it presented to us the appearance of a true lake, dotted with islands planted with trees which were reflected on the surface of the imaginary waters, creating the most perfect illusion. In proportion as we advanced, the lake, the waters, the islands fled before us——they diminished in size more and more, and finally disappeared as if by enchantment, much to the surprise of my companions who were little used to such sights."

On the plain are a number of montecillos, or little mountains. In the side of one of these is a cave, which M. Gay has named after Molina, the historian of Chile. It has been known heretofore in the province of San Fernando simply by the term "la cueva," the cave. It is supposed that it was once filled with soluble salts, as the sulphate of lime, the sulphate or carbonate of magnesia, or perhaps muriate of soda, and the water, which constantly filters into it, dissolving these salts, has formed this grot now called Molina's cave. Its form is more or less round,—embossed on all sides—from fifteen to eighteen yards long, and from ten to twelve wide. It opens by a great door which is shut in by a screen of flowers and shrubs, intertwined with the *Eccremocarpus*, and the delicate *Lardizabala*.

Among other things which he found during this excursion, was lignite under two forms, one of which is fibrous and of a dull black, which is the true lignite; the other compact and of shining black, which is the jet of which beautiful necklaces are made. He met with several valuable plants; the *Salsola*, *Salicornia*, and a species of *Rosella*. He collected also several minerals and petrified shells, as the *Retunculus*, *Pirula*, *Serita*, *Serpula*, *Dentalium*, &c.

Mr. J. N. Reynolds has been, for many months, travelling in the southern provinces of Chile and Arauco, collecting subjects of natural history. His attention has been principally directed towards the birds of the country, and he has already sent several hundred specimens to the United States, among which are many new and highly interesting species. He has been particular in studying the habits of all those he has taken, and he intends, if possible, to complete the ornithology of Chile before he leaves the coast.

I send these notes under the impression that they will be interesting to you; as they at least show that something is doing for science in this part of the world. W. S. W. R.

Art. VII.—*On the Vitality of Toads enclosed in Stone and Wood;* by the Rev. W. Buckland, F. R. S., F. L. S., F. G. S., and Professor of Geology and Mineralogy in the University of Oxford. Communicated by the Author.

From the Edinburgh New Philosophical Journal.

In the month of November 1825, I commenced the following experiments with a view to explain the frequent discoveries of toads enclosed within blocks of stone and wood, in cavities that are said to have no communication with the external air.

In one large block of coarse oolitic limestone, (the Oxford oolite from the quarries of Heddington) twelve circular cells were prepared, each about one foot deep and five inches in diameter, and having a groove or shoulder at its upper margin fitted to receive a circular plate of glass, and a circular slate to protect the glass; the margin of this double cover was closed round, and rendered impenetrable to air and water by a luting of soft clay. Twelve smaller cells, each six inches deep and five inches in diameter, were made in another block of compact siliceous sandstone, viz. the Pennant Grit of the Coal formation near Bristol; these cells also were covered with similar plates of glass and slate cemented at the edge by clay. The object of the glass covers was to allow the animals to be inspected, without disturbing the clay so as to admit external air or insects into the cell. The limestone is so porous that it is easily permeable by water, and probably also by air; the sandstone is very compact.

On the 26th of November 1825, one live toad was placed in each of the above-mentioned twenty four cells, and the double cover of glass and slate placed over each of them and cemented down by the luting of clay; the weight of each toad in grains was ascertained and noted by Dr. Daubeny and Mr. Dillwyn, at the time of their being placed in the cells; that of the smallest was one hundred fifteen grains, and of the largest one thousand one hundred and eighty five grains. The large and small animals were distributed in equal proportion between the limestone and the sandstone cells.

These blocks of stone were buried together in my garden beneath three feet of earth, and remained unopened until the 10th of December 1826, on which day they were examined. Every toad in the smaller cells of the compact sandstone was dead, and the bodies of most of them so much decayed, that they must have been dead some months. The greater number of those in the larger cells of porous limestone were alive. No. 1, whose weight when immured was nine hundred twenty four grains, now weighed only six hundred ninety eight grains. No. 5, whose weight when immured was one thousand one hundred and eight five grains, now weighed one thousand two hundred and sixty five grains. The glass cover over this cell was slightly cracked, so that minute insects might have entered; none, however, were discovered in this cell; but in another cell, whose glass was broken, and the animal within it dead, there was a large assemblage of minute insects, and a similar assemblage also on the outside of the glass of a third cell. In the cell No. 9, a toad which, when put in, weighed nine hundred eighty eight grains, had increased to one thousand one hundred and sixteen grains, and the glass over it was entire; but as the luting of the cell within which this toad had increased in weight was not particularly examined, it is probable there was some aperture in it, by which small insects found admission. No. 11, had decreased from nine hundred thirty six grains to six hundred fifty two grains.

When they were first examined in December, 1826, not only were all the small toads dead, but the larger ones appeared much emaciated, with the two exceptions above mentioned. We have already stated that these probably owed their increased weight to the insects, which had found access to the cells and become their food.

The death of every individual of every size in the smaller cells of compact sandstone, appears to have resulted from a deficiency in the supply of air, in consequence of the smallness of the cells, and the impermeable nature of the stone; the larger volume of air originally enclosed in the cells of the limestone, and the porous nature of this stone itself (permeable as it is slowly by water and probably also by air) seems to have favored the duration of life to the animals enclosed in them without food.

It should be noticed that there is a defect in these experiments, arising from the treatment of the twenty four toads before they were enclosed in the blocks of stone. They were shut up and buried on the 26th of November, but the greater number of them had been caught more than two months before that time, and had been imprisoned altogether in a cucumber frame placed on common garden earth, where the supply of food to so many individuals was probably scanty, and their confinement unnatural, so that they were in an unhealthy and somewhat meagre state at the time of their imprisonment.

We can therefore scarcely argue with certainty from the death of all these individuals within two years, as to the duration of life, which might have been maintained had they retired spontaneously and fallen into the torpor of their natural hybernization in good bodily condition.

The results of our experiments amount to this; all the toads both large and small inclosed in sandstone, and the small toads in the limestone also, were dead at the end of thirteen months. Before the expiration of the second year, all the large ones also were dead; these were examined several times during the second year through the glass covers of the cells, but without removing them to admit air; they appeared always awake with their eyes open, and never in a state of torpor, their meagreness increasing at each interval in which they were examined, until at length they were found dead; those two, also, which had gained an accession of weight at the end of the first year, and were then carefully closed up again, were emaciated and dead before the expiration of the second year.

At the same time that these toads were enclosed in stone, four other toads of middling size were enclosed in three holes cut for this purpose, on the north side of the trunk of an apple tree; two being placed in the largest cell, and each of the others in a single cell; the cells were nearly circular, about five inches deep and three inches in diameter; they were carefully closed up with a plug of wood, so as to exclude access of insects, and apparently were air-tight; when examined at the end of a year, every one of the toads was dead and their bodies were decayed.

From the fatal result of the experiments made in the small cells cut in the apple tree, and the block of compact sandstone, it seems to follow that toads cannot live a year excluded totally from atmospheric air; and from the experiments in the larger cells within the block of oolite limestone, it seems probable that they cannot survive two years entirely excluded from food; we may therefore conclude, that there is a want of sufficiently minute and accurate observation in those so frequently recorded cases, where toads are said to be found alive within blocks of stone and wood, in cavities that had no communication whatever with the external air. The fact of my two toads having increased in weight at the end of a year, notwithstanding the care that was taken to enclose them perfectly by a luting of clay, shews how very small an aperture will admit minute insects sufficient to maintain life. In the cell No. 5, where the glass was slightly cracked, the communication though small was obvious; but in the cell No. 9, where the glass cover remained entire, and where it appears certain, from the increased weight of the enclosed animal, that insects must have found admission, we have an example of these minute animals finding their way into a cell, to which great care had been taken to prevent any possibility of access.

Admitting, then, that toads are occasionally found in cavities of wood and stone, with which there is no communication sufficiently large to allow the ingress and egress of the animal enclosed in them, we may, I think, find a solution of such phenomena in the habits of these reptiles, and of the insects which form their food. The first effort of the young toad, as soon as it has left its tadpole state and emerged from the water, is to seek shelter in holes and crevices of rocks and trees. An individual, which, when young, may have thus entered a cavity by some very narrow aperture, would find abundance of food by catching insects, which like itself seek shelter within such cavities, and may soon have increased so much in bulk as to render it impossible to go out again, through the narrow aperture at which it entered. A small hole of this kind is very likely to be overlooked by common workmen, who are the only people whose operations on stone and wood disclose cavities in the interior of such substances. In the case of toads, snakes, and lizards, that occasionally issue from stones that are broken in a quarry, or in sinking wells, and sometimes even from strata of coal at the bottom of a coal mine, the evidence is never perfect to shew that the reptiles were entirely enclosed in a solid rock; no examination is ever made until the reptile is first discovered by the breaking of the mass in which it was contained, and then it is too late to ascertain without carefully replacing every fragment (and in no case that I have seen reported has this ever been done) whether or not there was any hole or crevice by which the animal may have entered the cavity from which it was extracted. Without previous examination it is almost impossible to prove that there was no such communication. In the case of rocks near the surface of the earth, and in stone quarries, reptiles find ready admission to holes and fissures. We have a notorious example of this kind in the lizard found in a chalk pit, and brought alive to the late Dr. Clarke. In the case also of wells and coal pits, a reptile that had fallen down the well or shaft, and survived its fall, would seek its natural retreat in the first hole or crevice it could find, and the miner dislodging it from this cavity to which his previous attention had not been called, might in ignorance conclude that the animal was coeval with the stone from which he had extracted it.

It remains only to consider the case, (of which I know not any authenticated example), of toads that have been said to be found in cavities within blocks of limestone to which, on careful examination, no access whatever could be discovered, and where the animal was absolutely and entirely closed up with stone. Should any such case ever have existed, it is probable that the communication between this cavity and the external surface had been closed up by stalactitic incrustation after the animal had become too large to make its escape. A similar explanation may be offered of the much more probable case of a live toad being entirely surrounded with solid wood. In each case the animal would have continued to increase in bulk so long as the smallest aperture remained by which air and insects could find admission; it would probably become torpid as soon as this aperture was entirely closed by the accumulation of stalactite or the growth of wood; but it still remains to be ascertained how long this state of torpor may continue under total exclusion from food, and from external air: and although the experiments above recorded shew that life did not extend two years in the case of any one of the individuals which formed the subjects of them, yet, for reasons which have been specified, they are not decisive to shew that a state of torpor, or suspended animation, may not be endured for a much longer time by toads that are healthy and well fed up to the moment when they are finally cut off from food, and from all direct access to atmospheric air.

The common experiment of burying a toad in a flower-pot covered with a tile, is of no value, unless the cover be carefully luted to the pot, and the hole at the bottom of the pot also closed, so as to exclude all possible access of air, earthworms and insects. I have heard of two or three experiments of this kind, in which these precautions have not been taken, and in which, at the end of a year, the toads have been found alive and well.

Besides the toads enclosed in stone and wood, four others were placed each in a small basin of plaster of Paris, four inches deep and five inches in diameter, having a cover of the same material carefully luted round with clay; these were buried at the same time and in the same place with the blocks of stone, and on being examined at the same time with them in December, 1826, two of the toads were dead, the other two alive, but much emaciated. We can only collect from this experiment, that a thin plate of plaster of Paris is permeable to air in a sufficient degree to maintain the life of a toad for thirteen months.

In the 19th Vol. No. 1, p. 167, of Silliman's American Journal of Science and Arts, David Thomas, Esq. has published some observations on frogs and toads in stone and solid earth, enumerating several authentic and well attested cases: these, however, amount to no more than a repetition of the facts so often stated and admitted to be true, viz. that torpid reptiles occur in cavities of stone, and at the depth of many feet in soil and earth; but, they state not any thing to disprove the possibility of a small aperture, by which these cavities may have had communication with the external surface, and insects have been admitted.

The attention of the discoverer is always directed more to the toad than to the minutiæ of the state of the cavity in which it was contained.

In the Literary Gazette of March 12, 1831, p. 169, there is a very interesting account of the habits of a tame male toad, that was domesticated and carefully observed during almost two years by Mr. F. C. Husenbeth. During two winters, from November to March, he ate no food, though he did not become torpid, but grew thin and moved much less than at other times. During the winter of 1828, he gradually lost his appetite and gradually recovered it. He was well fed during two summers, and after the end of the second winter, on the 29th of March, 1829, he was found dead. His death was apparently caused by an unusually long continuance of severe weather, which seemed to exhaust him before his natural appetite returned. He could not have died from starvation, for the day before his death he refused a lively fly.

Dr. Townson also, in his tracts on Natural History, (London, 1799), records a series of observations which he made on tame frogs, and also on some toads; these were directed chiefly to the very absorbent power of the skin of these reptiles, and show that they take in and reject liquids, through their skin alone, by a rapid process of absorption and evaporation,—a frog absorbing sometimes in half an hour as much as half its own weight, and in a few hours the whole of of its own weight of water, and nearly as rapidly giving it off when placed in any position that is warm and removed from moistnre. Dr. T. contends that as the frog tribe never drink water, this fluid must be supplied by means of absorption through the skin. Both frogs and toads have a large bladder, which is often found full of water; "whatever this fluid may be, (he says), it is as pure as distilled water and equally tasteless; this I assert as well of that of the toad which I have often tasted, as that of frogs."

Art. VIII.—*On the process of Memory*; by Isaac Orr.

TO THE EDITOR.

Dear Sir.—The following suggestions are probably new, and not altogether unimportant, since if they are correct they throw at least some light on the subject of Intellectual Philosophy.

In every *primary* intellectual operation, there are two things to be especially noted. 1st. The impression or influence on the organ or faculty of the mind, from the object of perception or observation; 2d. The perception of that object by the mind, or the attention of the mind directed toward it. The former of these, as far as impressions from without are concerned, Dugald Stewart has distinguished by the name of sensation, though it is questionable whether it does not often take place when the organ is entirely torpid. The latter he calls perception. The process is simply the following. The light from an object strikes upon the retina. If the mind is sufficiently unoccupied and awake, it perceives or observes the impulse. This is a voluntary or involuntary *act* of the mind; and may be in part both. It requires but a moment's reflection, to understand fully, that it is merely the repetition of this very act, which afterwards constitutes the recollection or memory of that object. Again, the air vibrates upon the ear, from some one of the various causes, to which sound is ascribed. The mind perceives or observes the vibration. This also is a mental act: and memory of the sound in question, is plainly a mere *repetition* of this very act, or otherwise the power of repeating it. In the same manner impressions are made on the organs of smell, taste and touch; the mind perceives or observes the impressions; and the memory of all the objects by which the impressions are made, is most evidently mere repetitions of the primary act, that is, the act of perception. One answer, then, to the question, what is memory? is, that it is a part of the very act of observation or perception. The only difference is, that the impression is not made on the organ. The act of the mind itself, is the very same in kind, and can differ in no respect, unless it is in the degree of vividness.

It is doubtful, even, whether the mind has not the power of producing on the organs of sense, just such impressions as are made by external objects. This power is at least indicated by the electric light,* which appears to exist in the eye, so scarcely latent, or slightly

* May not this perception of light, (we know of nothing to prove that it is electric,) arise, merely, from the impulse on the optic nerve?—*Ed.*

confined, that it is excited to action by a stroke, a jar, or by any sudden and vivid emotion. The ear, too, has the elements of sound so much at command, independent of any external cause, that a slight disorder or irregularity of the parts in or about the ear, will often produce the sensation of sound as vividly, as if an impression were really made upon the ear by the action of an external object. It is well known that the other organs of sense are not near so susceptible of seeming sensations, without the actual influence of external causes. The organs of touch may be thought an exception; but the sensations caused by internal pain, are very different from those produced by external objects, on the organs of touch. May it not be owing to these facts that the senses of seeing and hearing, are more concerned in dreams, than the other senses?

The *action* of the mind, then, in recollection or memory, is the same as in observation or perception; and there is, perhaps, a slight probability, that the mind goes farther, in some cases, and produces on the organs of sense, the phenomena of actual sensation. It is an interesting question, why the mind acts in one way, rather than another; or why the attention of the mind *seems* directed toward one object, rather than another? This question is best answered by well known facts; that the mind acts most readily in that way in which it has before acted the oftenest and most intensely; that those sensations are reproduced most readily, by the mind, which have been before the most frequent and the most vivid; or that the attention of the mind is most easily directed to those *seeming* objects, toward which it has been the oftenest and most earnestly directed. Now, all this would be well and simply called *mental habit.* On habit, too, much of association is plainly dependent. The mind goes from one thing to another, in a particular train, simply because it has done so before. Philosophical association may be thought to be somewhat different. But when it is analyzed, it will be found to be quite or very nearly the same. In going from cause to effect, from effect to cause, from premises to conclusions, from conclusions to premises, from like to like, and from opposite to opposite, there will be usually found elements in each, which the mind has before observed or contemplated together. Where it is otherwise, it is generally not a case of memory, but of actual perception.

Each of the very rapid motions, in the performance of instrumental music, and in other similar exercises, has been ascribed to a distinct act of the memory, and an act of the will. Be it so; and it goes to confirm the views which have been here taken of the subject. If the fingers make a series of movements, in such sure and rapid succession, it is not simply because the mind has time to determine and will each movement, but because it has been *accustomed* so to move them. It is a matter of habit. This is the decision of the great mass of mankind: and there is nothing in the whole circle of intellectual phenomena to contravene it.

When we have arrived at habit, we have arrived apparently at the ultimate fact. Every body knows that the mind is most apt to operate, and operates most readily, in the way in which it has operated before. But the question why or how it is so, probably admits of the sole answer, that it is an ordinance of the Creator. It is an ordinance designed and calculated to give to idleness and vice their punishment, and its reward to diligence.

If these views are correct, the proper and philosophical definition of memory is not, the recalling of ideas or images laid up in the mind, or the power of doing it; nor is it even, the renewing of former impressions and reflections, or the power of doing it, except in those doubtful cases in which the mind itself *may* produce actual sensations; but it is, *the acts of the mind in ways to which it has been accustomed, or the force of habit urging, disposing or helping the mind in the performance of customary acts.* Memory is either the influence or power of mental habit, or the results of that habit; and as a necessary consequence, the improvement of the memory mainly depends on the frequency and intenseness of mental action.

Washington, Nov. 1832.

Art. IX.—*Memoir on the Chemical Analysis of the Atmosphere;* by M. Brunner, Prof. of Chemistry at Berne. Translated for this Journal by Prof. Griscom.

An examination of the chemical constitution of the atmosphere, is a matter of such great importance, that we are not surprised to find so many efforts have been made to bring it to the highest possible degree of perfection. The attention of philosophers has been chiefly directed to the four substances of which the atmosphere, in its ordinary state, is always constituted,—to the determination of the proportions of these substances with as much exactness as the state of science and the accuracy of our instruments will permit.

The azote and oxygen form the great mass of atmospheric fluid, and in proportions which appear almost entirely constant,—at least the eudiometric methods show no greater discrepancy than the errors which may be regarded as inseparable from experiment. The changes however which we observe in the atmosphere,—the varying phenomena of meteorology, would naturally lead us to think that these proportions must undergo some changes; and although our experiments do not justify such a supposition, it is desirable to ascertain with certainty the variations, if any do occur, however small they may be.

The two other substances, which are generally regarded as accidental constituents of the air, water and carbonic acid, have equally engaged the attention of chemists. The estimation of the water constitutes the special branch of Physics called hygrometry, on which subject we have a great number of very valuable researches. The valuation of the carbonic acid has been less attended to. We are indebted to Theodore de Saussure for an interesting memoir on this subject.

Although the recent works on these latter points of physics leave little to be desired in relation to the exactness of the method employed, I think it may be useful to possess various methods, based on different principles, and which may on that account serve as checks to each other, and eventually lead to that exactness which this delicate part of chemistry appears to require. It is with this view that I have undertaken a series of experiments for obtaining an easy and sure method of determining in a direct manner the quantity of water and carbonic acid contained in a given volume of atmospheric air.

I. *Determination of the watery vapor contained in the atmosphere.*

A (Fig.1.) is a cylindrical vessel of glass or metal,—tin for example,—having two openings *a* and *b*, the latter furnished with a stop cock. It contains about thirty quarts of water. The upper orifice *a* being connected with a horizontal tube of glass, it is evident that the water which flows through the cock *b* is replaced, in the vessel, by an equal volume of air passing through the tube. By filling the latter with a hygrometric substance, capable of retaining the watery vapor which this air contains, we determine by the increased weight which the tube thus acquires, the proportion of water contained in a volume of air equal to that of the discharged water.

To use this very simple apparatus with perfect certainty, several conditions are requisite.

1. The vessel A must contain at least thirty quarts in order to act upon a considerable volume of air. Although in common experi-

ments, the half of this volume might be sufficient, there are cases in which this quantity becomes necessary.

2. The discharged water is received in a large bottle B, measured very exactly and marked on its neck with a file. The bottle which I use contains 12972.5 cubic centimetres. By filling it twice, I draw off nearly the whole volume contained in A.

3. The hygrometric tube is eleven or twelve inches long and from three lines to three and a half in diameter, internally. It has two enlargements near the two ends, destined to receive the hygroscopic liquid, when the tube is not in a perfectly horizontal position.

4. Common sulphuric acid serves as a hygrometric substance. A quantity of amianthus, sufficient to line the sides of the tube, is introduced, which is moistened by letting about fifty drops of acid fall into it. It is easy to moisten the amianthus uniformly throughout the length of the tube, by suitable inclinations. The tube, thus prepared and stopped at the two ends, is weighed in a balance which indicates milligrammes, (two hundredth part (nearly) of a grain.)

The flowing of the water must be carefully regulated. If too rapid, a part of the vapor might escape the action of the sulphuric acid. If on the contrary it be too slow, time would be lost unnecessarily, and the air would be acted upon during an interval in which some change might take place in the constitution of the atmosphere. Experience has taught me that thirteen thousand grammes of water* may be drawn from the vessel A in an interval of ten minutes, without the risk of any inconvenience.

6. In calculating the result furnished by the operation, the necessary corrections must be made for barometric pressure, temperature of the air which enters the vessel A by taking that of the discharging water, the temperature of the free air the moisture of which we are trying, and the tension of the water contained in the vessel. These reductions are too well known to philosophers to need further explanation.

Although in the use of this apparatus, there is no difficulty in following exactly the dimensions and manipulations described, it will be well for the student to adapt a second tube, containing sulphuric acid, between the hygrometric tube and the vessel A. If the weight of this latter tube is not altered by the passage of the air requisite to the operation, the arrangement may be deemed satisfactory. I have sent through the tube the required volume of air, saturated with moisture

* Between three and four gallons.

(by pressing it first through a tube containing moist cotton,) without finding the second tube altered in weight.

The increase of weight of the hygrometric tube, in causing the discharge of 12972.5 grammes of water, is found, under ordinary circumstances, included within the limits of sixty to one hundred milligrammes, an amount apparently considerable enough to be but little influenced by errors of observation. On the 26th of Dec. 1830, during the finest weather, at a temperature of 16° cent. (=60° Fah.) I obtained thirteen milligrammes from the same volume of air.

Although this method of estimating the moisture of the atmosphere always requires an experiment, and for which common hygrometers cannot be substituted for the instrument now described, it appears to me that this is the only one which can give a direct result, and that it must on that account be useful in regulating others. I think nevertheless, it may be used successfully in travelling. A tin vessel, of convenient dimensions, (from eight to ten thousand cubic centimeters) would be easily transported, as well as tubes containing amianthus moistened with sulphuric acid, and weighed beforehand, the barometer and thermometer always making a part of the equipment of a scientific traveller.

To those who could not conveniently obtain a vessel expressly adapted to this purpose, I would propose the use of a common bottle, thus—fill the bottle A, (Fig. 2.) with water, which may be drawn off by the syphon *ab*, and measured by means of a vessel of known capacity. To the tube *c* adapt the hygrometric tube in the common manner. With this apparatus, which may be constructed wherever bottles can be found, and a small portable measuring glass, with the weighed tubes, it is easy to make experiments of sufficient exactness. Care must of course be taken to guard against the influence of humidity arising from the flow of the water, the decanting from the measuring glass into the bottle, &c. which will never be difficult. With a fixed apparatus, it would be advisable to perform the experiment near a window, through an opening of which the hygrometric tube should pass into the open air.

II. *Determination of Carbonic Acid.*

The valuation of the carbonic acid in the atmosphere has been less studied than that of the other elements, either because it presents greater obstacles or is judged to be of less interest. All that is positively known, we owe to Theod. de Saussure, whose memoir, in the Journals of the *Société de Physique de Geneve*, is the result of numerous and extensive researches. His process was an improvement on the method of Thenard in 1812, and consisted in causing a large and known volume of air to act on barytic water, in a glass balloon, and to calculate the carbonic acid by the carbonate of barytes thus formed. This process, although founded on a theory perfectly established, presents many difficulties in the execution, which M. de Saussure has overcome and has described with admirable exactness. He found that the atmosphere, in its ordinary state, contains between 3.7 and 6.2 of carbonic acid in ten thousand parts of air in volume, and he studied the changes produced by the influence of seasons, hours and various local causes.* His researches are of great importance to meteorology. Although the method pursued by this philosopher can scarcely fail to attain the object proposed, I think it would be well to possess a second method, if only by way of comparison. The method, moreover, of de Saussure requires a train of operations which may easily lead into error in hands less careful than his own, and which, as he informs us, required nine days for each experiment.

I have endeavored to employ the hygrometric apparatus above described; having first tried the method practised by Thenard and de Saussure, as well as others, without obtaining results satisfactory to myself. The method by which I at last succeeded is the following.

A tube of glass three feet long (Fig. 3.)† and of the same calibre as the hygrometric tube, is filled in the first two thirds of its length *ab*, with hydrate of lime; the rest is disposed so as to serve as a hygrometric tube by putting into it amianthus moistened with sulphuric acid.‡ By the increase of weight of this tube, after a measured current of air has passed through, we determine the proportion of carbonic acid it contains. The following details are indispensable.

1. The hydrate of lime must be carefully prepared. The lime, well calcined, is reduced to a hydrate by moistening it with a few drops of water, and after it has completely crumbled, add a few drops more of water, so that in stirring it with a spatula it will form small clots or lumps. It is important to hit the proper degree of humidity.

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* Vid. American Journal of Science, Vol. XX, p. 183.

† The tube is bent as shown in the figure, in order to be placed more conveniently in the balance.

‡ The moistened amianthus is separated from the lime, by a few fragments of glass or porcelain, occupying the bend *b*.

If the lime is too dry, it absorbs the carbonic acid very imperfectly; if too moist, it is difficult to make it pass the bend of the tube. By a few trials the right point may be easily obtained.

2. The sulphuric acid included in the end of the tube, is placed in the same manner as in the determination of moisture. From fifty to sixty drops are always sufficient. The effect of this acid is evident. The lime in passing from the state of hydrate to that of carbonate, abandons its water, which would cause a diminution of weight, as well as the portion of water (still greater) carried along by the current of air passing through the tube. It is in order to retain this water that the hygrometric portion of the tube becomes necessary.

3. The air before it enters into the tube containing the lime, ought to pass through a common hygrometric tube, in order to deposit its water, which, without this precaution, would be confounded with the carbonic acid.

4. All the weighings ought to be done by substitution, that is to say, in taring (*en tarant*) a known weight,—for example, .2 of a gramme, with the tubes, and on the same plate of the balance, and in deducting from this weight, that required to be substituted for it after the operation,—the difference indicating the increase of weight of the tube produced by the operation. We should never neglect to wipe the tubes immediately before weighing, since the moisture which they attract from the air, may, in a certain time, occasion an error of some milligrammes, as I have ascertained by direct experiment.

5. The volume of air operated upon ought to be large, in order that the increase of weight of the lime may not be too small. In drawing 12972.5 grammes of water from the vessel A, I have obtained, in ordinary circumstances, an increase of seven to nine milligrammes. It is therefore preferable to operate upon a volume of twice this size, which may be done without difficulty in the course of fifty minutes.

6. To calculate the proportion of carbonic acid in the air analysed, we set out with the specific gravity of this gas, as determined by Berzelius and Dulong, and which gives for 1.97978 grammes of carbonic acid its volume equal to one thousand cubic centimetres at 0° and at 0.76 of the barometric column, (=29.52 in.) The volume found by calculation is reduced to the volume which it would have at the temperature of the vessel A and the prevailing height of the barometer, and from the sum representing the volume of analysed air, we obtain, by the rule of proportion, the volume of carbonic acid in a given volume of air, e. g. in ten thousand parts. The reduction

of the volume of air to that of dry air, or rather to the degree of humidity shown by the experiment, appears to me too minute to have any sensible influence on the very feeble proportion of carbonic acid existing in the air.

To determine the limits of the proportion of carbonic acid appreciable by this method, I operated upon air taken from two feet above a small charcoal fire, and passed it through barytic water, after it had passed through the lime tube. Although the carbonic acid was found to be near one per cent. in the volume of air, the barytic water was not troubled. When I repeated it with a similar air, but more highly charged, viz. two per cent. of carbonic acid, the barytic water was decidedly affected. But this proportion of carbonic acid surpasses, by more than thirty times, the maximum found by de Saussure in the atmosphere. I would observe, that in the latter experiments, I let the water flow in a natural stream. By slackening the current, or by lengthening the lime tube, we might probably operate upon air more highly charged with carbonic acid.

To be certain that the current of air does not bring with it any sensible quantity of water, I placed a second hygrometric tube between the lime tube and the vessel A. In several experiments of this kind, I never observed the least increase of weight in this tube.

In a series of experiments undertaken with a view of studying my apparatus, I constantly obtained results included within the limits of those obtained by de Saussure.

It appears therefore that the method now described furnishes an easy and certain means for ascertaining the proportion of the two accidental principles of the atmosphere. I think it susceptible of being extended to those researches which are properly styled eudiometric.* Perhaps a method may be derived from it, more exact than those now practised to determine the proportion of the oxygen, which has hitherto been scarcely brought within one hundreth of the point of rigorous exactness. It would also be desirable to employ some analogous methods in researches into the other elements which the atmosphere appears to contain. For this purpose currents of air should be passed, for some time, through different reagents, which might be enclosed either in tubes similar to those above described, or through Wolf's bottles, and in order to act upon large masses of air, an appa-

* Is it not to be regretted that the term eudiometry and eudiometer should be applied exclusively to the art of determining the quantity of oxygen in the air and the instruments for that purpose? Would not the terms oximetry and oximeter be more appropriate?—*Tr.*

ratus might be erected of large dimensions, by using for example, a hogshead, and causing the air to flow during whole days through different reagents. To experimenters residing near the Ocean this method may be specially recommended. It is known that some trials, made within a few years, of the air over the Baltic Sea, have furnished very curious results which it would be interesting to follow up.

But in a variety of other circumstances such researches may be very useful. I have endeavored to subject our autumnal fog, the peculiar odor of which is known to all, to the action of several reagents. I have passed air, loaded with this fog, through nitrate of silver, and chloride of silver dissolved in caustic ammonia. Nothing positive was obtained. In the last case a precipitate was produced which speedily assumed the color of chloride of silver exposed for some time to the light, and which was found to be in reality that salt, doubtless precipitated from its ammoniacal solution by the carbonic acid introduced with the atmosphere.

I advert to these incomplete trials only to suggest methods which I think may be followed in investigations of this nature.—*Bib. Univ. Mars*, 1832.

Berne, March 27th, 1832.

Fig. 1.

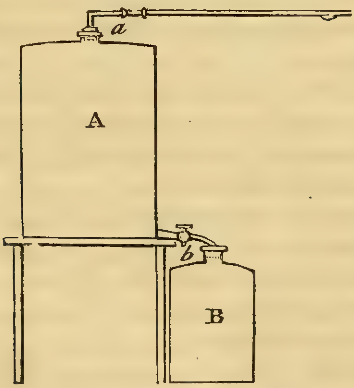


Fig. 2.

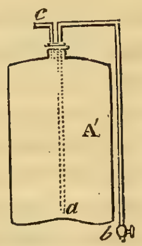
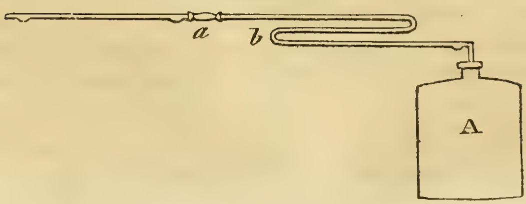


Fig. 3.



Art. X.—*Supplement to the "Synopsis of the Organic Remains of the Ferruginous Sand Formation of the United States," contained in Vols. XVII and XVIII of this Journal;* by* S. G. Morton, M. D., &c.

When my attention was first called to this subject, eight years ago, I could not trace the *marl region* beyond the peninsula of New Jersey and a small part of Delaware: subsequently, however, it has been discovered in almost all the Southern States, and I now believe it to be one of the most extensive formations on this continent.

Its localities in New Jersey, Delaware and Maryland have been so often referred to, that I shall not recur to them; but for the purpose of exciting the observation of tourists, and others, in the Southern States, it may be well to notice the green sand districts which are already ascertained to exist there.

North Carolina.—At Ashwood, near Cape Fear river, on the authority of Mr. Vanuxem.

South Carolina.—At Effingham's Mills, on Lynch's creek, on the authority of Dr. Blanding, who has brought me a number of characteristic fossils; also at Mars's Bluff, on Pedee river, and at Nelson's ferry, on the Santee river.

Georgia.—Near Sandersville, where it is chiefly recognized by Belemnites.

Alabama.—My friend Dr. Pitcher, U. S. A., informs me that he has traced the ferruginous sand all the way from Portland to Montgomery, a tract which embraces Cahawba, a locality already quoted by me, on the authority of Mr. Nuttall.

Mississippi.—This State has an extensive marl tract in the Chickasaw fields, near the borders of Tennessee. The characteristic fossils have been sent to me by my friend Mr. Brewster.

Tennessee.—The south western portion of Tennessee presents a continuation of the tract just mentioned, which takes a westerly direction across the Mississippi river at the Chickasaw Bluffs.

Louisiana.—Dr. Pitcher, in a recent letter, describes an extensive deposit of ferruginous sand between Alexandria and Nachitoches. Judge Bry has also noticed it near the township of Wachita, on the Wachita river, where it is recognized by Belemnites, Ammonites and Gryphææ.

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* See also a letter to the Editor, Vol. XXII, p. 90.

Arkansas.—Mr. Nuttall describes this formation as occurring extensively on the calcareous platform of the Red river, above and below the junction of the Kiamesha; and Dr. Pitcher has lately obtained there some large Ammonites and other fossils which I have not yet received.

Missouri.—Messrs. Lewis and Clarke, Mr. Nuttall and Col. Long found Baculites, Hamites?, Gryphææ, and other marl fossils at the Great Bend of the Missouri river (Lat. 43° 40′ N., Long. 72° W. from Washington) intimating the existence of the ferruginous sand in that remote region of our continent, as mentioned on a former occasion.

Now these various deposits, though seemingly insulated, are doubtless continuous, or nearly so, forming an irregular crescent nearly three thousand miles in extent; and what is very remarkable, there is not only a generic accordance between the fossil shells scattered through this vast tract, but in by far the greater number of comparisons I have hitherto been able to make, the same *species* of fossils are found throughout: thus the *Ammonites placenta*, *Baculites ovatus*, *Gryphæa Vomer*, *Gryphæa mutabilis*, *Ostrea falcata*, *&c.* are found without a shadow of difference, from New Jersey to Louisiana: although some species have been found in the latter State, that have not been noticed in the former, and vice versâ.

There seems also to be superposed on the ferruginous sand of the Southern States a calcareous deposit, in mineralogical characters not very unlike that of New Jersey; but of its organic remains I have seen but few species, consisting of Nummulites, Gryphites, and Pectens; all differing obviously from any others with which I am acquainted. The principal deposit of this kind occurs near Claiborne, Alabama. Another, noticed by Mr. Nuttall, near Wilmington, in North Carolina, appears to be a link in the same series.

In further corroboration of the views maintained in these essays I may add, that Mr. De la Beche, in his *Geological Manual*, p. 294, after giving a list of the fossils contained in the former parts of this Synopsis, concludes his observations on the cretaceous group in these words: "It is almost impossible not to be struck, in the foregoing list, with the great zoological resemblance of this ferruginous sand deposit with the cretaceous rocks of Europe. As has been above noticed, the genera *Baculites*, *Scaphites* and *Turrilites* have not been discovered out of this series in Europe. The *Pecten quinquecostatus* is a well known and widely distributed chalk fossil. But it is not so much by individual parts as by the general character of the whole that Dr. Morton's inference seems in a great measure established. How far the cretaceous group of the United States may be separated beneath and above, from other deposits more or less contemporaneous with those of Europe, remains an interesting problem which it is hoped American geologists will endeavor to solve.—Assuming that the American ferruginous sand formation belongs to this [cretaceous] group, of which there seems great probability, it would appear that the great white carbonate of lime deposit, or chalk, did not extend there; but that a series of sands, clays and gravels constituted the whole group."

In reference to the preceding passages, I may briefly observe, that the whole super-cretaceous group, or tertiary series, (excepting only the fresh water deposits) is now satisfactorily identified in this country. Thus we have the upper, middle and lower tertiary formations,* all based directly or indirectly on the ferruginous sand; and I may repeat, that so far as my observations have extended, not a solitary fossil of the latter formation has been detected in the superposed strata.

In resuming the subject of organic remains it may be observed, that I have figured on the present occasion, some of the most remarkable species only, the remaining illustrations being reserved for a separate edition of this Synopsis: for the same reason the plates here given do not follow each other in numerical order.

ORGANIC REMAINS.

CHAMBERED UNIVALVES.

AMMONITES.

A. telifer. (S. G. M.) A remarkable species, of which I possess several fragments from the Delaware marl, almost too imperfect for description, and yet so different from the other species as to induce me to give it a name. It will be figured in the second edition of this Synopsis.

I take this occasion to remark that the *A. hippocrepis* of DeKay, inserted in the first part of this Synopsis, is merely a transverse section of *Scaphites Cuvieri.* This formation, therefore, possesses but four published species of Ammonites, viz. *A. placenta*, *A. Delawarensis*, *A. Vanuxemi* and *A. telifer.*

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* I take the liberty (for reasons to be given in another place) of substituting these names for those of Upper marine, London clay and Plastic clay formations.

BACULITES.

B. compressa. (Say.) Pl. IX, fig. 1. This beautiful fossil was described by Mr. Say in the American Journal of Science,* but is now figured, for the first time, from a fine specimen in the possession of my friend, Jno. P. Wetherill, Esq. and brought from the Great Bend of the Missouri river. Although I have not been able to obtain any details of the geology of this remote region, I have no hesitation in placing the *B. compressa* in the series of ferruginous sand fossils.

B. asper. (S. G. M.) Transversely suboval, with prominent lateral nodes between the septa. From Alabama.

SCAPHITES.

S. reniformis. (S. G. M.) About an inch in length, with numerous costæ that bifurcate laterally. This species bears no resemblance to *S. Cuvieri* of this Synopsis, but is not very unlike *S. striatus*, of the British chalk.

NAUTILUS.

N. Dekayi. (S. G. M.) Pl. VIII, fig. 4. This is the only species hitherto found in our marls. It has been sometimes compared to *N. expansus* (Sowerby) but is much larger: it has also been confounded with the British *N. imperialis*, to which, however, it bears no other resemblance than all the species of this genus bear to each other. I have much pleasure in dedicating this fossil to one of the most zealous and intelligent of American naturalists.

NUMMULITES.

N. Mantelli. (S. G. M.) Pl. V, fig. 9. Flattened, thin, becoming sharp at the edge, and having a central pustuloid elevation. Diameter from half an inch to an inch and a half. Innumerable in the whitish, loose grained limestone near Claiborne, Alabama. I have much pleasure in dedicating this only known American species of Nummulites, to one of the most zealous and successful cultivators of geological science.

SIMPLE AND SPIRAL UNIVALVES.

PATELLA.

P. tentorium. (S. G. M.) Compressed, circular, with sixty or eighty delicate ribs; diameter half an inch. This fossil has some appearance of a shelly operculum, in which case it would belong to the genus *Hipponix.*

* Vol. ii, p. 41.

ROSTELLARIA.

R. arenarum. (S. G. M.) Pl. V, fig. 8. Noticed, but not named or figured in the former part of this Synopsis.

TORNITELLA.

1. *T.? bullata.* (S. G. M.) Pl. V, fig. 3. Ventricose, with very numerous striæ: less than an inch long.

2. A minute species, of which casts only are found.

BIVALVES.

TEREDO.

T. tibialis. (S. G. M.) Pl. IX, fig. 2. I propose this name for the Teredo so common and so beautifully preserved in the calcareous strata of New Jersey. The same species is also common in all the varieties of marl.

PHOLAS.

Mr. Cooper showed me a cast about an inch long, with concentric and longitudinal striæ, and a longitudinal groove.—Found in Monmouth county, N. J.

PHOLADOMYA.

P. occidentalis. (S. G. M.) Pl. VIII, fig. 3. Oblong-angular, ventricose near the beaks; with twenty five or thirty narrow, elevated, subtortuous costæ, having broad, slightly concave intervening spaces. Length two inches, breadth three inches. An extremely variable species: I possess five specimens, (all more or less broken,) in all of which there is a difference in the number and relative position of the ribs.

CYTHEREA.

C. excavata. (S. G. M.) Pl. V, fig. 1. Suborbicular, compressed, posterior slope deeply excavated; posterior side with an obsolete fold, margin angular. New Jersey.

CARDITA.

C. decisa. (S. G. M.) Pl. IX, fig. 3. A solitary cast obtained by me at St. Georges, Delaware.

NUCULA.

A few small casts in ferruginous clay, near Bordentown, New Jersey.

PLAGIOSTOMA.

P. gregalis. (S. G. M.) Pl. V, fig. 6. Shell irregular, thin; back armed with concentric squamous plates; within obsoletely stria-

Plate 5.

From Nature by M.E.D. Brown

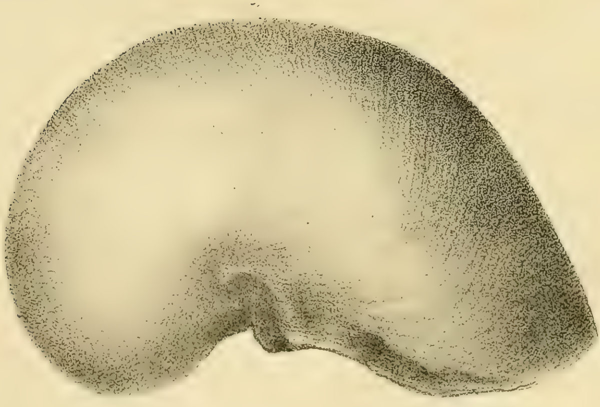
his Lith: Phil:

Plate 8

1.

2.

3.



n Nature by M. E. D. Brown

ted. Mostly found attached, and varies from one to three inches in length. Same as No. 1 of this Synopsis. Common in New Jersey.

P. pelagica. (S. G. M.) Pl. V, fig. 2. Subovate, convex, with twenty five or thirty narrow elevated ribs. An unattached shell. Found with the preceding. Resembles *P. duplicata*, (Sowerby) an oolitic fossil.

PECTEN.

P. craticula. (S. G. M.) Shell suborbicular, unequal, with about ten large, elevated, convex, longitudinally sulcated ribs, and a much smaller one interposed between each pair. New Jersey. Very rare.

P. anatipes. (S. G. M.) Pl. V, fig. 4. With four or five broad convex ribs, longitudinally striated; at the sides large striæ replace the ribs. Rarely more than half an inch in diameter. From the overlying limestone of Claiborne, Alabama.

P. perplanus. (S. G. M.) Pl. V, fig. 5. Depressed, with about twenty simple costæ, transversely striated. Diameter less than an inch. Found with the preceding species.

P. venustus. (S. G. M.) Pl. V, fig. 7. Shell thin, depressed, about half an inch in diameter, with fifteen or twenty double costæ; those on the lower valve delicately beaded. From New Jersey.

GRYPHÆA.

G. plicatella. (S. G. M.) Pl. IX, fig. 4. A minute species from the overlying limestone of Alabama. I defer further notice of it in the hope of obtaining larger specimens.

OSTREA.

In addition to the *O. falcata*, so common in New Jersey, I am now able to give the characters of the three following species, all from the same beds:

O. plumosa. (S. G. M.) Ovato-triangular; lower valve convex, crenated near the hinge; dorsum marked with delicate striæ, radiating with fasciculi from the beak to the margin.

O. panda. (S. G. M.) Same as species No. 2 of this Synopsis, where it is referred, with a question, to *O. Cristagalli* of Europe. (Vide Vol. xviii, pl. 3, fig. 22.)

O. urticosa. (S. G. M.) Discoidal, thin, with numerous spinous costæ; many individuals usually adhering together. From New Jersey.

ANOMIA.

A. argentaria. (S. G. M.) Pl. V, fig. 10. Thin, round, with numerous concentric striæ.

A. tellinoïdes. (S. G. M.) Pl. V, fig. 11. Irregular, but mostly subovate, with concentric undulations. Both these species are common in New Jersey; the latter resembles *A. ephippium*, to which it is referred in the first part of this Synopsis.

VENILIA.* (S. G. M.)

V. Conradi. Pl. VIII, fig. 1, 2. Trigonal, ventricose, concentrically sulcated; beaks long and incurved: diameter an inch and a half.

This singular marine shell, so different from any of the hitherto known genera, was discovered in New Jersey by my estimable friend Mr. T. A. Conrad, under whose name I gladly introduce it to notice.

ECHINIDEÆ.

SPATANGUS.

S. parastatus. (S. G. M.) Same as No. 1, of this Synopsis. See vol. xviii, Pl. 3, fig. 10.

CIDARIS.

C. diatretum. (S. G. M.) A compressed species, found with the preceding, in the calcareous beds of New Jersey.

NUCLEOLITES.

N. crucifer. (S. G. M.) Referred in the former part of this Synopsis to the genus *Ananchytes*, and figured, vol. xviii, Pl. 3, fig. 8.

CLYPEASTER.

C. florealis. (S. G. M.) Noticed generically in the first part of this Synopsis.

Very convex; each of the five ambulacra composed of two pairs of finely dotted lines: base subelliptical, concave; margin abrupt. From the blue marl of Delaware.

To be continued.

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* *Generic description.* An equivalve bivalve; hinge with three robust cardinal teeth in each valve, and an elongated, thick lateral tooth on the posterior side, similar to that of Unio: anterior muscular impression profound.

Art. XI.—*Account of the Russian Vapor Bath;* by T. S. Traill, M. D. Communicated by the Author.*

From the Edinburgh New Philosophical Journal.

The existence in Hamburgh of two establishments where the Russian Vapor-Bath is used, brought to my recollection the descriptions given by Acerbi, and other travellers, of the intense heat and sudden transition to cold, so much relished by the nations of Northern Europe, and raised my curiosity to experience in my own person the effects of this singular species of bathing. I was further induced to take this step from finding myself suddenly oppressed with a violent feverish cold, which raised my pulse considerably above 100°, and rendered me little able to join the public dinner-table in the Apollo Saal.

Accompanied by two friends who wished to make the same experiment, I repaired to the Alexanderbad, which is under the direction of its proprietor, a Jewish physician, who had liberally opened it gratuitously to the members of the Society of *Naturforscher*, then assembled at Hamburgh. We were ushered into a very neat saloon, provided with six couches, beside each of which stood a dressing table, and a convenient apparatus for suspending the clothes of the bather. Here we undressed, and were furnished with long flannel dressing-gowns and warm slippers, after which we were all conducted into a small hot apartment, where we were desired to lay aside our gowns and slippers, and were immediately introduced into the room called the bath, in which the dim light admitted through a single window of three panes, just sufficed to shew us that there were in it two persons, like ourselves *in puris naturalibus ;* one of whom was an essential personage, the *operator*, the other a gentleman just finishing the process by a copious affusion of cold water over his body. This sudden introduction into an atmosphere of hot steam was so oppressive, that I was forced to cover my face with my hands, to moderate the painful impression on the lips and nostrils, and was compelled to withdraw my head, as much as possible, from the most heated part of the atmosphere, by sitting down on a low bench which ran along two sides of the bath.

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* Read before the Literary and Philosophical Society of Liverpool.

At first our modesty felt some alarm at our perfect nudity, and that of those around us; but I soon *felt* that it would be absolutely impossible to endure the contact of any sort of covering of our nakedness in a temperature so high; and consoled myself with the reflection, that it was no worse than the promiscuous bathing I had so often practised at the sea-baths of Liverpool; an exposure which, notwithstanding my passion for bathing, was always disagreeable at the commencement of each season; but to which custom had soon rendered me indifferent.

The bath-room is about fifteen feet long by about as much in breadth. It is lined with wood, rendered quite black by constant immersion in hot steam. On two sides it has three tiers of benches, or rude couches, each of which is calculated to hold two persons, with their feet toward each other; so that twelve persons might bathe at the same time. The lowest bench projects farthest into the room; they rise two feet above each other; and each has a wooden pillow at the ends.

In one corner of the farther end of the apartment stands the furnace, which is supplied with fuel from without, and has a thin arch of fire-brick turned over the fire, against which the flame reverberates, until the arch is red hot. Over this arch is built a small brick chamber, the only aperture to which is by a small door about two feet long, and fifteen inches wide, opening nearly to the level of the arch. To increase the heated surface, numerous small earthern jars, or broken pottery, are piled on the arch, and all are kept up to a low red heat. On these, a basin of water is occasionally dashed; and the clouds of steam which instantly issue from the door of the heated chamber, form the source of heat employed to maintain the temperature of the bath.

In the corner opposite to the furnace is a reservoir of cold water, into which, during our stay in the bath, the person who manages it, frequently plunged to cool his surface; a precaution not unnecessary for an individual who is exposed daily eight hours, stark naked, to a temperature quite oppressive to the uninitiated. Yet this exposure and this alternation cannot be unhealthy; for I never saw a more athletic man than this person, who informed me that he had been constanly engaged in this occupation for sixteen or eighteen months.

The center of the ceiling of the bath-room is perforated by numerous holes which allow a copious shower-bath of cold water to descend on the head of the bather, when a valve managed by a cord is opened.

Such is the apparatus necessary for a Russian vapor-bath.

After remaining some time in the bath, the first sensations of oppressive heat subsided, and I ascended to the second tier of benches, the wood of which, however, was somewhat cooled by the plentiful affusion of cold water. At each remove this operation is repeated; otherwise the contact of the wood would be insupportable to the skin. It is needless to say, that the perspiration very soon began to run from every pore, not merely as a moist exhalation, but ran off in copious streams. This greatly moderated the sensation of heat.

After lying extended for some time on the second tier of benches, a bucket of cold water was dashed on the upper one, and we removed there; but the heat, so near the ceiling, was fully as oppressive as on first entering; and I found it necessary to allow the air to enter my nose through my fingers. If I inhaled it with the mouth wide open, I felt an oppressive heat in my chest; but by degrees even this degree of heat became supportable; though I never was able to sit upright on the upper bench; so strong was the temperature of the humid atmosphere close to the ceiling.

While we were groping our way from bench to bench, the assistant more than once plunged headlong into his cold bath, to refresh himself ere he commenced on us the next part of his professional occupation.

We were one by one requested to descend to the second tier; and the assistant, grasping in his hand a bundle of birch rods, began assiduously to whip his patients who lay extended on the bench at full length, from head to heel. This application differs essentially from the well remembered scholastic birch discipline; for the leaves are left on the twigs, and the sensations produced in no way resemble the effect of the instrument employed in English schools to convey a knowledge of Greek and Latin into the heads of our youth. In fact, this species of whipping is performed very dexterously, with a sort of brushing motion, from the shoulders downwards; and the application becomes general over the body and limbs, as the bather turns on his wooden couch. The sensations produced by this operation are agreeable, and are very far from producing that excessive redness of the surface described by Acerbi.

The operator now anoints the whole body with a liquid mild soap; and, after again mounting to the upper tier for some time, we descend one by one to the middle of the floor, where a powerful affusion of cold water from the shower-bath in the ceiling removes every vestige of soap. This sudden affusion of cold water is remarkably grateful: it is scarcely possible to describe the effect, which is highly exhilarating and refreshing.

It is usual again to undergo the steaming after the temperature of the bath is increased by the affusion of water on the glowing pottery in the furnace. For this purpose, the operator opens the door above described, and placing us out of the direction of the immediate efflux of the steam, he dashes, in successive jets, a small bucket of water into the furnace. The apartment is instantly filled with clouds of steam, at a high temperature; and when the door of the aperture is closed, we resume our places on the benches, gradually proceeding to the highest, as we become inured to the temperature. From the upper tier we finally descend to have the cold shower-bath repeated; after which we leave the bathing-room, are rubbed dry by assistants in the small heated apartment, where we resume the flannel dressing-gown and slippers, and are reconducted to the saloon, where we find the couches spread with blankets; and we recline for half an hour in a most profuse perspiration, and in a state of luxurious languor, and mental tranquillity.

On a subsequent occasion, I provided myself with the means of ascertaining the temperature of the bathing-room, and noted its effect on the pulse of myself and two other bathers. The heat is generally from 45° to 50° of Reaumur; that is, from 133°.25 to 144.5 of Fahrenheit. On the occasion referred to, it ranged in the bath, during my stay, from 32° to 46° R.,= 126°.5 and 135°.5 F. in the lower part of the bathing-room; but I was unable to examine the temperature near the ceiling, on account of the thick vapor, and the intensity of the temperature, which affected my eyes. This temperature, high as it is, is far short of what Acerbi asserts of the Finnish baths; he says that they reached from 70° to 75° of Celsius,= to 158° to 167° of our scale: but perhaps his thermometers were subject to the influence of the open fire-place in the rude baths of that people; for their furnace consisted of a few loose stones piled into a sort of rude arch, over a fire on the floor of the hut: or perhaps he did not accurately ascertain the temperature; as he never entered the bath but momentarily, for the purpose of placing his thermometer; and I am confirmed in this by observing that the Finnish operator, in his plate, appears dressed in her ordinary clothes, which I should think insupportable in so high a temperature as he assigns.

The effect of the Russian vapor-bath is to accelerate the pulse, which soon regains its natural standard on leaving the bath; and, when I took it in a highly feverish state, I was within an hour after entirely free of fever, and able fully to enjoy the philosophic soiree that evening.

On bathing a second time, I was accompanied by the same two friends: our pulses were about seventy four in a minute. On just coming out of the bath,

Dr. Traill's pulse, - -	= 116
Mr. Johnson's do. - -	= 88
Mr. Palk's do. - - -	= 88

A quarter of an hour afterwards, while on the couch, they were as follows:

Dr. Traill's pulse, - -	= 114
Mr. Johnston's do. - -	= 88
Mr. Palk's do. - - -	= 88

After being dressed, and sitting in an adjoining coffee-room, perhaps one hour after the bath,

Dr. Traill's pulse beat, - -	= 88
Mr. Johnston's do. - -	= 88
Mr. Palk's do. - - -	= 80

These experiments shew the great difference in the excitability of the heart in different individuals, from exposure to the same heat. My pulse in my best health, is about seventy; since I had the gout it ranges from seventy four to eighty, but is very easily excited; and I have often found it raised to more than ninety by an interesting conversation, or even a cup of strong tea.

The process of the vapor-bath is completed by a plentiful supply of towels, with which we gradually dry the surface, while we are well *rubbed down* by an assistant. We then resumed our dress, and retired to a coffee-room, where there was a plentiful supply of newspapers, and had a cup of good coffee for twopence Sterling. As I have already stated, the baths were free to the *naturforscher;* but I ascertained that the whole expense of the bath and its accompaniments is not more than one marc, or sixteenpence English, and for twopence more the bather is entitled to a cup of coffee, and to read the newspapers in a handsome apartment.

I received from the liberal owner permission to examine his splendid establishment of vapor and shower baths devoted to females.

The vapor-bath resembles that already described, but is much neater.

The variety of shower-baths surprized me. They are of every conceivable form, from the powerful stream to the minute drizzing of water from orifices as fine as a needle, which jet tiny streams of warm or cold water, at the option of the bather, in every possible direction on her person. By means of polished brass arms, curved so as to enclose the body, movable by universal joints, connected with a cistern, and perforated with innumerable minute holes, a *cross-fire* of jets (if I may be allowed the expression) is kept up on any part of the body. If the bather inclines to sit, a perforated seat is placed on a large flat trough, which collects and carries off the water, jets of water play from the various movable arms from each side, from above, and from below, so that every part of the surface is bedewed. A general stop-cock commands the whole flow of water, while each brazen-reed is under the control of one appropriate to itself. These are at the disposal of the bather; and each trough or bath is surrounded by curtains to skreen the person from the eyes of the assistant.

Similar shower-baths are appropriated to gentlemen. The whole forms one of the most elegant and perfect establishments of the kind I have ever seen, and is a source of emolument to the spirited proprietor.

I inquired anxiously into the medical efficacy of the Russian vapor-bath, and found that in chronic rheumatism, in the stiffness of limbs consequent on gout, and other long continued inflammations, in some cases of palsy, in various cutaneous diseases, it is a most powerful and valuable remedy. While in the establishment I saw an invalid enter, who informed me, that, after severe acute rheumatism, of several months' duration, he was so lame that he had been carried by two persons into the bath; but that, after five or six times undergoing the discipline I have described, he could walk alone as well as I saw him (he had walked, aided by a stick, from his house to the bath), and appeared confident that in a little time he should entirely recover the power and flexibility of his limbs.

From all that I could learn in Hamburgh, I am inclined to consider the Russian vapor-bath as a most valuable remedy in some chronic diseases, and regret that we have not a similar establishment in any of our medical charitable institutions.

February, 1832.

ART. XII.—*Notice of a Cetaceous Animal supposed to be new to the American coast; by* WILLIAM SAMPSON.

Read before the New York Lyceum of Natural History, Nov. 4, 1832.

THIS animal belongs to the eighth order of Mammalia which is grouped under the name of *Cetacea*. It is naturally arranged under the sub-genus *Phocæna* of Cuvier, which comprises the Porpoise, Grampus, and a few others which are not yet sufficiently known or distinguished. This genus is characterized by a single dorsal fin, and the short, abrupt and rounded head without the elongated beak. It has numerous teeth in each jaw. This had twenty teeth in the upper and eighteen in the under jaw, increasing in length towards the middle of each jaw, with a space between the teeth equal to the diameter of the tooth, so as to admit the teeth of the opposing jaw to shut into the interstice. The teeth were canine in their form and incurvated somewhat suddenly towards the point. The longest teeth were about three quarters of an inch out of the jaw.

The individual, under consideration, belongs to the species *Globiceps*, which was first accurately described and delineated by Cuvier in the Annals of the Museum. This animal, although now for the first time identified here, is by no means a stranger to our shores. Ten years ago a shoal, which amounted to near one hundred, came ashore on Welfleet near Cape Cod. In the notice which appeared in the papers they were called Black Whale-fish, and were described as being from ten to twenty feet long; and it is added that they were once common near these shores, but had not appeared here for many years previous. It is also stated to be a peculiarity of these animals, when they find themselves in shallow water, that from fright or other causes they run ashore and perish. They are common on the coast of Scotland; and Doctor Hibbert, in his account of the Western Isles, has given an amusing description of a whale hunt in which hundreds of these animals are captured in a day.

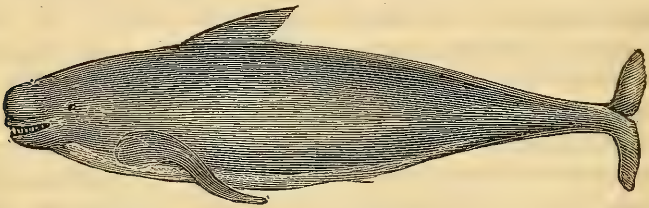
This same animal has also been described and figured in the Journal of the Academy of Natural Sciences, but the ingenious author of that description has considered it sufficiently distinct to merit a new name. The only striking difference appears to be in the stricture near the tail, which may have been an error of the engraver in the endeavor to represent the peculiar carina on the upper part of the body where it approaches the tail, and which terminates at the extremity of that member in a point, where the two lobes are separated by a small indentation. Or this appearance may have been produced in that particular individual by some extraneous and accidental cause; which idea we are more inclined to adopt, as the accomplished naturalist to whom we are indebted for that notice, had no opportunity of examining the animal in person.

The specific description of Cuvier will perfectly distinguish our new acquaintance, or we may employ the short specific phrase PHOCÆNA GLOBICEPS. Head very globular, carina extending to the extremity of the tail; pectorals long and slender.

Occasional *habitat.* Shores of the Eastern States.

Synonyms.

Delphinus globiceps. Cuv.: Ann. Mus. tom. XIX, pl. 1, fig. 2.
Ca-ing Whale. Neill's Tour in the Orkneys.
Delphnis —— Schreber, pl. 345, fig. 2 and 3.
Delphinus melas. Traill.: Nicholson's Jour., Vol. XXII, p. 81.
Delphinus deductor. Scoresby: Arctic Regions, I, p. 496, pl.
Dauphin a tête ronde. Desmarest: Mammalogie, p. 519.
Delphinus intermedius. Harlan: Jour. Acad. Nat. Sc. of Philadelphia, Vol. VI, p. 51, pl. 1.



The following are the dimensions of the animal as measured by John Glover, Esq., Dr. Blakeman, of Greenfield Hill, and W. Sampson. The above drawing was taken upon the spot.*

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* The following notice appeared, at the time, in the public papers.

A whale ashore.—On Friday last, a whale of the grampus species, was driven ashore on Fairfield Beach, about three miles from Bridgeport, Conn. He was about twenty four feet long, and thirteen in circumference; he lived from ten o'clock in the morning until three in the afternoon, when he expired after an hour of terrific struggling. Six yoke of oxen were required to draw him a few feet from low water mark, and fifteen men were scarcely able to turn him half way over. He was first discovered by a person who was gunning in the neighborhood, when he was in full vigor, and made a splashing in the shallow water that almost equalled the roar of a cataract. Thousands flocked from all quarters to see the self-imprisoned monster.

	Feet.	Inches.
Total length, - - - -	20	6
To the pectoral, - - -	3	
To the origin of the dorsal, - -	5	8
Length of the base of the dorsal, -	3	8
The greatest depth, - - -	3	11
Height of dorsal, - - -	1	4
Length of pectoral, - - -	3	0

Art. XIII.—*Documents in Commemoration of* Baron Cuvier.

Translated for this Journal by Prof. Griscom.

1. *Memoir of G. Cuvier; by* A. DeCandolle.

Europe has sustained an immense and irreparable loss. George Cuvier died on the 13th of May last, after an illness of four days by a paralysis of the throat, which rapidly reached the organs of respiration. He was only sixty three years of age, having been born in the month of February of that year (1769) which produced so many remarkable men,—Napoleon, Chateaubriand, Walter Scott, &c. His native town, Montbeliard, since united to France, was then a principality in alliance with Switzerland and dependent on the Duke of Wurtemberg. His early studies were pursued at the Gymnasium of Stuttgardt, and he commenced his career by entering as a sub-lieutenant of the Swiss regiment of Chateauvieux: the dissolution of this corps restored him to liberty, and he passed the whole of the turbulent period of the revolution in the business of education on the borders of the sea in Normandy. It was there, as a first essay of his talent, he made his great anatomical discoveries on the mollusca, and overthrew the zoological classifications which had been universally in vogue since the period of Aristotle.

This work, published in 1795, fixed upon him the attention of the learned world. Geoffroy St. Hilaire had the honor of first perceiving the importance of his discoveries, and contributed to the advancement of their author. Cuvier was called almost immediately to take a part in the class of science of the Institute, and to supply the place of the aged Mertrud as professor of comparative anatomy in the Garden of Plants. His lectures soon became remarkable for their clearness and eloquence, and attracted crowds of students. He appeared at this time to be threatened with phthisis, and he has often since observed that the exercise of his professorship, by giving activity to his lungs, restored him to health. Being appointed professor of natural history at the central school of the Pantheon, he dignified that station by the publication of his *Tableau du Règne Animal*, which, notwithstanding its elementary appearance, has served as the basis of all subsequent labors in classifications of zoology. He published, a short time after, his *Leçons d'anatomie comparée* (five volumes in 8vo.) which were afterwards designated by the Institute as having merited the grand decennial prize for the work which had contributed most to the advancement of knowledge in relation to the natural sciences. This work, abridged from his course, was edited under his inspection, at first, by his friend Dameril, and then, (the last three volumes) by his relative, M. Duvernoy. At the same period he published a series of memoirs on the anatomy of the mollusca, and then entered upon a detailed examination of the fossil relics of mammiferous animals. He devoted his attention particularly to the numerous fossils of the environs of Paris, and was assisted in the geological part of his labor by his friend Alexander Brongniart. The sagacity and precision which he bestowed in the determination of fossil bones, erected his study into a new science, which has thrown a brilliant light upon geology, and given it a far more philosophical direction. A multitude of learned works and profound memoirs published since that time by various naturalists, have demonstrated the prodigious influence which the labors of Cuvier have exercised over the study of geology, of the animal kingdom, and even on that of vegetable fossils. M. Cuvier refreshed himself in the intervals of those extended works, by special researches, which would have been sufficient to add lustre to any other man;—such are his beautiful memoirs on the chaunt of birds, on crocodiles, and on a great number of the diversified topics of zoology; such are, also, his description of the living animals of the menagerie, &c. On all subjects, even of the minutest detail, we observe that clear, luminous and methodical spirit and that sagacity which so remarkably characterized him.

He perceived the necessity of arranging the totality of the knowledge he had acquired on these subjects, and presented the public in 1817, with a general view of zoological classification. This work, entitled *Le Règne Animal distribtué d'après son organization* (4 vols. 8vo,) became immediately the basis of all zoological study. In most of the schools, the lectures, collections and researches were subjected to its guidance; a second edition which has since appeared, has proved its success. Cuvier was assisted in this labor by his friend Latreille in the class of insects, which is alone more numerous than the whole of the animal kingdom besides, and which would require the entire life of a laborious naturalist; but he had induced this able entomologist, to deviate in some respects from his accustomed track, in order that his portion might quadrate with the other parts of the system.

The arranging of this work enabled its author to perceive how greatly the study of fishes was in arrear with other divisions of zoology. It taught him the difficulties which had accumulated in this branch of science, both by the obscurity of the anatomy of these animals and the impossibility of discovering with precision the laws of the comparison of organs, by the want of large collections, and perhaps also by the too artificial methods which had till then regulated the study of Ichthyology. He used his influence in procuring for the Museum of Paris, specimens of fishes from all parts of the world, and such was his success in this search after the materials of his science, that the number of fish in the museum, which scarcely exceeded a thousand species, was increased in a few years to about six thousand. He anatomized a great number of them with a care before unknown. He associated himself in these details, Mr. Vallenciennes, a meritorious young man, with whose aid he was enabled in a space of time, which considering the immensity of the results, may be deemed very short, to form the elements of his great work on the history of fish, the first volumes of which have appeared, and the conclusions of which may be expected from his laborious coadjutor. The recent embarrassment of the book trade somewhat retarded its progress, and as the portion digested was in advance with the press, he was revising his lessons on comparative anatomy, preparatory to a second edition which has been long and greatly wanted. "It will be (he wrote on the 26th of April, to the author of this brief memoir) almost a new work, so numerous are the facts derivable from our immense collections, and from the labors of other anatomists since the first edition; but I see with pleasure that the frame of it will need but little change, and that it is still preferable, (at least in my opinion) to the plans which have been since adopted by other Savans. Nevertheless, (adds he) I shall by no means renounce (if I live) my labors on the large comparative anatomy, for which I have already thousands of large drawings." This project constantly cherished, and at which he had labored so many years, seemed to him to be a needful finish to all his works; but the melancholy doubt expressed in his letter (if I live) was but too soon verified. It would be the most appropriate honor that could be rendered to the glory of Cuvier to publish those original drawings, the perfection of which is known to all, and which, joined to the new edition of his comparative anatomy, would supply in part the great work which he had in prospect. Thus the man whose fruitful labors (not to mention his genius) all Europe has admired, has left, inedited, immense works, which would seem to demand the devotion of a whole life.

We may now ask, did this laborious attention to natural history, exclude him from other literary pursuits? Certainly not. Read the eulogies which he pronounced as perpetual secretary of the Academy of Sciences, in which pass in review so many men and so great a variety of subjects! From the depth of acquirements which he displayed, for example, in the account which he gave of the labors of Adanson, we are certain that none but a naturalist of the first order could have written it; but in reading his account of Bonnet, or Priestley we discover that no branch of human knowledge was foreign to him: in that of Lemonier, he betrays the man of sensibility, and the taste and graceful imagination of a scholar. Throughout these productions, are intermingled the most profound reflexions on the progress of science, the most penetrating views of human nature and of the social condition of the period in which he lived. In all is there intermingled that love of virtue, that feeling of the dignity of intellectual power which was one of the liveliest impressions of his mind: It is to this elevated sentiment that we must attribute the impartiality of his eulogies, of his reports, and his literary and scientific decisions, the entire absence of all intrigue, the zeal which he manifested for all the establishments with which he was connected, the ardor with which he protected and encouraged young men of talents, and the noble disinterestedness which induced him to spare no expense in the prosecution of his scientific labors.

His talents for administration were at first displayed in their influence upon natural history. He may be said to have almost created, (so graat were the changes and enlargements which he effected) the cabinet of comparative anatomy which constitutes one of the most admirable portions of the Paris museum of natural history, now the admiration of Europe. Frequently placed, by the choice of his colleagues, at the head of that establishment, he powerfully contributed to its progress, and introduced into the details of its administration his wonted activity and method. Called to coöperate in the direction of public instruction, first as an inspector of the University, then as a member of the council of public instruction, as chancellor, as head of the several faculties, he was through all distinguished by the same qualities: his report on the primary instruction of Holland is a monument of his solicitude for popular education, and all those who have traced him through the higher classes of study, know how much good he has effected and how much evil he has prevented! This latter benefit, less known than most others, always springs from an elevated mind, which disdains the applauses of the day for the reality and utility of the future. Gradually introduced into the field of civil administration, *maitre des requêtes*, counsellor of state, president of the section of the Interior, director of protestant worship, and finally peer of France, he traversed the circle of administrative functions, except those of Censor, which he nobly refused when offered to his acceptance. He evinced, in all these appointments, that superiority for which no one contended with him in science: he became as familiar with the laws, regulations, and even the minutiæ of official acts, as with the body and details of science. His colleagues, wholly devoted to the business of administration, were every day astonished at his wonderful capacity.

That head, morally as great as it was physically capacious, seemed to be the depositary of all human knowledge. He had, throughout his life, read much, observed much, and forgotten nothing. The gigantic memory sustained and directed by a severe logic and a rare sagacity, was the principal basis of his immense and successful labors. That memory was remarkable, in a special manner, for all that has relation to forms, considered in the most extensive sense of the term. The figure of an animal seen in reality or in a drawing, was never forgotten, and served as a standard of comparison for all analogous objects: the sight of a chart, of the plan of a city, was sufficient to preserve his intuitive knowledge of places; and amidst so many faculties, that memory which may be called *graphic* seemed the most evident. He was consequently an able draughtsman; he seized forms with justness and rapidity, and had the art of giving by the pencil an appearance of the tissue of organs in a manner suitable to his purpose. What the Italian sculptures call *morbidezza* in statues, he produced in a superior manner in his anatomical drawings.

In the midst of so busy a life, he was far from neglecting the attractive accomplishments of social intercourse; his conversation, sometimes grave and solemn, sometimes keen and witty, always just, circumspect and original, constituted the ornament of the saloon and the charms of intimacy. He was a warm, sincere and faithful friend. He gained the hearts and affections of those who surrounded him, and the skill with which he directed the efforts of others towards their proper end, was not one of the least of the causes of his remarkable success. His perseverance in friendship, his gratitude towards those who contributed to his youthful advancement, his moderation in all disputes, the devotedness with which he inspired all his dependents, are testimonies of those qualities of the heart and explanatory of that moral empire which can be obtained only by depth and sincerity of feeling. He was associated with hearts worthy of his own; his wife, his daughter in law, angels of kindness, of grace and resignation in his misfortune, lived only to render him happy. His brother, a man of distinction, and who could have appeared still more so had he not been placed by the side of a giant, was his true and faithful friend. His domestic life, which might have been so happy, was greatly troubled. Three sons in their minority, preceded him to the tomb, and his daughter, a model of grace and virtue, was taken from him when on the eve of a hymeneal union which promised the greatest happiness. Of the four children of his wife by a former marriage, and whom he had adopted in a true paternal spirit, two were removed by death at an age in which dangers appeared to be past and hopes brightening into reality. Oh! what balms to a wounded mind, what consolation in trouble is the love of labor, the love of truth and of public good! How numerous are the friends that I could name, were I permitted to go beyond the circle of natural ties in which so many claimed his affection, who were dear to him and who loved him tenderly. The homage rendered to the moral qualities of Cuvier might, I am sensible, appear like exaggeration. He who draws this hasty outline was a friend of thirty four years' standing, and who held his heart in higher honor even than his celebrity, but although he writes this in tears, he has conscientiously described, very imperfectly indeed, but with truth, the traits of that eminent man whose loss Europe now deplores.—*Bib. Univ. Avril*, 1832.

2. *Subscription for a monument to the memory of* G. Cuvier.

At the session of the academy of sciences at Paris on the 9th of July, 1832, the following prospectus was distributed among the Academicians.

The unexpected stroke which has taken from us our great naturalists, has spread mourning not only throughout France, but in all parts of the globe where science is held in honor. George Cuvier was one of those privileged geniuses which appear only at long intervals.

France has been long distinguished for the love and respect which she bears for the great men whom she has produced; she knows that they constitute her highest glory, and this glory must survive all other.

France knows also, that at the period in which we live, it is more than ever important to draw more closely the fraternal band which unites enlightened men of every nation; she will not be diverted by the political agitations which are working within her, from the great duty which this noble confraternity imposes upon her.

The king has already confided to the chisel of one of our ablest statuaries the task of reproducing for the academy of sciences, the features of the immortal Cuvier.

The town of Montbeliard will consecrate, by a monument, the honor of having given him birth.

These homages are insufficient, to honor the memory of him whose labors have benefited the whole human race. Public opinion calls for something further; it is the wish that a general subscription should invite the friends of science in all nations to concur in the public honor which it claims for the Aristotle of modern times.

Subscribers have presented themselves from all quarters; the learned bodies literary and political, of which Cuvier was a member have been in earnest to lead the subscription.

To consider of the means of collecting these subscriptions, and concerting upon the nature of the monument to be raised, it appeared most suitable to form a joint committee of members of the Institute of the University, of the Council of State, and of the Society of natural history.

This joint committee has not hesitated with respect to the proper place for the erection of such a monument: what place indeed could possibly be more appropriate than the garden of plants, the theatre of all the labor of Cuvier.

With respect to the monument, the amount of subscription will determine its nature and importance. It may, however, be primarily understood, that an essential part of it will be the statue of him whom it honors.

At a time when every country seems to be agitated with political convulsions, it will be interesting to witness the elevation of a peaceful monument, which will attest to future ages, that neither the rivalship of nations, the spirit of party, nor the war of opinions has been able to divert the men of our age from the respect which in all places is held to be due to letters and to science.

N. B. At the invitation of the minister of public instruction, the receivers of colleges and the money agents of the university academies will receive the subscriptions of the departments. The Consuls of France in foreign countries will be willing to perform the same service. M. Cardot, the special agent of the Institute, will hold the central purse, and will also receive the subscriptions of Paris.

This programme will be addressed to all learned societies.

In all cases in which the amount of the subscription is sufficient, the subscriber will receive an engraving representing the monument and the traits of M. Cuvier.

(Signed) Jouy, of the French Academy; F. Arago, Perpetual secretary of the Academy of Sciences; Geoffroy-Saint-Hilaire, Vice President of the Academy of Sciences; Dureau DeLamalle of the Academy of Inscription and Belles Lettres; Degerando, Counsellor of State, Member of the Institute, President of the Committee; David of the Institute; Villemain; Duparquet, Secretary of the Committee; A. Brongniart, President of the Society of Natural History; Percier, Architect, Member of the Institute.

3. *Perpetual Secretary in the room of* G. Cuvier.

The committee appointed to propose a list of candidates deemed this step to be unnecessary, as all the members of the Academy were sufficiently acquainted with all who had any pretensions to the station. While the votes were being collected, it was rumored through the hall that Geoffroy-Saint-Hilaire renounced his candidature. The number of votes given in was forty five, of which *M. Dulong* had twenty; *M. Flourens*, eleven; *M. Geoffroy*, seven; *M. Bendant*, five; *M. Dumeril*, one; blank, one.

Their being no majority, a second balloting took place, when *M. Dulong* received thirty votes, and the president proclaimed the election in his favor.

4. *Chair of Comparative Anatomy in the room of* G. Cuvier *at the Museum of Natural History.*

The committee presented as candidates MM. *Flourens*, *Serres*, *Geoffroy-Saint-Hilaire*, *Dumeril* and *DeBlainville*.

The number of votes deposited in the urn was forty five, of which DeBlainville had twenty two; Dumeril, twenty; Flourens, one; blank, two. DeBlainville was declared elected.

Session of July 23.

A letter of condolence on account of the death of Cuvier, addressed to the Academy, was received from the secretary of the Royal Institution of Great Britain. "Cuvier," says this letter, "by the power of his genius, and the vast extent of his knowledge, held the most eminent rank in science which it is given to man to attain. His death is not a loss to France only, but to the whole world. The Royal Institution which reckoned him in the small number of its foreign honorary members is forcibly impressed with an event which deprives it of the lustre which his name reflected upon it, and of the example held forth by his admirable works."—*Rev. Encyc. Juillet*, 1832.

Art. XIV.—*Notices of American Steam Boats; by* W. C. Redfield, of New York.

The increase in the number of steam boats in the waters of the United States, within the last fifteen years, which has not failed to excite both surprise and gratulation, is hardly greater than the improvements which have been made in their structure and efficiency. Before the commencement of the period alluded to, the steam en-
ne had been brought nearly to the maximum of its efficiency, as a
ng power, and the adaptation of its energies to the purposes of
gation, though less advanced, was supposed to have nearly reach-
the same stage of perfection. About ten years since, the steam
ts which navigated the river Hudson, and which were doubtless
erior to any others of that period, performed the passage between
w York and Albany, in from eighteen to thirty hours, according
he favor of circumstances: five years later, and from one to four
ly laden vessels, each of more than two hundred tons burthen,

were *towed* through the same rout, by a single steam boat, in an equal range of time.

The power and speed of the Hudson river steam boats, as well as those employed on the Mississippi and elsewhere, have continued to be annually increased, up to the present time. In the year 1827, the passage between New York and Albany, which is supposed to be equal to one hundred and fifty statute miles,* had been performed under favorable circumstances, in about twelve hours. In 1829, this passage had been accomplished in ten hours and thirty minutes, and in 1831, in ten hours and fifteen minutes; all the stoppages on the river being included in these statements. But the giant offspring of science and the arts had not yet attained its full strength and maturity, and during the present season (1832) the passage has been performed in *nine hours and eighteen minutes*, including the time spent at the different landings. Claims to this rate of speed, have also been set up by more than one competitor. It appears highly probable, that with the means now possessed or in preparation, the passage may yet be performed in something less than nine hours, nothwithstanding the obstacles presented by the shallowness of the river and the intricacies of the navigation, in the thirty miles nearest to Albany. It may be remarked here that the length of the route as above given, is not supposed to be overrated, as is usually the fact with inland navigable routes; nor can the assistance of the tides in ascending the river be fairly estimated at more than one mile per hour, on an average of the whole distance; while, in the descending passage, little or no advantge can be derived from this source, because the ebb and flood are then made to alternate in three hours, or even in a shorter period. Twelve landings are usually made on each passage, and at six of these places, the steam boats are commonly brought to, and fastened to the wharves.

Those who are conversant with the difficulties which attend the attainment of high velocities in navigating a medium whose resistance accumulates in a ratio exceeding the squares of the velocities by means of an artificial power, the reaction for which, is obtained through the medium itself, will justly consider the above rates of speed truly extraordinary. Nor will this view of the subject be weakened [illegible]

* The distance between the two points by the river road is reputed to be equal to one hundred and sixty two miles. The direction or course, of the channel of the river, though generally favorable, ranges between west, and east-north [illegible]

statements, which may chance to gain currency, of the attainment of greater speed in more open waters, by steam vessels, possessing less comparative efficiency, on routes either overrated in their extent, or affording great occasional advantages, from the strength and rapidity of the tides. It sometimes happens, that, owing to the inadvertence of a compositor, or some other cause, a mistake of an hour finds its way into the published accounts of the passage made by a favorite steam boat.

In addition to twelve steam boats which are employed on this river in the various lines of transportation, and on short routes, there are ten boats of the first class which have been employed in daily trips for the conveyance of passengers between New York and Albany; viz. the North America, Albany, Novelty, Erie, Champlain, Ohio, New Philadelphia, De Witt Clinton, Constitution, and Constellation. Of these, the five first named depart in the morning at seven o'clock, and perform the passage in nine and a quarter to thirteen hours; the latter five, depart usually at five in the evening, and accomplish the passage in nearly the same time. Passengers in the former, may enjoy airy accommodations, and the interesting scenery of the Hudson, together with their accustomed repose at night; and by means of the latter, men of active and provident habits, are able to transact their daily business at will, either in our commercial metropolis, or in one of the flourishing cities at the head of navigation; the intervening space of one hundred and fifty miles being passed over during the hours of relaxation and repose, with no other discomfort, than attends the occupation of a good matress with clean linen, in a steam boat usually loaded with passengers. The price of passage is commonly fixed at three dollars.

Most of these boats have undergone a material change in their size, form, and general outfit since their first construction, in order to maintain a successful competition for the business of this noble river. It will not be necessary to give an account of the various efforts of professional skill, by means of which these boats have attained to their present degree of perfection and efficiency, but a general, and somewhat definite description of one of the number, may prove acceptable to the readers of the Journal.

The *De Witt Clinton*, having been twice enlarged, is now of the following dimensions, viz. entire length on deck, two hundred and thirty three feet. Breadth of the hull at the water line, twenty eight feet. Projection of the deck or wheel-guards on each side, eighteen feet. Maximum width of deck, including guards, sixty four feet. Depth of hold, ten feet. Height of the upper deck, eleven feet. Length of the great cabin, one hundred and seventy five feet. Draft of water, not exceeding four feet six inches. Diameter of the water-wheels, twenty two feet. Length of the same, measured on the buckets, each wheel, fifteen feet. Dip of the buckets or paddles, thirty seven inches. Diameter of the iron water-wheel shafts, fourteen inches. Length of the crank, five feet. Length of the stroke made by the piston, ten feet. Diameter of the piston, sixty six inches, its superficies being equal to three thousand four hundred and twenty one square inches. The gross length of the working cylinder, which is placed in a vertical position, is eleven feet, ten inches. Its lateral apertures, by which the steam is received and discharged, are forty two by ten and three fourth inches. The engine is worked by means of four circular receiving valves, each of seventeen inches diameter, (two at either end of the cylinder,) and four exhausting valves of the same dimensions. The diameter of the main steam pipe, and side pipes, is twenty five inches.

The entire capacity of the cylinder, deducting the space occupied by the piston, and including one of the side apertures extending to the valves, is equal to two hundred and fifty two cubic feet, which is equal to one thousand eight hundred and ninety standard wine gallons, or to *sixty three* barrels of thirty gallons each. Should the engine perform twenty six revolutions or double strokes per minute,* there will be exhausted 13.104 cubic feet = 3276 barrels, per minute, and 786.240 cubic feet of steam, or 196.560 barrels, will be exhausted every hour, during the time in which the engine is in full motion! But the steam is allowed to enter freely from the boiler, only during a part of each stroke, the throttle valve being then closed, and the steam which has previously entered the cylinder is allowed to expand during the remainder of the stroke. If the pressure of steam maintained in the boilers be equal to twenty pounds per square inch above the mean pressure of the atmosphere, (and greater pressure is frequently employed in these boats,) the average effective pressure on the piston may be safely estimated, even with less pressure, at about ten pounds for each square inch of its superficies.

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* The engines of some of the Hudson River boats are often seen running at the rate of twenty eight double strokes per minute, the velocity of the piston being five hundred and sixty feet per minute.

To this must be added the *net* pressure of the atmosphere, obtained by the use of the condenser and air-pump, which is fully equal to ten pounds to the inch, the vacuum in the condenser ranging generally from twelve and a half to thirteen and a half pounds to the inch, by the barometrical guage. This estimate which is obtained by near approximations, will give an average pressure on the piston, equal to twenty pounds to the square inch ; but lest we should be charged with overrating, we will reduce it to sixteen pounds, effective pressure to the square inch, on three thousand four hundred and twenty one inches of piston, running fifty two single strokes, of ten feet each, per minute. Estimating now the full power of a horse as equal to one hundred and fifty pounds, moving at two and a half miles an hour, or to raising thirty three thousand pounds one foot per minute, we have the following formula ; $\frac{3421 \times 16 \times 52 \times 10}{33.000}$ $=\frac{28462720}{33.000}=862$, showing a force exerted upon the engine which is equal to the power of eight hundred and sixty two horses. From this result we are to deduct the power necessary for moving the engine, or that required for overcoming the friction and resistance of its parts, which is comparatively less in engines of this magnitude, working on such an extended crank, than in the average of smaller engines. We will estimate it, however, as equal to one third of the force applied, which gives the effective working power of the engine as equal to that of five hundred and seventy five horses! An engineer with whom I have conferred, and under whose direction several of the engines in these boats have been constructed, estimates the net effective pressure, *exclusive of all deduction for friction, &c.* as equal to twelve pounds for every square inch of the piston. This may be nearer the truth, and gives the working power of this engine as equal to six hundred and forty six horses. Such results may at the first view appear to be of a startling character, even to professional readers, but having been arrived at by gradual approximations, they seem hardly to have attracted the attention, either of men of science, or practical engineers.

The following may be given as a summary statement of the principal dimensions of the other boats which have been named, and which, if not minutely correct in all its particulars, is sufficiently so for purposes of general information. The Champlain, a new boat, is one hundred and eighty feet in length, twenty eight feet beam on the water line, and has two engines of forty two inches cylinder and ten feet stroke, which with wheels of twenty two feet, run from twenty six to twenty eight revolutions per minute. The Erie, also, a new boat, is of the same size, and somewhat greater power, her cylinder being of forty four inches diameter.* The North America is two hundred and eighteen feet in length, including a cut-water bow, (which has also been affixed to most of the other boats,) thirty feet beam, and has also two engines with cylinders of forty four inches diameter, and eight feet stroke. The Albany is two hundred and seven feet in length, twenty six feet beam, and has one engine of sixty five inches cylinder, and nine feet stroke. The Ohio is one hundred and ninety two feet in length, thirty feet beam, and has one engine with cylinder of sixty inches diameter and nine feet stroke. The New Philadelphia is one hundred and seventy feet in length, twenty four in breadth, and carries one engine of fifty five inches cylinder and ten feet stroke. The Constitution is one hundred and forty five feet in length, twenty seven feet beam, and has one engine of forty two inch cylinder and nine feet stroke. The Constellation is about one hundred and forty nine feet in length, twenty seven feet beam, and carries one engine of forty four inches cylinder, and ten feet stroke. The Novelty is about two hundred and twenty feet in length, twenty five feet beam, and has two engines with cylinders of thirty inches in diameter and six feet stroke, working horizontally, using steam of higher elasticity, and dispensing also with the use of a condenser and air pump. Most of the above steam boats carry their boilers on the wheel-guards, entirely without the body of the boat. The Erie and Champlain carry each four boilers, and the same number of chimney pipes. The Novelty has four *sets* of boilers, of about forty inches in diameter, three in each set, and carries also four chimneys.

Little apprehension in regard to personal safety is now entertained by persons travelling in steam boats. At a former period, two commodious safety barges were employed on the Hudson, which, in order to obviate all danger arising from this source, were devoted exclusively to passengers, and towed at the stern of a steam boat. These barges which were run during the summer season from 1825 to

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* These two boats run to the city of Troy, a prosperous and beautiful town, situated six miles above Albany. A large lithographic drawing of these steam boats, including also a sketch of the scenery in the Highlands of the Hudson near the mountain called *Anthony's Nose*, has been published by the company owning the boats.

1829, had attained to a speed of eight to nine miles per hour; but the increase which, during the same period, was given to the speed and size of the steam boats, tended to discourage this mode of conveyance, and it has since been discontinued, to the regret of those who love quiet enjoyment, and whose nerves have not been inured to composure by frequent proximity with the moving power.

It has been frequently remarked that the exposure to fatal accidents on board of steam boats, is much less than attends the use of the ordinary means of conveyance, either by land or water, and it has been suggested, that the average loss of life by steam boat explosions, is even less than is annually occasioned by lightning. In order to test the accuracy of this suggestion, I have noted during the present year, such accidents by lightning, as were attended with fatal results, so far as the same have come to my knowledge. The whole number of cases thus ascertained is *twenty six*, which were distributed as follows. In New Hampshire, 1; Massachusetts, 1; Rhode Island, 1; Connecticut, 2; New York, 7; Pennsylvania, 5; Delaware, 3; Virginia, 1; South Carolina, 2; Louisiana, 2, and Illinois, 1. It is hardly to be supposed that this statement comprises one moiety of the whole number of fatal casualties of this kind, which have occurred in the United States during the past year, and it comprises but a single accident, in the four great states of Virginia, North Carolina, Kentucky and Tennessee. In recurring to the list of steam boat accidents, which was recently published in this Journal,* it will be seen that the entire mortality from this cause, is estimated at three hundred in a period of twenty years, which amounts to an average of fifteen for each year. The loss of lives by the bursting of steam boat boilers, during the present year, I have recorded as follows:—Steam boat Post-boy, on the Mississippi, 1 killed; Ohio, on the Hudson, 5 killed and drowned; Adam Duncan, on the Connecticut, 1 drowned; Connecticut, in Boston harbor, 1 killed; Monticello, on the Mississippi, 2 killed.—Total, 10. Of this last number, as far as I have been able to ascertain, three were passengers, and the remainder persons who were employed about the engine, showing that the risk to passengers is extremely small.

What further improvements in safety, or speed, are yet to be elicited in the art or science of locomotion, time only can shew us. The steam boat, a short time ago, appeared to our view, as the *ne plus ultra* of human effort, but the successful application of steam power on rail-

* Vol. XX, pp. 336—338.

roads, has already rivalled, if not greatly surpassed, our achievements in steam navigation. It is however, probable that the maximum of useful effect, has been nearly attained in both these departments, which, when practically considered, will be found auxiliaries, rather than rivals, to each other. The art of obtaining the full power of steam, and of applying it to the purpose of locomotion on a fluid which sustains the load and affords sufficient reaction for the moving power, is now well understood; and in regard to railroads it is doubtless true, that *a level metallic surface, not only sustains the vehicle, in the most perfect manner, but affords the least possible resistance, with the best possible reaction for the propelling power, and combines, therefore, the greatest conceivable facilities for the transit of persons and property.** Other expectations, which are often entertained, without due consideration, will doubtless end in disappointment. It is to the establishment and extension of these unequalled means of conveyance, that the enterprise of our growing country should be directed. It has been truly said that the career of improvement in our age, is too impetuous to be stayed, were it wise to attempt it, and "though it be a futile attempt to oppose so mighty an impulse, it may not be unworthy our ambition, to guide its progress, and direct its course."

Art. XV.—*On the Economy of Fuel with reference to its domestic applications;* by Walter R. Johnson, Prof. of Mechanics and Natural Philosophy, in the Franklin Institute, Philadelphia.

The art of heating apartments in the most economical and salutary manner, is of truly vital importance to the interests of society. Connected with this, the art of ventilation stands preëminent, and with *both* the art of constructing dwellings and other buildings, is intimately related. In all our larger towns and particularly in our maritime cities, the annual expenditure for fuel is enormous. New York and Philadelphia are believed to pay each, not less than twelve hundred or fifteen hundred thousand dollars per annum, for *combustibles*, to be employed either in domestic uses, or in manufactures. In respect to both

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* It may be noticed, that the power employed for propelling a single steam boat of the first class, is equal to that of fifty locomotive engines of the power of twelve horses each. These would probably be adequate to the conveyance of all the passengers and property now transported upon the Hudson river, if the same were transferred to a level rail way of equal extent.

of these objects, but particularly the former, the most astonishing disregard of economy is often perceptible, as well in the arrangements for burning, as in the manner and extent in which the heat is applied.

So long as the original forests of our country were standing, little importance was attached to this branch of economy. The burning of a huge mass of *cord-wood* in a broad open-mouthed chimney, supplied to a certain extent, the desired temperature, and involved as a consequence, the production of such currents of air as effectually prevented stagnation in the atmosphere of apartments. Hence the occupants were seldom exposed to the peculiar maladies which arise from a stifled air.

Indeed, the rude and almost primitive method of heating apartments, then in use, rendered their inmates subject to a contrast of sensations, quite as striking as that paradox, which the philosopher exhibits, when by the ebullition of one liquid, he causes the simultaneous congelation of another. The chilling blast which assailed one part of the person, vied strangely with the scorching radiance which beset the opposite.

The present expensiveness of fuel, renders it desirable to arrange our houses in some manner different from the ancient method; so as at once to limit the consumption of fuel, and to secure an ample supply of wholesome air. The latter requisite is too often sacrificed to the mere elevation of temperature. Not only is the composition of the air allowed to be deteriorated by frequent respiration, but its hygrometric state is sometimes such, as to operate most injuriously on the system. Nature is, in general, careful to supply our lungs with air capable of receiving from them some portion of moisture; if this portion be either too great or too small, the lungs, and eventually the whole body, will suffer either from the excess or the deficiency. To regulate this quantity is one part of our own duty.

The gradual introduction of mineral fuel, especially of anthracite, will probably introduce some changes in domestic arrangements, which will supersede the use of those more bulky, troublesome, and unsafe materials, heretofore employed in combustion. The consequences of such changes, if judiciously made, will doubtless be the diminution of expense, the saving of labor, the gaining of comfort, and the economizing of space and time.

Those awkward projections which now encumber and *deform* our apartments, under the name of chimnies, filling, in many cases, from one-twentieth to one-sixteenth of the whole area of the room, and that too on every floor from the cellar to the garret, will be wholly excluded. This expenditure for land on which to build chimnies, is no mean item in the first expense, and is anterior to the building, as well as to the maintaining of a chimney. Even admitting that one-thirtieth only of the ground were thus uselessly encumbered by the stacks of chimney, the aggregate loss on the original investment would still amount to no mean sum for the population of a large city. The *cost* or *rent* of ground, on which to build chimnies, is therefore, the first object to be economized. The next item in the expenditure is the *construction* of chimnies and fire-places, including the materials and the various furniture, either for use or for decoration,—the bricks, the marble, the brass and the iron; the fenders, the hearths and hearth-rugs, the mantles and their ornaments, elegant or tawdry; and the glasses; that have been invented in all possible variety for no other conceivable purpose but to hide the *deformity* in question.

But we have not yet done with the taxation to which the inhabitants of large cities submit for the purpose of warming the *air above their chimney tops*. There comes an incessant call for kindling materials, for wood, for bark, "chips," charcoal, or the rather less evanescent, but far more *fumitory* cannel coal. There is the labor of one or more domestics almost constantly kept in requisition to build or to renew fires, to watch for falling brands and wipe from tarnished furniture the clouds of ashes, dust, and smoke. There is not *seldom* found the noise of shovels, and tongs, the distressful, asthmatic, respiration of the bellows; the far spreading odor of a scorched hearth rug; the soon frayed and tattered carpet, cut though by fragments of combustible, crushed beneath the feet, and worn threadbare by the incessant application of the broom.

But if the present mode of heating apartments is a grievous tax upon the purse, how much more upon the person? How many of the long catalogue of diseases, incident to our citizens, may be traced to the unequal and ever variable temperatures to which the mode of heating houses now exposes them? Even admitting that a uniform temperature has been obtained in the room chiefly occupied by the family, yet we seldom find the same heat prevalent throughout the house. The entries, staircases and other passages are in the cold weather exposed to frequent currents, of an icy chillness, even while the parlour suffers the torrid influences of a roaring fire. The current up the chimney created by the latter only serves indeed to increase the severity of the cold in the halls and passages by requiring a constant supply of fresh air from without. To pass from the parlour into the open air, seldom occasions much sensible inconvenience, because the person is suitably prepared by supernumerary garments, hats, bonnets, and hoods, coats, cloaks and belts, gloves, mitts and overshoes—to encounter the frosty rigor of the winter. But when we merely pass from the parlor to the "hall," or through the staircase to a chamber, we scarcely think of a similar precaution, and consequently encounter a fearful hazard by exposing ourselves to the opposite extremes of summer and winter temperatures without the slightest change of apparel. Nor are these exposures always of short duration. They not unfrequently extend to a length of time, during which no prudent person would venture to remain in the *open air*, at the same temperature, as the entry in which we stand, perhaps conversing,—or giving directions—or reciprocating compliments, or paying *cold* civilities. We retire at night to our lodging rooms which have been all day in a freezing state, and load ourselves with numerous and heavy coverings to keep off the cold,—or we sink into masses of feathers and down for the same purpose, thus stifling and enervating ourselves in the most effectual manner, instead of enjoying the elastic and refreshing curled hair matress which proved so agreable and healthful in summer. Or, we cause a fire to be lighted in the evening and heat up our lodging rooms for the former part of the night, only to become more sensibly dreary and comfortless in the morning. We descend to the breakfast parlor, and find that want of care, or want of skill, in a domestic, has allowed the fire to remain inactive till a late hour, or in removing the "*dust and ashes*" under which the family had been *humbled* on the preceding day, he had found it convenient to throw up the sash and admit a copious supply of cold air, which now begins to riot about the room, and at length takes full possession, driving from the house even that remaining vestige of comfort which the *walls*, warmed by yesterday's appliances had hitherto afforded. The true purpose of heating apartments is not merely, to allow the occupants to derive heat from a *direct exposure* to fire, much less from a *contact* with the source of heat. It is to supply in winter that equable temperature to our persons which nature has provided in summer. The means, too, of communicating it, ought to be similar, and that is, chiefly, through the warming influence of the air in which we move, and by the respiration of which, the due temperature of the vital organs is maintained. Although these truths are almost too obvious to require to be seriously urged in argument, yet such is the force of habit, as to render most persons insensible to the justness of this distinction; and to induce a supposition that *actual exposure to fire* is the only means of maintaining a comfortable condition of body, and a cheerful state of mind. But, do we ever sigh for the spectacle of a glowing fire in the days of July, or the evenings of August? Do we, at *that* season, contend that the parlor is void of *social* attraction, because it has no *brilliant grate*, or the breakfast room cheerless, because no "blazing hearth" is seen to greet our entrance? And *why* do we *not* shiver at the sight of a drawing room without its fire in *summer*, as well as in *winter?* Obviously, because the idea of discomfort is *then* in no way connected with the absence of firelight. And the same would be true of our apartments in winter, were we equally accustomed to be free from pain, and equally sure of beholding cheerful countenances around us, while removed from a sight of the *process of combustion.* So strong a prepossession has taken hold of many minds on this subject, that mere reasoning would probably not convince one in ten, that he would be able to endure a winter's evening without a sight of the fire. But I have seldom seen an individual, who when present in a room, otherwise heated, did not actually soon forget his *artificial want*, and become not merely reconciled to the deprivation of a glowing fire, but actually delighted with the summer-like influence which prevailed around him.

But aside from the mere consideration of temperature and from its variableness, when governed by the action of *fire within the apartment to be heated*, there is, in the very pleasure which we fancy to be found only in the sight of a fire, not unfrequently, an intermixture of pain and of peril, sufficient, one should suppose, to counterbalance all the good proposed by that peculiar arrangement of things. The eye is often pained and sometimes actually injured by the continued glare to which it is exposed. Resort is then had to screens or other defences to shield us from the blasting "excess of light" on which it has been our *pleasure* to fix our gaze.

Again, the radiation of heat, at first grateful, is by degrees increased until not only the face but the whole person is found in a glow far beyond what the system can safely endure. But the retreat which at length becomes necessary, is not always made until profuse perspiration has been induced, and then we remove to a distance at which the radiation is almost unfelt and where its effects on the air of the room has been wholly neutralized, by the currents from doors, windows, and other apertures. Thus is the body kept in a manner oscillating between extremes of temperature, until a confirmed "*cold*" or catarrh has taken possession of the system.

That pulmonary complaints should ensue, is but the natural consequence of this artificial variableness of climate, to which we are frequently exposed, and such a consummation has, it is believed, often been brought about by the *very prudent* caution of *keeping near a good fire* for a single evening.*

It were needless to enumerate the dangers to which the inmates of a house, and even the house itself are exposed where young children have free access to an open fire. The many appalling accidents which are annually recorded as resulting from this cause, are sufficient to make us desire some more secure method of keeping up an agreeable warmth among the tender objects of maternal and parental solicitude.

That the nursery may be secure from danger, recourse is had to close stoves; but in attendance upon these, many of the same evils are experinced which belong to the open fire. In apartments for the sick, and particularly when wood is the fuel, they are objectionable on account of the constant watchfulness, required for preserving a uniform temperature. Hence it is not in the construction only of houses and chimnies, or in the arrangements of receptacles for the burning fuel, that a want of economy is visible. The very manner in which the combustion is carried on, and the disposal made of its products, are widely at variance with philosophical principles. Every mode of producing combustion, in which more cold gaseous matter is allowed to approach the ignited mass, than is actually required for the support of combustion, involves a loss of useful effects dependent on the quantity and *capacity* of the gas, and on the elevation of temperature which it acquires by passing over the fire. But the quantity of unburnt air which passes up an open chimney where wood is consumed, bears a very large proportion to the gaseous products of the combustion. In stoves, the economy is but little better, especially where the gas-pipe passes almost immediately from the presence of the fuel into the chimney. The occupants of some an-

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* In a house heated in the manner hereafter described, there has for three winters been scarcely a cold, or any kindred disease experienced by the inmates. In the winter of 1831—32, when influenza was nearly universal, the family was wholly exempt from that troublesome and dangerous complaint.

cient dwellings are perhaps contented, that they can by closing the fire-place with a board, and conveying through this the pipe of a small stove, escape the dreariness incident to their former mode of consuming fuel. They do not appear to imagine that as the gas is red hot at the moment of entering the chimney, it would, if conducted a considerable distance within the apartments, be capable of imparting to the air of the room, several hundred degrees of its heat. The admixture of unburnt air is the evil of open grates and fire places; the escape of hot gas without discharging its proper office, is that of close stoves as now generally arranged.

The culinary operations of almost every family involve an immense waste of heat, and of heat too which might be turned to valuable account, were but a small portion of the ingenuity bestowed on less important subjects turned towards that much neglected branch of domestic operations. Philosophy is slow in descending to the kitchen. Nineteen centuries of time, and twelve hundred leagues of space, have not impaired the truth of the remark,

"COQUUS præter jus fervens, nihil *novi* potest imitari."

Indeed, a new process or a new fashioned utensil is often regarded by that important dignitary, as a signal for open hostility, or for a sullen retirement from the "*place*" which it has invaded. Hence from ten to twenty cords of wood are annually consumed in many a family for the sole purpose of cooking, while every other part of the establishment is supplied with anthracite. In economizing culinary heat, it seems probable that at least one half of all the fuel usually consumed in families may be saved.

The method proposed to be substituted for that which has been described, is one which has, under some modifications, been employed, to a limited extent, for heating public edifices, and on a still more limited scale, for the warming of private buildings. It consists in placing in the basement story, or in the cellar, (as the case may be,) a single furnace capable of effecting the combustion of as much fuel as will be required to heat all parts of the house. Where anthracite is employed, this arrangement is perhaps more desirable than where any other fuel is used, because the labor of attendance is then reduced to an amount utterly insignificant, compared with the expense of fuel and is extremely small compared with what it would be with some other kinds of combustibles.

The furnace may be either of cast or rolled iron, the latter being preferable on account of its lightness and pliability; the former, for its resistance to corrosion and for the cheapness of the material. A stove or furnace, formed of either of these materials, may be placed in the basement, and surrounded, except in front, with any substance suitable for forming a chamber to receive air at the bottom, which, after ascending around, and over the surface of the iron, may pass up through openings in the floor. The front part of the furnace may be made to join the enclosure allowing access to the fire, but not admitting a communication with the hot air chamber.

The air to supply the combustion may be taken from the apartment immediately around the furnace, or, what is perhaps preferable, may be conducted to the grate through a trunk descending from the floor of one of the upper heated apartments. In the latter case, it serves to carry down the colder parts of the air of the room in proportion as the warm air rises from the furnace to take its place.

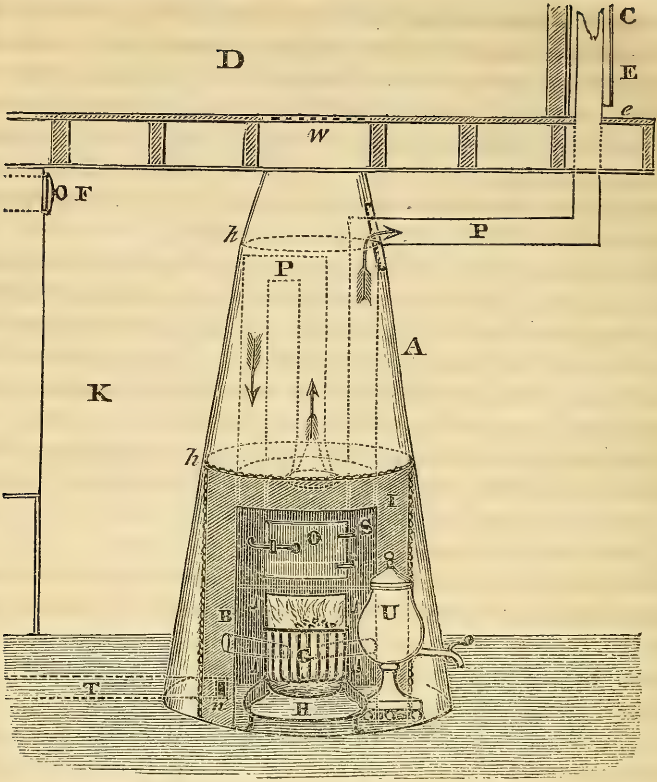
By the arrangement above described, the fire is left open, and at liberty to be used for culinary purposes, while the posterior part of the stove or furnace is employed to heat the air for supplying parlors, chambers and passages.

The air to be used for this latter purpose should be derived from a source not subject to any species of contamination. It would generally be advisable to receive it through a conducting tube from the open air, and to keep it separate from that which supplies the combustion.

Pipes of conduit may be used when several stories, not connected by an ample stair case, are to be kept at uniform temperatures, but the opening or closing of doors will often be sufficient to regulate the heat. It has been found by experience, that when once admitted into the lower apartment, the warm air will soon make its way into every open apartment in the house.

The annexed figure exhibits the arrangement above described with the exception of representing the gas-pipe as passing upwards through the entry passage, where it is enclosed by a metallic column C, instead of being carried into the kitchen chimney according to the actual arrangement, of which this is a representation.

The advantage to be attained by the plan here delineated, is, that a portion of air from the first floor may be allowed to enter the metallic column at an opening *e*, seen on one side, at the bottom, and, ascending between it and the gas pipe, may be discharged into any of the upper rooms where it may be required.



A, is the canvass covering (rendered incombustible) through which air ascends, after being heated by the stove.

K, is the kitchen in the basement.

D, is the parlor above it.

E, the entry or passage extending from front to rear of the house with a staircase leading to the chambers.

S, is the stove lined with fire brick.

O, the oven immediately above the fire.

G, the grate with the ash pit below. The grate and fire are represented as open; but hooks on the right and left show where the doors are to be suspended, which when shut convert it into a *close stove.*

H, is the hearth raised six inches from the floor, the stove resting on a base not seen in the figure.

U, is an urn with a spigot, and a pipe on the opposite side leading with a gradual descent obliquely into the fire through an aperture in the plate of the stove.

B, is a similar aperture to receive the pipe from a boiler in the same manner as at that attached to the urn.

P, is the gas pipe six or eight inches in diameter, of which the various directions within the canvass are indicated by dotted lines.

I, is a piece of sheet iron, six inches broad, extending across the top and down the sides of the stove in front serving for an attachment to the cloth, and sufficiently insulating it from the hot metal. The front of the stove thus constitutes a part of the circular enclosure.

F, is a pipe which may be opened or closed at pleasure for conveying to the chimney any fumes which may chance to escape into the kitchen.

T, is a wooden trunk, beneath the floor, for conveying pure air to the exterior of the furnace.

n, its aperture within the air chamber.

h, *h*, are light iron hoops within the canvass covering to keep it extended, and prevent contact with the pipe, P.

w, is a wire netting, covering the aperture in the parlor floor, and resting on the edges of a few thin iron bars, seen in the section. The netting is painted in colors and figures precisely corresponding with those of the carpet, so that the eye of a stranger seldom detects the source of heat unless he happen to pass over the aperture.

The canvass is rendered incombustible by any heat which can be radiated from the stove, first, by dipping it in a strong solution of alum, and afterwards by covering both surfaces with a coat of whitewash, composed of eight parts of quick lime to one of common salt. The same covering has been three years in use without the slightest sign of combustion. The whole apparatus may have cost, in addition to the price of the cooking stove, about five dollars. It can be put up or taken down in an hour, and at the approach of warm weather, when heat is no longer wanted for the other apartments, the aperture in the floor is closed, the canvass detached, the grate and base of the stove removed to an ordinary kitchen fire-place; and with proper supports for boilers and other apparatus, a summer cooking range is at once constructed out of the materials which had been used in the winter, and thus no change of fuel becomes necessary at that season. With a gas pipe of sufficient dimensions to convey away the fumes, little annoyance can arise from that quarter. To be entirely freed from inconvenience on account of their occasional production, it is only necessary to provide an escape in the manner indicated at F. The kitchen fire place is of course completely closed during the winter. By the adoption of this plan, every flue in the house except one, is rendered useless; and much worse than useless, because, besides occupying a great space, they carry off the hot air which is sent up from the furnace. And yet they do not perform all the purposes of ventilation, since their apertures are below the proper level for that object. Seven out of eight have consequently been closed at the top, by boards laid in mortar.

Ventilation, when required, is readily effected by letting down a sash from the top.

From November to April, (the time this apparatus is in use,) the average consumption of anthracite is one ton per month; and no other fuel whatever is required except a little charcoal, and a trifling quantity of light wood for rekindling the fire, should it accidentally become extinct.

Canvass has been adopted to form the air chamber, because it is lighter, cheaper, more manageable than either iron or brick, and occupies no space of importance, when removed for the summer. Where such removal is not desirable, or where the slightest danger is apprehended, it were probably better to form it of some ordinary building material. The whole of the above apparatus would not perhaps be improperly termed a *tent furnace.*

As already stated, the gas pipe in the actual arrangement above described, passes into a kitchen chimney, and the column C, is omitted; consequently considerable loss is sustained notwithstanding the quantity of pipe enclosed in the air chamber.

In order to assure myself of the practicability of heating an apartment on the third floor, by means of the gas thus escaping from the kitchen, as well as to determine the relation of the temperature of the escaping gas, to that of the open air, and to the highest temperature required in the rooms below, experiments were made at the top of the chimney, and at several stages below. Care was taken to allow the thermometer, (which for this purpose was suspended to a measuring line,) time to attain the temperature of the gas at each stage, and then to withdraw it quickly, when about to be examined.

Exp. 1. In this experiment the air was at 40°; the parlor D, 72°; the gas at the very top of the chimney, 134°; and at four feet below, 139°.

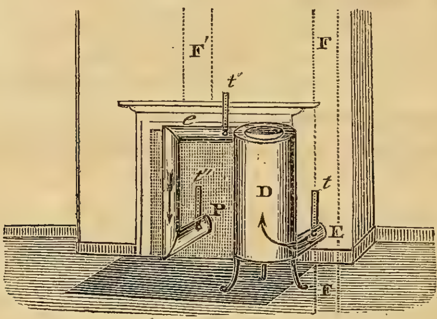
Exp. 2. The air was now 26°; parlor, 70°; the air at top, 118°; three feet below, 123°; six feet below, 131°; nine feet below, 137°; ten and and a half feet below, 139, showing an average diminution of 2° per foot, in the height of the chimney as the gas approached the top.

Exp. 3. This was a cold day and a brisk fire was maintained. The air was at 18°; the parlor, 75°; gas at the top, 180°, and twenty one feet below, 220°, showing a diminution of $1\frac{9}{10}$° for each foot of the height, and demonstrating that the gas had, at its escape, nearly thrice as much excess above the surrounding air, as any room in the house. The temperature at which the gas escapes, must obviously depend upon the state of the fire, as well as upon the quantity of unburnt air, which obtains admission above it. When the fire door of the stove is open, the air enters rapidly and mixing with the gas, partakes of its heat, but probably derives from the fire above which it passes, a small part only of its ultimate temperature. The same is true of the air which enters at the throat of a chimney, beneath which a grate is in action. The air which approaches to mix with the gas, continues cold until the moment of passing the throat, and in this current of cold air, the hand may be held with impunity, while just within the throat the temperature is that due to the mixture of hot gas and cold air. If this throat be much larger than is necessary to receive the gas, a greater proportion of the air of the room will there find an outlet, and the useful effect of the fuel will be neutralized by sending up the chimney that air which it was the chief purpose of the fire to warm, in order that it might be retained in the apartment and applied to its occupants.

Exp. 4. This experiment was made upon a chimney, the gas from which was derived from an open grate in the basement, and of course contained much common air, mixed with the products of combustion. The open air was at 50°, the escaping mixture at 120°.

Exp. 5. A similar examination of another chimney fed by a large kitchen range in full action, gave 125° for the temperature of the gas, that of the open air being 45°. The foregoing experiments served to indicate, that the gas of a close stove, if not of an open grate, might be usefully employed to warm an additional apartment, since it constantly escaped at a much higher temperature than it could be desirable to maintain in any part of a dwelling.

To effect the proposed saving, it was only necessary to arrest the gas by a partition at the proper point, perforate the side of the chimney, and insert a pipe connected with a proper air chamber, or *drum*, of sheet iron through which the gas might be made to pass and again be returned to the flue above the intercepting partition. The plan actually adopted, as the most simple, was to cover the top of the flue from which the gas originally escaped, with a board laid in mortar over the top of the chimney, and when the hot air had traversed the drum, to turn it into another flue which remained open at the top, but closed at bottom, except a single aperture for the admission of a pipe from the drum. The arrangement is seen in the accompanying figure, where F is the flue coming from the basement; E is the six inch



pipe which receives the gas; D is the drum three feet and nine inches high by two feet in diameter, from which proceeds the pipe *e* for the exit of the gas, into the chimney at P, through the brick wall with which the fire place has been closed. F′ is the flue through which the gas finally makes its escape into the open air; *t* is a thermometer with its bulb descending through a hole perforated in the sheet iron, to the center of the pipe, and near where it comes out of the flue. This is intended to mark the temperature of the *entering* gas. *t′* is another thermometer similarly inserted into the pipe where it *leaves* the drum, and *t″* is a third one, serving to note the final temperature of the gas at its exit. The drum supports on its top a broad shallow dish containing water to be evaporated. The thermometer which marked the temperature of the room stood within one foot of the upper end of the drum. The several thermometers represented, were designed not only to show the temperature at which the gas entered and left the apartment, but also the relative portions abstracted by the main body of the drum, and by the pipe respectively, and the extent of variation between the proportions taken off when the temperature of the entering gas was increasing, when it was diminishing, and when stationary. It was likewise important to determine whether the proportion withdrawn when the excess of the temperature in the entering gas above that of the room was great, were the same as when it was less; or whether, on the contrary, the difference in the velocity of movement, of the gas due to the difference of density, would sensibly increase the proportion of that excess which would be withdrawn at the lower temperatures.

	Sq. inches.
The area of the convex vertical sides of the drum was	3091.4
Do. of the two ends of do. - - -	923.6
Do. of the pipe *e* from the drum to the thermometer t'',	1234.6
Total area,	5249.6

Equal to about 37.8 square feet.

Having made this arrangement, I found the temperature of the apartment which had, in former years, required a separate grate, or stove, to keep it in a comfortable condition, entirely freed from that necessity, and during the whole season, which will long be remembered as one of uncommon severity, not a single hour is known to have found it untenantable from cold. At night, the fire in the kitchen was prepared for a slow operation, by adding a fresh supply of coal covered closely by a layer of the finer kind called "*chestnut coal*," or, what is still better, the coarser parts of the sifted cinders from which the earthy and vitrified portions were always carefully rejected. In this state of the fire, the temperature of the entering gas was considerably reduced, but in no instance was it found lower than 100°. It is probable that the mass of brick work, constituting the chimney having become hot during the day, contributed to keep up the temperature in the drum during the night,—a contribution which would have been utterly wasted on the "upper air" according to the usual method of arranging both wood fires and open grates.

In the following table are given the results of numerous observations made, some at irregular intervals during the winter, others at regular periods of five or ten minutes apart, coutinued for several hours in immediate succession. They are arranged according to the temperature of the entering gas which, it will be observed, was never higher at the time of any observation, than 231°. The changes were, in general, so gradual as to allow a perfect facility in noting the rate of variation. The remarks* on this subject are probably sufficiently numerous to enable us to judge even in those cases in which the variation was not noted, what was the actual change taking place, or whether the temperature were stationary.

As these experiments were made for a purpose purely practical, it was no part of their aim to determine the abstract laws relating to the rate of cooling. Nor is that, probably, necessary in the present state of science. The very elaborate experiments of Dulong and Petit† (as well as of many other philosophers,) have left little to be desired in regard to the rate of cooling in vacuo, and in a limited quantity of gas.

They have separated these two things, and given the influence of each circumstance a distinct consideration. But in what manner will those laws which have been deduced, be modified by the currents of gas traversing the trunks of chimnies or the pipes of stoves? Will the greater or less velocities of the currents materially influence the proportion of heat which will be abstracted by a given extent of surface, when the velocity itself depends on an excess of temperature in the moving fluid?

Even allowing for these circumstances, will the quantity of heat abstracted bear any constant ratio to the *excess above the temperature of the room*, with which the gas first enters from the chimney? The table is intended to furnish some data for answering these inquiries.

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* It will be understood that the remarks in the eighth column, refer to the *particular* results contained in the sixth, and not to the more *general* averages which may chance to fall on the same lines in the seventh.

† See Ann. de Chim. et de Phys. Vol. vii, pp. 113, 225 and 337.

Temperature of the gas when entering the chamber.	Corresponding temperature of the room.	Excess of the temperature of the *entering* gas above that of the room.	Temperature of the gas when it re-entered the chimney.	Loss of heat by the gas while in the chamber.	Part of the excess abstracted by the combined action of radiation and conduction.	Averages of five consecutive experiments, taken at the different temperatures of the entering gas.	Remarks on the variations in the temperature of the entering gas, at the moment of the corresponding observations.
100°F.	65°	35	84	16	.457		
102	66	36	85	17	.472		Rising rapidly.
102	64½	37½	85	17	.453		
105	60	45	85	20	.444		
107	60	47	88	19	.404	.446	
109	60	49	90	19	.387		
110	66	44	92	18	.409		
110	59½	50½	88	22	.435		
115	57¾	57¼	92	23	.402		Beginning to rise.
117	56	61	91	26	.426	.412	Rising after closing the stove doors in the morn.
119	58	61	95	24	.393		Falling 1° in 10′.
120	58	62	94	26	.420		Rising 4½° in 10′.
120	58	62	96	24	.387		Falling 1° in 10′.
121	60	61	92	29	.495		Fire very low—covered up for the night.
124	58⅓	65⅔	98	26	.396	.428	Rising 4° in 5′.
125	68	57	101	24	.470		
128	61	67	100	28	.418		Rising rapidly.
134	61	73	102	32	.438		Rising 8° in 5′.
134	58⅔	75⅓	102	32	.424		Rising rapidly.
135	59	76	102	33	.434	.437	Rising rapidly—temperature 8° in the open air.
140	59	81	106	34	.420		Rising 6° in 5′.
142	63	79	111	31	.392		Nearly stationary.
142	58	84	110	32	.381		
144	62	82	113	30	.362		Falling 4° in 5′.
146	59¼	86¾	110	36	.405	.392	Rising 5½° in 5′.
146	56¾	89¼	110	36	.402		Rising gradually.
147	60	87	113	34	.390		Stationary.
148	62½	85½	116	32	.374		Falling 4½° in 5′.
151	59⅓	91⅔	114	37	.403		Rising 6° in 5′.
152	72	80	123	29	.362	.386	
152	65	87	120	32	.367		
152	64	88	120	32	.364		Falling–fire recently renewed.
152½	62½	90	119½	33	.366		Falling 7½° in 5′.

Temperature of the gas when entering the chamber.	Corresponding temperature of the room.	Excess of the temperature of the *entering* gas above that of the room.	Temperature of the gas when it re-entered the chimney.	Loss of heat by the gas while in the chamber.	Part of the excess abstracted by the combined action of radiation and conduction.	Averages of five consecutive experiments, taken at the different temperatures of the entering gas.	Remarks on the variations in the temperature of the entering gas, at the moment of the corresponding observations.
153°F.	68°	85	122	31	.364		Falling.
154	56⅔	97⅓	115	39	.400	.372	Rising.
156	63½	92½	120	36	.388		Falling.
158	59½	98½	117	41	.416		Rising 7° in 5′.
160	62⅓	97⅔	124	36	.368		Falling 8° in 5′.
160	60	100	126	34	.340		
160	56¾	103¼	120½	39½	.382	.379	Rising.
162	71	91	130	32	.352		
163	62	101	126	37	.366		Falling 13° in 5′.
164	62	102	125	39	.382		Falling 1° in 5′.
165	59⅔	105⅓	122	43	.408		Rising 6½° in 5′.
168	70	98	132	36	.367	.375	
168	64	104	122	46	.442		Rising rapidly.
168	62¼	105¾	128	40	.378		Falling 4° in 5′.
171	59¾	111¼	126	45	.404		Rising 5½° in 5′.
172	64	108	136	36	.333		Falling very rapidly—fire just renewed with cold fuel.
172	62¼	109¾	131½	40½	.369	.385	Falling 10° in 5′.
172	60	112	128	44	.393		
173	63	110	129	44	.400		Rising.
173	61	112	131	42	.375		Falling.
173	58	115	133	40	.346		
174	66	108	130	44	.407		
174	66	108	129	45	.416	.389	
174	61	113	129	45	.398		Rising slowly.
176	64	112	130	46	.410		Rising rapidly.
176	62	114	130	46	.403		Rising 9° in 5′.
176	62	114	136	40	.351		Falling 18° in 5′.
176	59⅞	116⅛	129	47	.404	.393	Rising 5½° in 5′.
182	65	117	138	44	.376		
182	62½	119½	136	46	.384		Falling 2° in 5′.
182	62½	119½	135	47	.392		Rising 4° in 5′.
182	62½	119½	134	48	.401		Rising.
182	60	122	133	49	.401	.391	Rising 5° in 5′.
183	65	118	140	43	.364		
184	65	119	136	48	.403		Rising moderately.

Temperature of the gas when entering the chamber.	Corresponding temperature of the room.	Excess of the temperature of the *entering* gas above that of the room.	Temperature of the gas when it re-entered the chimney.	Loss of heat by the gas while in the chamber.	Part of the excess abstracted by the combined action of radiation and conduction.	Averages of five consecutive experiments, taken at the different temperatures of the entering gas.	Remarks on the variations in the temperature of the entering gas, at the moment of the corresponding observations.
184°F.	$62\frac{1}{4}$°	$121\frac{3}{4}$	$136\frac{1}{2}$	$47\frac{1}{2}$	.390		Stationary.
185	$63\frac{1}{2}$	$121\frac{1}{2}$	$139\frac{1}{2}$	$45\frac{1}{2}$	.375		Falling.
186	$63\frac{1}{2}$	$122\frac{1}{2}$	141	45	.367	.380	Falling—stove just replenished—cold day.
186	63	123	144	42	.341		
186	$60\frac{1}{16}$	$125\frac{15}{16}$	136	50	.396		Rising 4° in 5′.
188	70	118	148	40	.340		
188	65	123	136	52	.422		
189	57	132	138	51	.385	.377	Rising—very cold day.
190	67	123	140	50	.406		Rising.
190	66	124	140	50	.403		Rising.
190	64	126	146	44	.349		
190	$62\frac{1}{2}$	$127\frac{1}{2}$	139	51	.400		Rising.
190	62	128	$140\frac{1}{2}$	$49\frac{1}{2}$	.386	.389	
190	$60\frac{1}{8}$	$129\frac{7}{8}$	138	52	.400		Rising 3° in 5′.
192	64	128	141	51	.398		Rising very little.
192	$60\frac{1}{3}$	$131\frac{2}{3}$	141	51	.387		Stationary or falling a little.
192	$60\frac{1}{4}$	$131\frac{3}{4}$	140	52	.392		Rising 1° in 5′—stove opened for an instant.
194	$61\frac{1}{2}$	$132\frac{1}{2}$	142	52	.391	.393	Stationary.
194	61	133	142	52	.391		Stationary.
194	$60\frac{2}{3}$	$133\frac{1}{3}$	142	52	.390		Stationary.
197	65	132	154	53	.401		
198	$62\frac{1}{2}$	$135\frac{1}{2}$	143	55	.406		Rising.
200	70	130	152	48	.369	.391	
204	$66\frac{1}{2}$	$137\frac{1}{2}$	149	55	.400		Rising.
204	$57\frac{3}{4}$	$146\frac{1}{4}$	148	56	.383		Rising slowly—a very cold day.
206	67	139	154	52	.374		
206	60	146	150	56	.383		
206	$58\frac{3}{4}$	$147\frac{1}{4}$	150	56	.380	.384	Rising slowly—very cold abroad.
210	$59\frac{1}{2}$	$150\frac{1}{2}$	154	56	.372		Nearly stationary—very cold day.
210	59	151	152	58	.384		
212	63	149	155	57	.382		Nearly stationary.
212	$59\frac{3}{4}$	$152\frac{1}{4}$	154	58	.381		Rising slowly.

Temperature of the gas when entering the chamber.	Corresponding temperature of the room.	Excess of the temperature of the *entering* gas above that of the room.	Temperature of the gas when it re-entered the chimney.	Loss of heat by the gas while in the chamber.	Part of the excess abstracted by the combined action of radiation and conduction.	Averages of five consecutive experiments, taken at the different temperatures of the entering gas.	Remarks on the variations in the temperature of the entering gas, at the moment of the corresponding observations.
213°F.	67°	146	155	58	.397	.383	
214	63½	150½	159	55	.365		Falling.
215	61½	153½	159	56	.364		Falling.
220	70	150	160	60	.400		Rising gradually.
222	69	153	161½	60½	.395		Rising slowly.
222	72	150	168	54	.360	.377	
223	70	153	162	61	.399		Rising.
228	70	158	165	63	.400		Rising.
231	68	163	170	61	.374	.391	
Mean,	62½						

It will be found that the least portion of temperature abstracted was thirty-three and a third per cent of the excess, with which the gas entered the drum; and this occurred when a quantity of cold anthracite had just been added to the fire, which greatly reduced the temperature of the gas. The drum in the mean time retained some portion of its previous temperature and imparted to the gas instead of taking from it, a quantity of heat. The greatest per cent was forty-seven and a half, which was abstracted when the temperature was rising very rapidly and when, of course, the iron of the drum, as well as the air of the room was acquiring temperature. It also occurred when the fire was covered with cinders and the fire-doors opened at night; the slowness of motion in the gas having apparently more than counterbalanced the diminution of tension in the heat, and allowed a greater portion of the excess to escape.

The result of all the above observations is, that with a temperature in the room, varying from 56° to 72°, and in the entering gas, from 100° to 231°, the number of degrees of heat abstracted by about thirty-eight square feet of surface, varied, (according to the temperature,) from 16° to 63°, showing, when compared with the excess of the gas above that of the room, a portion abstracted equal to $\frac{393}{1000}$ of that excess, or about one per cent for each foot of metallic surface.

The thermometers t' and t'' were so situated as to embrace between them forty-five inches in the length of the pipe, exhibiting a surface of eight hundred forty eight and one fourth square inches. The following observations will show the efficacy of this part of the apparatus. When the thermometer t was 145°, t' was 121°, t'' 109.5°; whole quantity abstracted 35.5°; part taken off by the pipe between t' and t'' 11.5°. Hence, $32\frac{4}{10}$ per cent. of the whole diminution was due to this portion of surface, although it was only $16\frac{2}{10}$ per cent. (less than one-sixth) of the whole surface exposed. It will be remarked that in this part, the gas was compelled to move vertically downwards, while in the body of the drum it ascended somewhat obliquely, and that too, through a medium of gas in the centre of which it may have formed a *current*, which being enclosed as it were, in a *pipe of gas*, (a very bad conductor) could not readily discharge its heat through the iron.

The mean result of seven experiments made in this manner was, that $33\frac{4}{10}$ per cent. of the heat taken off was abstracted by this part of the pipe. This proves that the form of a drum is by no means the most favorable for abstracting heat. The flattened pipe would doubtless be most efficacious for this object, where space could be allowed for carrying it to a considerable extent.

Art. XVI.—*The Rattle Snake,* (Crotalus horridus, L.) *disarmed by the leaves of the White Ash,* (Fraxinus Americana, *Mich. f.*) Communicated by Judge Samuel Woodruff, in a letter dated Windsor, December 4th, 1832.

TO PROFESSOR SILLIMAN.

Dear Sir.—Last evening while perusing your very interesting Journal, I found in Vol. iii, p. 85, a communication to you by Prof. Jacob Green, giving an account of a large quantity of *rattle snake skeletons*, found in a cave near Princeton College; Prof. Green closes his communication with a passing notice of a *popular story*, among the former inhabitants of that town, that the leaves of the white ash were obnoxious to those reptiles.

This brought to my recollection an occurrence connected with this subject, of which I was a witness, and now proceed to relate.

During the summer months of 1801, I resided in the north eastern part of the state of Ohio. Rattle Snakes were then very numerous in that region. I found the opinion universally prevalent among the inhabitants there, that the leaves of the white ash were highly offensive to the rattle snake. Several persons of respectability assured me that the rattle snake was never found on land where the white ash grows, that it was the uniform practice among hunters, as well as others, whose business led them to traverse the woods in the summer months, to stuff their shoes and boots, and frequently their pockets also, with white ash leaves, as a preventive of the bite of the rattle snake, and that they had never known or heard of any person being bitten who had used this precaution.

Sometime in the month of August, I went with Mr. T. Kirtland and Dr. C. Dutton, then residing at Poland, to the Mahoning, for the purpose of shooting deer, at a place where they were in the habit of coming into the river, to feed on the moss attached to the stones in the shoal water. We took our watch station on an elevated part of the bank, fifteen or twenty yards from the edge of the water. About an hour after we had commenced our watch, instead of a deer, we discovered a large rattle snake, which, as it appeared, had left his den, in the rocks beneath us, and was slowly advancing across a smooth, narrow sand beach towards the water. Upon hearing our voices, or for some other cause, he stopped and lay stretched out with his head near the water. It occurred to me, that an opportunity now offered to try the virtues of the white ash leaves. Requesting the gentlemen to keep, in my absence, a watch over our subject, I went immediately in search of the leaves, and on a piece of low ground thirty or forty rods back from the river, I soon found, and by the aid of my hunting knife, procured a small white ash sapling eight or ten feet in length, and with a view to make the experiment more satisfactory, I cut another sapling of the sugar maple, and with these *wands* returned to the scene of action. In order to cut off a retreat to his den, I approached the snake in his rear. As soon as I came within about seven or eight feet of him, he quickly threw his body into a coil, elevated his head eight or ten inches, and brandishing his tongue, "gave note of preparation" for combat. I first presented him the white ash, placing the leaves upon his body. He instantly dropped his head to the ground, unfolded his coil, rolled over upon his back, writhed and twisted his whole body into every form but that of a coil, and appearing to be in great anguish. Satisfied with the trial thus far made, I laid by the white ash. The rattle snake immediately *righted*, and placed himself in the same menacing attitude as before described. I now presented him the sugar maple. He lanced in a moment, striking his head into a tuft of the leaves, "with all the malice of the under fiends," and the next moment coiled and lanced again, darting his whole length at each effort with the swiftness of an arrow. After repeating this several times, I again changed his *fare*, and presented him the white ash. He instantly *doused his peak*, stretched himself out on his back, and writhed his body in the same manner as at the first application. It was then proposed to try what effect might be produced upon his temper and courage by a little flogging with the white ash. This was administered. But instead of arousing him to resentment, it served only to increase his troubles. As the flogging grew more severe, the snake frequently stuck his head into the sand as far as he could thrust it, seeming desirous to bore his way into the earth and rid himself of his unwelcome visitors.

Being now convinced that the experiment was a satisfactory one, and fairly conducted on both sides, we deemed it ungenerous to take his life after he had contributed so much to gratify our curiosity; and so we took our leave of the rattle snake, with feelings as friendly at least as those with which we commenced our acquaintance with him, and left him to return at leisure to his den.

Art. XVII.—*On some new Fossil and Recent Shells of the United States; by* T. A. Conrad.

To the Editor of the American Journal of Science.

Sir—As I have a considerable collection of tertiary fossils of the United States, many of which appear to be new to science, perhaps you may deem it useful to publish descriptions of some of them, although unaccompanied with figures; which it is to be hoped the increasing interest in geological researches will some day enable me to furnish. I shall here describe only a portion of those species which I believe to be nondescript, but they will suffice to convince the naturalist that interesting and perfect fossils are scattered as profusely in America as in any part of the world. Scarce a rivulet, or the bank of a river, in the eastern portion of the Southern States, is without some trace of organic remains; and persons residing in the neighborhood of such places would confer a favor on the members of the Academy of Natural Sciences of Philadelphia, if they would forward specimens to that Institution. Yours, &c. T. A. C.

Philadelphia, December 5, 1832.

MACTRA.

1. *M. clathrodonta.* Shell subovate; posterior side cuneate; dorsal slope but little curved; posterior lateral tooth much elongated and elegantly striated; fosset oblique, ovate; anterior lateral tooth elongated. Length, two inches.

Locality.—Yorktown, Va. *Upper marine formation.*

So closely does this shell resemble *Clathrodon cuneata*,* Gray, that on a superficial examination it might almost be taken for the same species; the hinge, however, is that of a true Mactra. The *Clathrodon* has been arranged among fresh water shells, and considered as nearly allied to *Cyrena*, but I should prefer to place it next to *Mactra* in a natural arrangement, as the hinge does not greatly differ from that genus, and the palleal impression is exactly similar. With regard to its habit of living in brackish water, it may be observed that other marine shells are frequently found in like situations, and I have seen the *Solecurtus Caribæus* and other shells of our coast many miles above the mouth of the Potomac and in its tributary rivers. I obtained many specimens of *Clathrodon* from the sea beach near Cape Henry, Va., and Mr. I. Lea showed me others from the coast of South America.

2. *M. congesta.* Shell triangular, convex, thick; posterior side cuneate, beaks nearly central; lunule none; fosset small, circular, profound; lateral teeth thick. Length, one inch.

Locality.—Suffolk, Va., where it is extremely abundant. A much smaller variety occurs at James river, generally shorter in proportion to the height, and with central beaks. *Upper marine formation.*

3. *M. confraga.* Shell subtriangular; narrow, somewhat thick, with coarse concentric lines; umbo oblique; beaks a little elevated, approximate; posterior side longer and less obtuse than the anterior; fosset large cordate, oblique; lateral teeth strong; muscular impressions large. Length, two inches.

Resembles *M. solidissima*, Chem., but the apex is not directed forwards as in that species. It was found by Mr. Finch in Maryland and is from the *upper marine* beds.

4. *M. modicella.* Shell subtriangular, compressed; posterior side shortest and abrupt or truncated at the extremity; fosset a little oblique, triangular; lateral teeth strong. Length, three fourths of an inch.

Locality.—Yorktown, Va. *Upper marine.*

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* *Rangia cyrenoides*, M. des Moulins.

CORBULA.

1. *C. idonea.* Shell subtriangular, convex, thick, obscurely undulated; with a fold on the posterior sub-margin and the extremity angular; basal margin acute; cardinal tooth very thick and elevated. Length, one inch.

Locality.—Choptank river near Easton, Md., common; *Upper marine.*

2. *C. oniscus.* Shell elevated; larger valve ventricose, with profound sulci terminating at the umbonial slope, which is carinated; posterior extremity narrowed and truncated, from the posterior angle of which a carina extends to the apex, nearly parallel with that of the umbonial slope; superior valve concentrically striated. Length, one third of an inch.

Locality.—Claiborne, Alab. *London clay.*

This species can hardly be distinguished from the *C. angustata* of Sowerby, Geological Trans. 2d series, vol. iii, pl. 38, fig. 4. The latter was found in the valley of Gosau, Saltzburg Alps.

CHAMA.

1. *C. congregata.* Shell sessile, dextral; superior valve a little convex, with numerous erect elevated arched scales; beaks occasionally rostrated; apex sub-spiral; scales on the inferior valve broader and more elevated; inner margin crenulated.

Locality.—James river, near Smithfield, Va. *Upper marine.*

2. *C. corticosa.* Shell sinistral; with strong concentric undulated laminæ transversely striated; superior valve flat; inner margin crenulated. Found with the preceding species.

PETRICOLA.

P. centenaria. Shell oblong oval, with numerous prominent radiating striæ, and concentric wrinkles; lunule small, cordate, profoundly impressed; hinge with two teeth in one valve, and three in the opposite, the middle one bifid. Length, two inches.

Localities.—James river near Smithfield, Va.; Choptank river near Easton, Md. *Upper marine.*

PECTEN.

P. eboreus. Shell suborbicular, compressed, thin, a little oblique; ribs about twenty two, rounded, little elevated and smooth; inferior valve nearly flat. Length, two inches.

Locality.—Suffolk, Va. *Upper marine.*

VENERUPIS.

V. subvexa. Shell subglobose, rather thin and fragile; beaks central, elevated and inclined a little forwards. Length, one inch.

Locality.—James river, near Smithfield, Va. *Upper marine.*

CARDITA.

C. alticostata. Shell subcordate, convex, with about twenty two profoundly elevated nodulous ribs, which on the anterior side are laterally carinated. Length, two inches.

Locality.—Claiborne, Alab. *London clay.* Extremely abundant and very variable in outline.

ASTARTE.

1. *A. tellinoïdes.* Shell oval, with concentric sulci; posterior side with a slight groove or fold terminating in a slight emargination of the basal edge; umbo flattened; apex acute but not prominent; muscular impressions a little elevated and very distinct. Length, half an inch.

Locality.—Claiborne, Alab. *London clay.*

2. *A. ungulina.* Shell slightly elevated or obovate, a little convex, with fine concentric sulci becoming obsolete with age; beaks inclining a little forward and the apex acute; inner margin entire; lunule none. Length, half an inch.

Locality.—Accompanies the preceding species.

PECTUNCULUS.

1. *P. cuneus.* Shell cuneiform, broad, posterior end flattened and forming an angle at the umbonial slope. Length, half an inch.

This is a remarkable species, very unlike any I have hitherto seen.

Locality.—Claiborne, Alab. *London clay.*

2. *P. trigonella.* Shell subtriangular, elevated, with radiating striæ; anterior margin nearly rectilinear and subangular at the extremity; inner margin serrate. Length, half an inch.

Locality.—Claiborne, Alab. *London clay.*

3. *P. stamineus.* Shell suborbicular, ventricose; with distant radiating and finer intermediate lines, crossed by minute crowded striæ; inner margin serrate. Length, one inch and a half.

Locality.—Found with the preceding species.

LUCINA.

1. *L. pandata.* Shell oval, compressed, obscurely cancellated; anterior side somewhat corrugated; beaks nearly central; teeth three in one valve; anterior muscular impression profoundly elongated; lunule excavated, minute. Length, one inch and one fourth.

Locality.—Claiborne, Alab. *London clay.* This shell is allied to *Lucina mutabilis*, Lam.

2. *L. dolabra.* Shell elevated, with distant concentric imbricated and obscure radiating striæ; posterior submargin profoundly channeled, beaks prominent and curved forwards; lunule impressed, cordate; inner margin crenulated. Length, half an inch.

Locality.—Claiborne, Alab. *London clay.*

CYTHEREA.

C. Marylandica. Shell obtusely ovate, smooth, thick; umbo obtusely rounded posteriorly; lunule ovate-acute and slightly impressed; hinge with the anterior tooth very robust.

This shell is from the upper marine formation; it is about the size and shape of *Venus mercenaria*, and is vastly abundant in the bank of the Choptank river, about four miles from Easton, Md. and occurs in no other locality which I have visited.

NUCULA.

1. *N. bella.* Shell ovate elongated, rostrated, with numerous regular concentric striæ, and two carinated lines on the anterior submargin diverging from the apex; on the posterior side is a slight furrow from the apex to the base. Length, half an inch.

Locality.—Claiborne, Alab. *London clay.*

2. *N. cœlata.* Shell ovate elongated, with irregular undulated ridges; anterior sub-margin with three minutely crenulated carinated lines diverging from the apex; beaks nearly central. Length, half an inch.

Locality.—Found with the preceding species.

FULGUR.

F. incilis. Shell fusiform, with coarse alternated with finer spiral striæ; spire elevated; whorls five, rounded, flattened a little above, but crowned with a carinated line; suture broadly and profoundly channeled; body whorl ventricose.

Locality.—Yorktown, Va. *Upper marine.*

This shell is about the size of *F. canaliculatus*, which it distantly resembles.

MELONGENA.

M. alveata. Shell subglobose, with revolving striæ; a few of which are distinct; body whorl with a broad channel above; spire very short, columella callous, profoundly so above; basal emargination profound. Length, one and a half inches.

Locality.—Claiborne, Alab. *London clay.*

CREPIDULA.

C. lirata. Shell oblique, elevated, compressed: longitudinally ribbed; beak prominent, incurved, and turned to one side.

Locality.—Claiborne, Alab. *London clay.*

SOLARIUM.

1. *S. elaboratum.* Shell discoid, with numerous revolving crenulated striæ of different sizes; beneath slightly channeled on the submargin, with a few strong grooves; margin of the umbilicus profoundly crenulated; the crenulations extending to the apex; aperture nearly circular. Length, one third of an inch.

Locality.—Claiborne, Alab. *London clay.*

2. *S. cancellatum.* Shell elevated, cancellated; volutions angular, channeled at the suture; umbilicus cancellated; aperture orbicular. Length, one fifth of an inch.

Locality.—Suffolk, Va.

SIGARETUS.

S. bilix. Shell obliquely oval, convex, with fine crowded striæ revolving in pairs. Length, one third of an inch.

Locality.—Claiborne, Alab. *London clay.*

TYPHIS.

T. gracilis. Shell fusiform, elongated, slender, volutions about eight; ribs of the body whorl 4, thickened and slightly reflected; with two or three arched scales on each; margin of the aperture elevated but not reflected. Length, one third of an inch.

Locality.—Claiborne, Alab. *London clay.*

2. *T. acuticosta.* This shell is described by me as a Murex in the Jour. Acad. Nat. Sciences, Vol. 6.

RECENT SHELLS.

LUCINA.

L. Floridana. Shell suborbicular, compressed, with regular concentric striæ, and covered with a very thin pale brown deciduous epidermis; anterior and posterior sides each with an obscure fold; beaks central, not elevated; hinge edentulous; anterior muscular impression not greatly elongated. Length, one inch.

This shell resembles the fossil *L. anodonta*, of Say, but is very distinct. It was found near Pensacola by Dr. Hutchins, who sent it to Dr. S. G. Morton.

CYTHEREA.

C. Sayana. Shell subovate, convex, with coarse concentric lines, and destitute of polish; lunule large, cordate, marked by a simple impressed line; hinge, with the teeth compressed. Length, one inch and one fourth.

Syn. Cytherea convexa, Say. *Jour. Acad. Nat. Sciences*, vol. iv, p. 149.

Found on the coasts of Rhode Island and New Jersey; it is pale yellowish or white and appears not to differ specifically from the *C. convexa*, of Say, but I have changed the name because M. Brongniart had previously applied it to a very dissimilar species.

MELAMPUS.

M. borealis. Shell ovate acute, elongated; pale horn color with darker longitudinal bands; whorls six or seven, with a revolving impressed line below the suture; spire elevated, conical; columella with three distant and distinct plaits, the middle one most prominent; aperture obovate-acute. Length, one fourth of an inch.

This small species of Melampus has been found sparingly on the coast of Rhode Island, by Lieut. Brown of Newport. It is similar in form to a Bulimus and is very unlike the common species with which it associates.

Ungulina transversa. Lam. As the history of this rare shell is rather obscure, it may be worthy of remark, that I discovered two specimens in a piece of limestone, inhabiting cavities which appeared to have been formed by themselves. The limestone was perforated in every direction by shells of the genera *Arca*, *Crenatula*, *Venerupis*, *Petricola*, *&c.*, all the species being such as are common in the West Indies, from whence no doubt, the stone which contained them had been brought. From the circumstance of its occurring in this situation and from the peculiar form of the shells, I have no doubt that the genus Ungulina may be properly classed among the lithophagous Testacea.

Lima glacialis. Lam. It is a singular fact in the history of this shell that although it swims with great ease and rapidity, it is often found in the calcareous rocks of the West Indies, and the entrance to the cavities in which they reside is far less than the shells themselves, a proof that they have the power of perforating limestone, for they must have entered the rocks when very young and gradually enlarged their habitations as they increased in size. For this fact I am indebted to General Parker who presented me a specimen which he himself had procured by breaking the rock in which it was concealed.

Pholas costata. Lin. The same gentleman bought in the Havanna market fine living specimens of this Pholas, far larger than are generally met with on our coast. Dead shells are common on all the coasts of the Middle and Southern States, but I believe a living specimen has never been obtained here. They must certainly however, burrow in the sand at or near low water mark.

Cardium Mortoni. This shell, described and figured by me in the 6th. vol. Jour. Acad. of Natural Sciences, was at that time supposed to be peculiar to the Eastern States, and especially the shores of Long Island Sound. Specimens however have lately been sent from the extreme Southern States; Dr. Blanding obtained it in East Florida, and Dr. Hutchins in the vicinity of Pensacola.

Art. XVIII.—*Report on the Filter and Prepared Charcoal of M. Dumont,** *by MM. Serullas, Bussy, and Derosne.* Translated from the Journal de Pharmacie, by Franklin R. Smith, of Philadelphia.

To the Sociétie de Pharmacie de Paris.

Gentlemen,—M. Dumont, an experienced manufacturer of beet sugar, called your attention to a filter of his invention, and to a prepared charcoal, which he employs in the bleaching of syrups, and you charged MM. Serullas, Bussy, and myself, (Derosne,) to give you an account thereof.

The discovery of the decolorizing property of charcoal, is due to Lowitz of St. Petersburg, who however did not remark the difference in activity between vegetable and animal charcoal. Therefore the former only was employed in the sugar refineries for the decoloration of syrup. In 1811, M. Figuier of Montpellier ascertained that

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* This paper would long since have appeared, but for the accidental circumstance of its having been mislaid and forgotten. In searching for another document, we were glad to recover this.

animal charcoal was superior, and employed it to remove the color of wine, vinegar and the residuum of sulphuric ether. We cannot ascertain from his published memoir that he applied it to syrups. It was a year later that M. Charles Derosne introduced it into the sugar refineries and manufactories of beet sugar, thus rendering great service to these two branches of national industry, and perhaps a greater to the manufacturers of sal ammoniac, who, until that time, had thrown away as useless all the residuum of their distillations. Since that period the consumption of animal charcoal has been continually increasing and its manufacture has become a source of considerable revenue. Its mode of use underwent little change. After pulverization and mixture with the syrup to be decolorized, this was boiled and passed through a woolen cloth; by these means its full action was thought to have been attained, and we could not have imagined the possibility of the great improvements in the manner of its employment which M. Dumont has recently introduced.

This manufacturer, reflecting upon the difficulties of the old process not only in the use of the charcoal, but also in the washing of the residue and upon the foreign tāste acquired by the syrup during ebullition, with that agent sought to remedy them all, and has completely succeeded. His discovery comprises the preparation of the charcoal and its employment by means of a filter of his own invention. The preparation of the charcoal is very simple; it consists in reducing it to grains of equal bigness with those of sporting gun powder, and removing the dust; these grains, however, vary in size withe the density of the syrup to be bleached.

The filter of M. Dumont is a truncated pyramid turned base upward, made of wood and lined throughout with tinned copper. At the lower part is a spigot for drawing off the syrup, a little above that an opening communicating with a tube external to the filter, and used for removing the air of the apparatus. The filter is furnished with two diaphragms of different sizes. When a syrup is to be filtered, the small diaphragm is to be placed on the bottom of the filter resting upon four feet, elevating it higher than the spigot and opening of the air tube. Upon this diaphragm a piece of coarse cloth is to be extended and upon it the charcoal previously moistened with one sixth of its weight of water, is to be placed in such a manner that all parts shall be equally furnished. The level surface receives another coarse cloth and the larger diaphragm upon which the syrup is to be poured. By this arrangement the effusion of the syrup occasions no derangement of charcoal and the irregular flow of the liquid is prevented. The syrup, in percolating the beds of charcoal, displaces the water with which that article was moistened and forces it out at the spigot, where it may be received until it is ascertained that its place has been supplied by syrup, which soon flows in an uninterrupted stream, to be kept up by renewed additions upon the filter. If the charcoal be not wetted with water, the syrup will have more difficulty in penetrating its substance, it may pass more in one part than another, and the filtration will not proceed regularly. Besides, the water acts another part when animal charcoal is employed, that is, in lixivating (in a partial manner at least) that article, which may be recognized by the salt taste which it acquires.

M. Dumont made a trial of his filter in our presence with a syrup made from raw sugar. The experiment was successful, and we present you with the product numbered in the order of their flowing; the syrup No. 1 is almost colorless. No. 2 of a light amber color. No. 3 a shade darker. By mixing these in equal proportions, a syrup equal to that from good clayed sugar was produced. The purity of taste forms an additional recommendation to these syrups, the flavor of raw sugar being entirely removed. We made a comparative trial of charcoal in the same proportion, by the old process, and upon the same kind of raw sugar, but the product did not approach the beauty of that obtained by M. Dumont's filter, its color was darker than that of No. 3, and in the taste there was still greater difference, from the syrup having acquired a disagreeable flavor by ebullition with the charcoal. For the decoloration of sugar M. Dumont employs twenty five per cent. of charcoal. This will certainly appear to be a large proportion, but we would observe, that after the first operation, the charcoal retains much of its decolorizing property. Syrup equal in quantity to the first may be poured in and will lose three fourths of its original color; in fact it will be bleached more than if we had treated the same quantity of sugar with twelve per cent. of charcoal in the ordinary way.

When decoloration ceases M. Dumont's process still offers advantage. By the way, we would observe, that in the experiments performed before us, M. Dumont employed only fifteen per cent. of charcoal. We have no doubt that had he employed twenty five per cent., as he usually does, the product would have equalled a syrup made with fine refined sugar. After the second operation, the charcoal has lost a great part of its decolorizing action, but M. D. has discovered a property which he calls *apechante*, that is to say, a property of modifying or weakening the action of those substances contained in the syrup which are capable of reacting upon the sugar during the boiling. He, therefore, advises the filtration of a third or fourth quantity of syrup through the same charcoal, persuaded that afterward they may be crystallized much more readily.

Long experience only can demonstrate the value of this opinion; we can, however, cite one fact which appears to confirm it. A syrup of beets which had passed through a partially exhausted charcoal without losing any of its dark color, took the fire much better and crystallized more readily than a portion of the same syrup unfiltered.

M. Dumont's filters are of different sizes. The small contain from twelve to fifteen pounds of charcoal, and the large as much as two hundred pounds. By them, syrups of all densities from the least to the greatest, may be filtered.

Syrup of 28° to 30° of the areometer filters very well cold, those of 36° to 38° require to be poured in hot, and the charcoal coarser, as before stated, the operation lasts about the same time, but the product is not so well decolorized.

The syrup of twelve hundred pounds of sugar can be filtered in twenty four hours.

Why are the syrups filtered by M. Dumont more decolorized than those operated upon the old process? Several reasons can be assigned in reply. It is easy to conceive, that syrup, in passing through the different layers of the column of charcoal should deposit a portion of its coloring matter in each layer, thus producing greater effect than in the broad and shallow filters used in the old process. Besides, it is not improbable that the ebullition of a syrup with charcoal counterbalances, in part, the decolorizing action of the agent; perhaps the caloric effects a reaction of charcoal upon the syrup which, in destroying one coloring principle elicits another: for the decoloration is uniformly more perfectly effected without heat. With regard to the superiority in point of taste, of the syrups filtered by M. Dumont, over those which have been boiled with charcoal, it is much more easily to be comprehended, it being an incontestable fact, that animal charcoal imparts to syrups with which it is heated, a disagreeable flavor;—a flavor which increases with the proportion of charcoal.

On the other hand, M. D. removes from the charcoal a large proportion of the soluble matters by means of the water with which he moistens it. He operates without heat, which is is another reason why his syrups should not acquire any bad flavor. If for perfect decoloration and good taste the filter of M. Dumont affords decided advantages, it offers yet another in the facility of washing the charcoal.

The old process required repeated mixtures of the coaly residuum with large quantities of water to separate the sugar which it retained, and those washings required expensive evaporation. This disagreeable and tedious labor is almost done away with by M. Dumont; for without deranging the apparatus, the addition of water promptly removed all the sugar, and, what is still more valuable at the commencement of its action, a considerable portion of syrup is obtained of a density almost equal to that which flows in the first instance.

The simplicity and rapidity of this washing will be especially appreciated in large manufactories. We need not dwell upon the importance of M. D.'s process in point of economy; those to whom the manipulation of sugar is familiar, will readily comprehend it. M. D. estimates the results obtained by his process as four times greater than by the old, and assures us that his decolorized syrups are enhanced thirty per cent. in value. Were it even necessary to abate somewhat of these valuations, it is not the less certain that his process will secure great benefits to those who employ it. Already some pharmaciens have adopted it and it is used by confectioners and distillers. We know that a director of one of the largest sugar refineries in Paris, has commenced its trial, and every thing induces the belief that he will have reason to congratulate himself upon the experiment.*

The ready employment of M. Dumont's filter, and the good quality of the syrups obtained whether for consumption in that state or for crystallization; the simplicity and promptitude of the washing induce us to believe that his process will effect marked changes in the arts connected with the manufacture and refining of sugar.

We think M. Dumont has rendered great service to the arts, and we propose that the society thank him for calling their attention to his process and congratulate him on his success.

N. B. The syrups must be clarified and perfectly limpid before being poured upon the charcoal. This condition is essential to the success of the operation.

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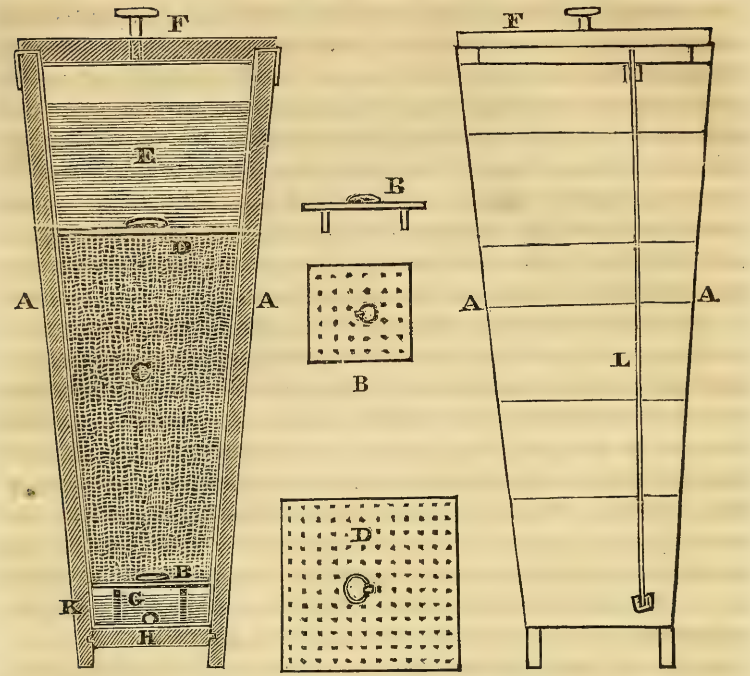
* In another number of the Journal de Pharmacie is the following: "the use of the filter and animal charcoal to which he (M. Dumont,) gives a particular preparation, has already enabled several manufacturers to vend domestic sugar of superior quality to any heretofore made."



AA, wooden box lined with tinned copper. B, lower diaphragm pierced with holes and supported upon four feet; it is movable. C, space for charcoal. D, upper diaphragm, (movable) E, space for the colored syrup. F, wooden cover lined with copper. G, space into which the decolorized syrup flows. H, spigot. K, opening to which the tube L is adapted, giving passage to the air.

Art. XIX.—*An Introduction to Natural Philosophy; designed as a Text Book, for the use of the students in Yale College; by* Denison Olmsted, A. M. Professor of Mathematics and Natural Philosophy. In two volumes, pp. 346 and 352. New Haven: Hezekiah Howe.

We have long regarded the objects of a liberal education as threefold :—first, to develop and discipline the powers of the mind itself; secondly, to store it with useful truths; and, thirdly, to give to it the power of communicating its ideas to others. Or, briefly, thus: it is the great purpose of a collegiate education to learn us to think, to furnish us with ideas, and to teach us how to express them. We fully believe that all the different studies that compose the system of education pursued in Yale College, and in most of the colleges of our country, severally and conjointly contribute to this main purpose. Geometry and Mechanics, indeed, unite, in a remarkable degree, the three objects specified; for nothing is better suited to mental discipline than the demonstrations of the truths they contain; the truths themselves are of great value as subsidiary to other branches of knowledge, particularly the knowledge of nature and of the principles of art; and the practice of conducting long demonstrations on the black board in the presence of a class, accustoms the student to express himself with perspicuity and correctness.

All great and accurate attainments in Natural Philosophy and Astronomy, are founded in the science of Mechanics, which is, indeed, little more than an expansion of the three great laws of motion, followed out through all their consequences. So long as mankind supposed that motion was one thing on earth and another thing among the heavenly bodies, they made no progress in investigating the laws of the Universe. We owe to Newton the full development of the doctrine of the uniformity of the laws of nature. The Principia first taught the world how to ascend from simple observations and experiments on the motion of bodies around us, to a knowledge of the sublime but equally simple movements of the spheres.

A philosophical education, therefore, must have its foundations laid deep in the science of Mechanics. But it must not stop here. The student of philosophy must not only have his mind stored with these universal truths, but he must be initiated in the daily practice of philosophizing, both upon the phenomena of nature and upon the operations of art, which latter are, indeed, for the most part, only operations of the powers of nature as modified by the ingenuity of man. We would have our men of education commence philosophers as soon as they begin the study of philosophy, and ever afterwards cherish the habit of seeking an explanation of every phenomenon whether of art or nature that is presented to their observation.

The want of a good text book for classes in Natural Philosophy, has long been felt in our colleges. Enfield's Institutes, although a crude compilation, abounding in errors,* and far behind the present state of science, long maintained its ground in spite of all these diadvantages, because, imperfect as it was, it was better adapted on the whole

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* See a copious list of these errors, pointed out by Professor Fisher, in Vol. iii, p. 125 of this Journal.

to be used as a class-book than any other similar work. Cavallo's Elements of Natural Philosophy, and the Treatises of Wood and Vince, have been used in a few of our colleges; but the diffuse style of the former work, and the absence of practical applications in the latter, rendered them both ill adapted to the purposes of a class-book.

The late publications at Cambridge by Professor Farrar, comprising an entire course of mathematical and philosophical text books, compiled chiefly from the French writers, ably supplied the deficiency alluded to, and might seem to have rendered the present work unnecessary. But, for several reasons, the Cambridge Philosophy was found not to be adapted to the course of mathematical and philosophical instruction in Yale College; particularly, as it does not correspond, in its references, to the mathematical works of President Day, which are used in this Institution (and which there is no inclination to exchange for any other) and, moreover, it is so extensive as to require a greater amount of time, than can be spared for this purpose consistently with the other exigencies of the Philosophical department, and with the claims of the other departments of instruction.

The general design of Professor Olmsted's work, is expressed in the preface. It is, "first, to make the student thoroughly and familiarly acquainted with the *leading principles* of Natural Philosophy, and, secondly, to furnish him with as much *useful information*, as possible, within so limited a compass." In prosecuting the former design, the compiler has first confined the attention of the student to the "Mathematical Elements," comprising a selection of the most important principles in the science of Mechanics;—principles which, on account of the universality of their application, are particularly worthy of standing in the fore-ground of Natural Philosophy, and of occupying for a considerable time the undivided attention of the student.

Under the impression that the interest felt in the investigation and contemplation of abstract truths, like those of pure geometry, and theoretical mechanics, is, in its nature, different from that derived from pursuing these truths into their practical applications, and even that the two kinds of interest are in some degree incompatible with each other, the practical part of Mechanics is entirely separated from the theoretical, and made to constitute Part II, of the first volume. Two incidental advantages, also, result from this arrangement;—the first is, that the second part furnishes an excellent general review of the principles of Mechanics, in their connexion with each other; and the second is, that in the explanation of the phenomena, either of nature or art, we may avail ourselves of principles taken from every part of the science,—a circumstance which is frequently of great importance to the full and complete explanation of a natural phenomenon.

On this point, a gentleman who has taught the work to a class, and who is very competent to judge of its merits, has furnished us with the following observations. "The arrangement adopted in Olmsted's Introduction to Natural Philosophy, I have found to posses peculiar advantages. By separating the "mathematical elements" from the "practical part," and confining the student, at first, exclusively to the former, his attention is not diverted from the fundamental principles of the science; but these he studies with the same interest as he does branches of the pure mathematics and understands them as perfectly. Those who have either taught or studied Enfield's Philosophy, know that quite the reverse is true in regard to that system, in which the theoretical and practical parts are so blended that each impairs the interest of the other. The pleasure derived from the contemplation of abstract truths depends on qualities of the mind so different from those which delight to follow out their application to useful and economical purposes, that the two kinds of interest can hardly exist together in the mind, but, by a kind of incompatibility, tend to neutralize one another. In this Treatise also, the fundamental principles of Natural Philosophy, are impressed upon the mind of the learner by a great variety of *problems* annexed to each chapter, which, in addition to the intellectual advantages, usually attendant on the solution of mathematical problems, serve to render the student exceedingly familiar with those principles. Thus, the most difficult parts of the work having been first mastered, the perusal of what relates to the practical applications, is easy and delightful. In this part of the work, moreover, there is embodied an amount of useful information rarely to be met with in works of this size. In short, both the plan and execution of the work are such as can hardly fail, it is believed, to commend it to all experienced instructors."

Part I., to which so much importance is justly ascribed, is abridged with numerous additions and alterations, from a Treatise on Mechanics, published a few years since for the use of the students of the East India College, by the Rev. B. Bridge, fellow of St. John's College, Cambridge. We know not where a work could have been found better adapted to the purpose. Bridge is an uncommonly luminous writer; and his Mathematical Treatises bear the impress of a mind well informed of its subject, and (which is quite as important) accustomed to teach. A peculiarity which distinguishes the Treatise of Bridge from almost every similar work, is the great variety of problems with which the work is enriched. This feature Professor O. has borrowed very fully, having retained (though with considerable modification) the greater part of the *Questions for Practice*, contain-tained in the original work, and having added many more. Upon this subject he makes the following remarks. "A great variety of problems are annexed to each chapter, the utility of which must be obvious to every experienced instructor. Indeed, problems hold so important a place in the estimation of the writer, that he has introduced them into various parts of the work, wherever the subject appeared to be susceptible of deriving aid from them. Problems put the student upon his own resources; they compel him to think for himself; they lead him to a just understanding of the principles demonstrated; and they teach him how to reduce his knowledge to practice. These truths are so obvious, that it is difficult to account for the singular fact that treatises on Natural Philosophy, usually contain few or no problems, although they occupy so large a space in most of the branches of pure mathematics."

In the subsequent parts of the work, Hydrostatics and Pneumatics, Acoustics, Magnetism, Electricity and Optics, have severally their proportionate share of attention. To seize upon a few principles of very extensive application; to make the learner well acquainted with these; and to follow them out in many of their practical bearings; are objects which the writer has evidently had constantly in view.

Accordingly, along with these fundamental principles, the truth of which is established by the best evidence of which they are respectively susceptible, the learner is supplied with as great an amount of practical information as could be brought within so narrow limits. For example, in the course of the work, the student will be made familiarly acquainted with the principles of the Steam Engine, the Microscope and the Telescope.

The work is neatly printed, and contains nearly three hundred diagrams in wood, which serve a very valuable purpose, especially in cases where the student has not the advantage of extensive experimental illustrations; and even where he has such aid from apparatus, the diagrams prepare him to take the benefit of them much more fully than he would otherwise do.

The Analysis which is prefixed to each volume, furnishing a clue to all the principal matters contained in every paragraph of the text, and serving a convenient purpose for reviews and examinations, we regard as a highly useful appendage to an elementary work. No better way can be devised for storing in the memory the contents of a book, than to connect with each head of such an analysis, a train of ideas, which, after a few reviews, will, on the principle of association, all recur to the mind, almost at a glance.

We commend Professor Olmsted's book to the examination of teachers of Natural Philosophy, esteeming those the best judges of the merits of any class book, who have had an opportunity of witnessing its effects on the mind of the learner.

Art. XX.—*Obituary Notice of* Dr. Gaspar Spurzheim; *compiled chiefly from the oration of Professor Charles Follen, delivered at his funeral.*

It was the will of God, that the course of this eminent and excellent man should be finished in this country, only four months from the time when he arrived at New York. He had been long known to fame, and was the subject of intense curiosity and interest, on the part, both of those who favored, and of those who did not favor his peculiar views. With only one exception, no stranger ever visited the United States, who, (so far as the short career of Dr. Spurzheim among us will justify the parallel,) possessed the power at once so fully to excite and absorb and gratify the public mind, and at the same time to surpass the public expectation. In every place where he stopped, he inspired respect and kindness; and, fortunately for his fame, and for the feelings of his European friends, the only great intellectual effort which he made in America, was put forth in a community, in which, a high state of mental culture and of benevolent feeling gave him every possible advantage. Boston, including Cambridge, is both a focal and radiant point of intellectual light; and, no where in this country, could Dr. Spurzheim have made his entrance with a more cordial welcome; his displays, with a more undivided admiration; or his exit, with a more sincere and poignant regret. His visits to other places began to be anxiously expected. At Hartford, a large audience, pledged to attend his lectures, was impatiently waiting his arrival; and the hand, that now attempts a feeble tribute to his memory, was already engaged in the grateful duty, of inviting him to give his courses of instruction in the sister city of Connecticut, when, without premonition of his illness, his death was abruptly announced. It was one of those thunder strokes, which, in the full career of life, bring us up with a sudden check, and throw us, all aback. Every man, especially, who presses onward in the habitual pleasure of intellectual effort, and who lives less for himself than for his fellow men; less for the idolatry of his own poor fame than for the honor of his maker; every such man, feels, on an occasion like this, a momentary paralysis of his powers, and is, for the time, disposed to cease from the vain struggles of life. This feeling, so inconsistent with the discharge of duty, is happily temporary. We look on the illustrious dead—we mourn—we pay them the last honors, and then resume our arms, and press onward in our warfare.

On the present occasion, however, we are more desirous to advert to facts than to pursue a course of moral reflections, however, in other circumstances, proper and useful; and happily, we have an interesting biograpical notice of Dr. Spurzheim in the excellent funeral oration pronounced by Professor Charles Follen, in honor of the deceased, which we are permitted to use on the present occasion. We shall quote, in Dr. Follen's own words, the biographical sketch of his departed friend and countryman.

"Gaspar Spurzheim was born on the 31st of December, 1775, at Longvich, a village about seven miles from the city of Treves, on the Moselle, in the lower circle of the Rhine, now under the dominion of Prussia. His father was a farmer, and in his religious persuasion, a Lutheran. Young Spurzheim received his classical education at the college of Treves; and was destined by his friends, for the profession of Theology. In consequence of the war between Germany and France, in 1797, the students of that college were dispersed, and Spurzheim went to Vienna. Here he devoted himself to the study of medicine, and became the pupil, and afterward the associate of Dr. Gall, who was at that time established as a physician at Vienna.

"This extraordinary man had been induced, by an observation made by him when a boy of nine years old, to attempt a new mode of scientific investigation. While at school, young Gall felt mortified at seeing himself surpassed by a number of his school-fellows in all those exercises that required verbal memory. The mortified pupil tried to find out some reason to account for this fact, that boys who in their other exercises were much his inferiors, yet showed better heads in committing lessons to memory. He was struck with the observation that those boys who learned so easily by heart, had remarkably large and prominent eyes. The connexion of this external sign and that mental faculty occurred to him, and he inferred that prominent eyes were a mark of good memory. This observation, insignificant in itself, led Gall to study minutely, on the one hand the prominent talents and individual characters of men, and on the other hand, the form of their heads. Little by little he flattered himself that he could perceive one constant shape in the head of every great painter, every great musician, every great mechanic, severally denoting a decided predisposition in the individual to one or the other of these arts. The study of medicine, and particularly of anatomy, to which he devoted himself, soon induced him to consider the peculiar form of the skull only as the evidence and the effect of that of the brain. This part of the human body, which had always been considered as the principal instrument of the mind, became now the chief object of Gall's investigation; and instead of considering the whole brain, as was formerly the case, as required for each of the different manifestations of the mind, he examined each part with special reference to those prominences of the skull which he had before perceived to be indications of particular talents and dispositions. He considered each of these parts of the brain as the particular organ of each of the different faculties of the mind, in the same manner as the eyes are the organs of sight, and the ears of hearing. Thus, from two sources of observation, from the study of the variety of talent and character, and of the organization of the brain, there arose a new science, the Physiology of the brain, that is, the theory of the different parts of the brain considered as the organs or instruments of the various animal, intellectual and moral capacities.* The physiology of the brain which at first frequently went by the name of Craniology, or the doctrine of the skull, is now more generally known by that of Phrenology, or the doctrine of the mind, by which Spurzheim preferred to designate this new science.

"It was at Vienna, in the year 1800, that Spurzheim first attended a private course which Dr. Gall had repeated from time to time, during the four preceding years, in order to explain to a select audience his new theory of the organs and functions of the brain. The dissec-

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* Hence the medal that was published at Paris after Gall's death, in 1828, bears the inscription, 'Au createur de la physiologic du cerveau.' (To the author of the physiology of the brain.)

tion of the brain itself still remained imperfect untill 1804, when Spurzheim became his associate, and undertook especially the anatomical department. From that time, in their public as well as private demonstrations of the brain, Spurzheim always made the dissections, and Gall explained them to the audience.

"The great interest which was excited by these lectures at Vienna, and throughout Germany, roused the fears of that inveterate enemy of all innovations, the government of Austria. An imperial decree, which prohibited all private lectures unless by special permission, silenced the two teachers, and induced them, in 1805, to quit Vienna. They travelled together through Germany, explaining and demonstrating their physiological discoveries in the principal universities and cities; particularly in Berlin, Leipzig, Dresden, Halle, Heidelberg and Munic. Their anatomical demonstrations excited everywhere great interest and applause. The great German anatomist and physiologist, Reit, before whom Gall and Spurzheim dissected a brain in 1805, at Halle, said to Professor Bischoff, who wrote an exposition of their doctrine, 'I have seen in the anatomical demonstrations of the brain, made by Gall, more than I thought that a man could discover in his whole life.' Their peculiar physiological doctrines on the organization of the brain being adapted to various innate qualities of the mind, found many opposers, but also some warm adherents, and gave rise to a great number of publications in which the subject was discussed.*

"In the year 1807, Gall and Spurzheim went to Paris, where they demonstrated their theory of the brain in the presence of Cuvier, then the chief of the anatomical department of the French Institute, and before many other distinguished men, and learned societies. Meanwhile their collections of skulls and casts of heads, had much increased, so that they were able amply to illustrate their doctrines of special parts of the head, as indicative of mental powers. Cuvier showed himself at first well disposed toward the new doctrine, and expressed his approbation of its general features. But in the year 1808, when Gall and Spurzheim delivered their memoir, containing an account of their scientific labors, to the French Institute, Cuvier was appointed to draw up the report, in which he seemed to labor

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* The first expositions of the doctrines of Gall and Spurzheim were published in Germany between the years 1802 and 1805, by Froriep and Walter, Bischoff, Knoblauch, Bloede; and in Paris, in 1806, by Demangeon.

to diminish as much as possible the merit which he was forced to allow to this new mode of dissection. It is said that Cuvier, whose firmness and independence were by no means commensurate with his great talents, was swayed by the haughtiness of the First Consul, who had seen with displeasure that the French Institute had awarded a prize medal to Sir H. Davy for his galvanic experiments, and 'at a levee rated the wise men of his land, for allowing themselves to be taught chemistry by an Englishman, and anatomy by a German.'

"In Paris, Gall and Spurzheim began to publish their great work on the anatomy and physiology of the nervous system in general, and that of the brain in particular. They also continued their public lectures and demonstrations. They remained and labored together in Paris till the year 1813. In the following year Spurzheim went over to England, and gave his first public lecture in London, in the amphitheatre of Mr. Abernethy. Mr. Abernethy, though he did not give full credit to the evidence brought forward by phrenologists to prove that special parts of the brain are the organs of certain innate qualities of the mind, fully acknowledged the superiority of Dr. Spurzheim's anatomical demonstrations over every previous mode of dissecting the brain. I have been assured by a gentleman who at that time attended Mr. Abernethy's lectures, that he directed the attention of his class to Dr. Spurzheim's anatomical labors as most important discoveries.* Still, the truly scientific method of establishing phrenology by anatomical demonstration, though it secured the respect of learned men, did not render it popular.

"From London Dr. Spurzheim went to Bath, Bristol, Cork, and Dublin, where also he delivered lectures. He then proceeded to Edinburgh. His desire to visit that city was increased by a very abusive article on phrenology, which had appeared in the Edinburgh Review, for June, 1815, concluding with the confident assertion of the writer that his statement of the doctrine of phrenology could 'leave no doubt, in the minds of honest and intelligent men, as to the real ignorance, the real hypocrisy, and the real empiricism of the author.'

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* Mr. Abernethy, in one of his publications, speaks of Dr. Spurzheim as 'a man who had made the motives of human actions a particular study, possessing also great intellectual powers combined with benevolence and caution in decision;' he also expresses the 'great gratification he had in being intimate with Dr. Spurzheim whilst he remained in London.'

"Dr. Spurzheim procured one letter of introduction for that city, and but one; that was to the reputed author of the vituperating essay. He visited him, and obtained permission to dissect a brain in his presence. He succeeded in convincing some of his hearers of the truth of the results of his researches. A second day was named. The room was crowded to overflowing. There, with the Edinburgh Review in one hand, and a brain in the other, he opposed fact to assertion. The writer of the article still believed the Edinburgh Review, but the public believed the anatomist. Dr. Spurzheim now opened a course of lectures on the anatomy and the functions of the brain, and its connexion with the mind. He used to say to the Scotch, 'You are slow, but you are sure. I must remain some time with you, and then I will leave the fruit of my labors to ripen in your hands. This is the spot from which, as from a centre, the doctrine of phrenology shall spread over Britain.'

"Edinburgh, the city from which the great anathema had issued against phrenology, actually became the principal seat of it. There, in 1820, a phrenological society was formed, at the head of which stands Mr. G. Combe, extensively known by his interesting works; and there a phrenological journal continues to be published.

"After a residence of seven months at Edinburgh, Dr. Spurzheim returned, in 1817, to London, where his doctrine had meanwhile made many converts, and where he was made Licentiate of the Royal College of Physicians. During the three years of his residence in England, he published several works on Phrenology, particularly one under the title, *The Physiognomical System*, of which he afterwards published an abstract (*Outlines of the Physiognomical System.*) He also wrote in defence of his principles, his *Examination of the Objections made in Great Britain against Phrenology.*

"Dr. Spurzheim returned to Paris in 1817, where he gave lectures on the anatomy, physiology and pathology of the brain. He also devoted himself to the practice of medicine, and visited, in this capacity, several American families then residing in Paris. Still the medical profession did not seem to be his favorite occupation. At the same time he published some new works in French, and became Doctor of Medicine at the University of Paris, in 1821.*

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* He published a work, *Sur la Folie;* another, *Sur la Phrenologie;* another, *Essai philosophique sur la nature morale et intellectuelle de l'homme;* besides his medical dissertation, *Du cerveau sous les rapports anatomiques.*

"In Paris, Dr. Spurzheim married a lady of great merit. She was a widow and had three daughters when he married her. Dr. Spurzheim had no children of his own. Several ladies of this city, who were introduced to Mrs. Spurzheim in Paris and in London, remember her with the highest esteem and delight. Her whole manner expressed a union of true humility, tender attachment, and conscious power, which excited at once affection and confidence.—She entered fully into her husband's pursuits, and aided him by her uncommon skill in drawing. To her pencil we are indebted for a number of those excellent drawings used by Dr. Spurzheim in his lectures. But far more important to him was the aid which he derived from the unseen and inexhaustible treasures of a true and devoted heart. It was often observed how well their characters seemed to be fitted for each other. They were both adepts in that profoundest of all sciences, and most pleasing of all the fine arts—Christian benevolence shown forth in beautiful manners. It is characteristic of Dr. Spurzheim, that one of the reasons which influenced him in the choice of his wife, was the knowledge that she had undergone great suffering, which he thought essential to the perfection of human nature. An ancient philosopher thought that no one could become a good physician, who had not himself endured many diseases.—Whatever be the merits of this speculation as regards the medical profession, it is certainly true in morals—that no one can so readily perceive and deeply understand, and so successfully alleviate the sufferings of others, as he himself who is a man of sorrows, and acquainted with grief. Dr. Spurzheim was devotedly attached to his wife, and he remained so after her death to the end of his own life. While he was in this country, though surrounded by many whom he had soon made his friends, he often mourned the loneliness of his situation, particularly when indisposition, or fatigue, made him long after those small services of domestic affection and ever watchful care, of which those who devote themselves wholly to one of the great general interests of mankind, be it the cause of religion or of science, stand in special need—that wholesome atmosphere of constant love, the absence of which seems to be felt more painfully the more unconscious we are while we inhale it. In his last sickness, he, in a mournful manner, ascribed his illness to the want of warm linen on his return from his lectures, saying with a sigh, that if his wife had been living, it would have been before the fire ready for him. The disease of his heart he ascribed to his loss of her, saying, his pulse had intermitted ever since her death.

"The death of his wife, which took place about three years since, seemed to remind him more strongly that his life and his labors belonged to all mankind, whose vital interests he thought most effectually to promote by developing particularly the principles of education, morality, and religion, to which his studies of human nature had led him. He had visited England again in 1825, and was engaged partly in lecturing, and partly in the publication of different books. The first work he had published in England, 'The Physiognomical System,' contained several summary views of different branches of anthropology, which he now endeavored to make more generally appreciated, by extending the principal chapters, and making them separate books. In one of them, *Phrenology*, he treats of the different powers of the mind, and their cerebral organs, in general. A smaller book, *Outlines of Phrenology*, is an abstract of that work. The two principal doctrines of Phrenology, that of the brain, and that of the mind, were carried out in different works.

"In his *Anatomy of the Brain*, he laid down his and Gall's investigations of the brain and the nervous system. On the other hand, the doctrine of the mind, with its practical bearings on religion and morality is carried out in his *Philosophical Principles of Phrenology.* The same principles, in a more condensed and practical form, are set forth in his *Philosophical Catechism of the Natural Laws of Man.* The subject of education, on which he rested all his philanthropic hopes, was treated of in his *Elementary Principles of Education*, a book full of the most important information, and excellent counsel. The deranged functions of the brain is the subject of his interesting work on *Insanity*, for which his frequent visits at the Insane Hospitals afforded him a great number of important observations. All the works which Dr. Spurzheim edited after his separation from Dr. Gall in the year 1813, show a spirit of free and indefatigable inquiry.—The improvement in the anatomy of the brain, was chiefly Spurzheim's work; he also discriminated more minutely between different faculties of the mind which Gall had confounded, and he endeavored to point out their relation to the development of the brain; he moreover brought method and order into the scattered doctrines of Phrenology.

"So great was the interest excited by his lectures, on his second visit to England, that in 1826, when he delivered his course in London, 'not only the large lecture-room of the London Institution, but all the staircases, corridors, and passages leading to it, were filled with hearers.' Still, from the nature of the science itself, which requires constant, extensive, and minute study, it was to be expected that many of those who had been induced to embrace it either by the eloquence of the celebrated teacher, or by a partial success in their own phrenological divinations, relaxed in their scientific pursuits; and a number of phrenological societies, formed during the full tide of popularity, dwindled away until they wholly disappeared. Still in Edinburgh, which city Dr. Spurzheim again visited in 1828, the study of Phrenology is pursued with unabated ardor, and diligence. From England Dr. Spurzheim returned to Paris, where he continued to lecture, and where he had collected a large phrenological cabinet.

"In the summer of the present year, Dr. Spurzheim came to this country, where lectures on Phrenology had been delivered long before his arrival, and a phrenological society formed at Philadelphia. On board the ship he proved himself a friend in need to a number of poor emigrants; many of whom being taken sick on their passage, experienced his kind and successful medical assistance. Dr. Spurzheim arrived at New York on the 6th of August, in the heat of summer, while the cholera was raging there, and immediately went on to New Haven, where he stopped a few days. A letter from one of the most eminent men of Yale College, in whose family Dr. Spurzheim spent much of his time, speaks of the 'amiable, winning simplicity of his manners, and his unpretending good sense, and good feeling.' From New Haven he came on to this city, with which he felt already familiar, through a number of Bostonians, with whom he had become acquainted in Europe. He intended to stay in this country about two years, to lecture in the principal towns, then to visit the different tribes of our Indians; and at last to return to Paris. The easy access which that city presents to so many treasures of science, and its being the place of residence of some of his most intimate friends, gave rise, now and then, to feelings of homesickness; which were soon merged, however, in that universal benevolence which made him consider any portion of the human family with which he happened to be connected, and to whom he could do some good, as his nearest relatives."

He delivered in Boston, chiefly for medical men, one course of lectures on the anatomy of the brain; and two popular courses on Phrenology, one in Boston and the other in Cambridge, "which he had nearly completed when death overtook him, in the midst of his labors. In his anatomical demonstration of the brain, he endeavored to unfold the design of nature in the complicated structure of this organ, by tracing its gradual development from its lowest and simplest beginning in the spinal marrow, to its continually increasing, various and harmonious ramifications. This scientific demonstration of the brain, which was made without any reference to the peculiar doctrines of Phrenology, together with his discoveries of some of the constituent parts of this organ, obtained for Dr. Spurzheim here the same high respect as an anatomist of the brain, which had been accorded to him in Europe by the eminent men in that department."

His lectures on Phrenology were attended by large numbers, who listened with high interest to his powerful, natural eloquence, flowing with "impressive earnestness and persuasive sweetness." He had a "fulness of thought and action embodied in a frame which nature herself seemed to have made a strong hold of life and health." His course of reasoning was the Baconian or inductive, founded on facts; he rejected metaphysical speculations founded on nominal distinctions—his maxim being *res non verba*. The principal topics in Phrenology are, the anatomical structure of the brain;—the variety of talents and dispositions among men, and their conformity with particular dispositions and talents,—the latter constituting the *physiology* of the brain. Having never studied phrenology, we are not entitled to pronounce any opinion upon its merits. Dr. Follen remarks that "its results can never amount to more than probable conjectures, and that the great subject which lies at the foundation of moral philosophy, the moral freedom and responsibility of man cannot be determined by the physiology of the brain, however true to nature." He adds, that should phrenology be rejected, the important facts and principles which they have advanced, and among them eminently, "Dr. Spurzheim's principles of education will ever hold a distinguished place. The merits of Gall and Spurzheim as anatomists and observers of man, will never be forgotten."

The great object of Dr. Spurzheim's instruction was the improvement and happiness of mankind and "universal benevolence to the whole family of man was the burthen of his life and of his philosophy." He thought that his system had prevented him from being a misanthrope, and had taught him to love, respect and pity his fellow beings. He evinced himself to be "a true friend of human freedom and universal happiness," and the light that shone in his countenance "was the spirit of truth and goodness."

He was kind even to animals; in his visits to Cambridge, his horse was placed under a warm shelter when he was sometimes regardless of himself.

When he found a child whose head or whose conversation indicated an extraordinary mind, he would find out the parents and warn them of the danger of exciting too much the mental faculties, and of the importance of attending to the moral and physical education of their child. In his visits to the schools in Boston he denounced emulation and mere authority as motives of action, but delighted when benevolence and a sense of duty were made the motives of action.

He was anxious not to give trouble—to prevent future sufferings in others, and was to the last, grateful for every kind service rendered him.

In education he was anxious that the moral and physical cultivation of the pupil should not be sacrificed to the intellectual, and he thought many of our establishments for education deficient in these respects. In his choice of duties, Dr. Follen remarks that he "always chose for himself in preference, the performance of that duty which required the greatest effort and self-denial;" and he adds, what it gives us much pain to learn, "that his anxious desire to fulfil his engagements in Boston and in Cambridge, was the chief cause of his death. Although oppressed by indisposition and contrary to the entreaties of his medical friends, he continued to lecture; and once in his last sickness, he started up with the intention to dress himself to go to Cambridge." At the close of each lecture, he listened patiently to every inquirer, however humble, and never turned him by, to attend to the great, who were waiting.

He never suffered poverty to exclude any one from his lectures, and when his friends were his almoners in the distribution of free tickets, he wished never to be informed to whom they were given.

His love of truth was supreme; he wished no one to believe any thing on his authority but simply from conviction, after due examination. He was unwilling that phrenology should become an instrument of soothsaying and quackery, and he always refused to designate the characters of living individuals by the application of the rules of his science.

He did not believe, with Dr. Gall, that there was an organ for theft and one for murder, which he thought inconsistent with the benevolence of God.

"All his writings and lectures (says Dr. Follen,) were marked by the decidedly religious tendency of his mind. He firmly believed in the essential truths of natural and revealed religion. He adopted christianity as a divine system, chiefly on the ground of its great internal evidence, its perfect adaptation to human nature, and the spirit of truth and divine philanthropy which gives life to all its precepts. All morality, he thought, was contained in two precepts—'Thou shalt love the Lord thy God and thy neighbor as thyself.' All prayers, he thought were comprised in this one—'Father, thy will be done.'"

"The great aim of all his inquiries was to search out the will of God in the creation of man. Obedience to his laws he considered as the highest wisdom and the most expansive freedom," included in the short sentence 'Thy will be done.' "We look to him perhaps," he would say, "amid great trials and on great occasions; but not in smaller things. We say 'they are too little.' It is this, in which we err. Can any thing that concerns his children be too little for a *Father?*"

"Religion he thought, must be the result of the freest and most exalted use of our reason;" we presume, however, in accordance with revelation, for one of his friends writes to him from Paris, as one "well acquainted with Holy Writ."

In Boston, his time was spent principally in preparing and delivering his lectures, and in visiting all kinds of public institutions, and he evinced the deepest interest in education, reformation of morals and and prevention of vice.

He thought favorably of our American institutions; he considered it as a great happiness that wealth is not here, long, hereditary, and that men have, in this country, to make their own way.

He thought, however, that we were in danger from self love and ambition, and that if feelings of veneration and respect were not cultivated in the young we should, by and by, have fighting.

To the compiler of this notice he said, with reference to the permanency of our institutions, when it was stated that, as they had lasted two hundred years, it was hoped they might be permanent. "True—but, as yet, you have room enough and bread enough, but how will it be when your population becomes so dense that man touches man, and there is no more room nor place; how will it be then? I give you, added he with a smile, five hundred years for your experiment; if your institutions stand five hundred years, they may perhaps be permanent."

Dr. Spurzheim fell a victim to his great intelleetual labors and to undue exposure, by night rides, to Boston after his lectures at Cambridge. During his lectures, his mental and physical exertions were so great, that large drops rolled from his face, while his delivery was, at the same time, "easy, calm, systematic and even sportive." "At one of his last lectures in Boston, (the beautiful one on charity and mutual forbearance) he was seized with shivering, which proved the commencement of a fever; but, against the wishes of his friends, he continued to lecture, thinking that it would assist him to throw off his indisposition. Owing to the constantly increasing number of his hearers, he exchanged the lecture room in the Athenæum for the large hall in the Temple. He had finished his course except one lecture, and before he left the hall he asked "In what place shall we meet next time?"

Alas! it was not to be in this world!

He returned to his lodgings and never left them again. During his sickness, every professional and friendly assiduity was shown him, for which, while his faculties were his own, he was very grateful; but he relied more on nature than on medicine, and frequently refused to take the remedies prescribed.

Through his sickness, however, he was patient and submissive, and distinctly announced his own views of his case in the emphatical words "I must die;" when his friend replied—I hope not—he added "Oh yes, I must die; I wish to live as long as I can, for the good of the science; but I am not afraid of death."

His feelings were affected even to weeping by letters from his friends in Paris,* received a day or two before his death. An increasing delirium ended in stupor, from which he was occasionally roused, especially when addressed by a friend in his native tongue.

With his hands folded upon his breast, and an uplifted countenance, he died without a groan, on the night of the 11th of November; and although he breathed his last in a land of strangers, he was surrounded by affectionate friends, and by able physicians, emulous of doing something to rescue him from death, or to smooth his downward passage to the grave. He was in the 56th year of his age.

Artists were eager to copy the outlines of his "noble and benign countenance;" the most eminent men met to arrange the solemnities of his funeral, which was honored by a public religious service in the ancient and venerable South Church; his body, after being examined, was embalmed and placed in the receiving tomb of Mount Au-

* The public prints mention his having then received a letter from an affectionate sister.

burn,* that if desired, it might be at the disposition of his friends in Europe ; a secure and proper disposition of his papers, specimens, and effects, was made, in the hands of responsible men ; a solemn and pathetic ode was composed for the occasion of his funeral ; the medical association met and passed appropriate resolutions to honor his memory, and no circumstance was omitted which could gratify the living or honor the dead.

Dr. Spurzheim's temperance and abstemiousness were very remarkable. "We have seen him, (says Dr. Follen,) sitting down to sumptuous meals provided in honor of him, and have seen him fasting for the want of food adapted to his simple taste." The same fact was conspicuous at New-Haven ; at evening, a tumbler of milk and a cracker, or a piece of the simplest cake, satisfied the demands of his athletic and commanding frame, and left his fine intellect without a cloud.

In his last sickness he appears to have relied too confidently upon the strength of his constitution, and the simplicity of his habits of living, which led him to neglect the use of medicine; his vigorous intellect sunk under the exertion of its own intense energy, and his physical powers were broken down by his mind; as was happily said by another, *the sword eat up the scabbard.* Such a catastrophe should prove a warning to all ardent, intellectual men, who, when impelled by great motives, are in peculiar danger of prostrating their faculties, and of coming prematurely to the grave.

Dr. Spurzheim was in New-Haven during the week of the annual commencement. He was much interested in the public exercises, the whole of which he attended, and it was easy to read in his expressive features the impressions made upon his mind by the different speakers; it was obvious that he understood every thing that he heard. In the evening of the commencement day he attended the annual meeting of the society of the Alumni, and listened attentively to their discussions.

He dissected the brain of a child that had died of hydrocephalus, and gave great satisfaction to the medical gentlemen present by the unexampled skill and the perfectly novel manner in which he performed the dissection. At Hartford he was deeply interested in the fine Institutions in that city, particularly in the Asylum for the deaf and dumb, and in the retreat for the insane.

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* The Père la Chaise of Boston.

Had he lived to perform his purposed tour of two years in this country, and to give lectures in its principal cities, there can be no doubt that he would have produced a powerful impulse in favor of moral and physical education, which, whether his views of phrenology had gained ground or not, would hardly have failed to be very serviceable. Except detached notices of his lectures published in the foreign journals, we have not read his writings, and therefore do not pretend to give any opinion of them. The most important are now in a course of republication at Boston, and will, doubtless, be extensively read.

MISCELLANIES.

FOREIGN AND DOMESTIC.

Extracted and translated by Prof. Griscom.

NECROLOGY.

1. Within the first six months of the year 1832, the following distinguished individuals have paid the debt of nature.

England.

George Crabbe, one of the best poets of the age, aged 63.

Andrew Bell, D. D., well known as the founder of the system of instruction pursued in the national schools of England. Born in 1753, at St. Andrews. His remains were deposited in Westminster Abbey.

Sir James Mackintosh, a distinguished jurist and writer, aged 62.

Jeremy Bentham, a noted philanthropist, and civilian, aged 85.

Sweden.

T. Ornie, a celebrated writer. Destroyed himself by charcoal—attributed to domestic grief.

Switzerland.

C. De Bonstetten, a metaphysician and politician, aged 86.

Naeff, founder of a school for the deaf and dumb at Yverdun.

Italy.

Camille Borghèse, brother-in-law to Napoleon.

Abbé *Angelo Cesaris*, first Astronomer of the observatory of Milan; editor of the *Ephemerides Astronomiques de Milan.*

France.

Baron *Boissel de Monville*, anthor of Geodesical works, and a work on Philosophy in 1824, under the title of *Peut-être*, aged 68.

Baron *George Cuvier*, perpetual secretary of the Academy of Sciences; a distinguished naturalist, aged 63.

George Simon Serullas, a celebrated Chemist, aged 58. Seized with Cholera, on returning from the obsequies of Cuvier. He had been just elected to the chair of Chemistry in the Garden of Plants, vacant by the death of M. Laugier. The vacancy again produced by his death, was filled on the 6th of August, by the election of M. Dumas.

——— *Christian*, ex-director of the Conservatory of Arts and Trades.

Auguste Duvau, a distinguished botanist, aged 61.

Evariste Gallois, professor of Mathematics.

Doctor *Leroux*, dean of the Medical Faculty of Paris, aged 83.

Albéric Deville, professor of Natural History; author of Fables in poetry.

——— *Meyranx*, professor of Natural History; author of various useful works.

Jean François Champollion, celebrated in Egyptian Antiquities, aged 42.

——— *Abel Remusat*, a celebrated orientalist.

Guillaume-Louis-Julien Carré, author of a learned work on the Civil Code, aged 55.—*Rev. Encyc.*

2. *Sketches of the lives of* Louis Simond *and* Charles-Victor Bonstetten, by M. DeCandolle.—In an anniversary discourse, delivered by M. DeCandolle, as Rector of the Academy of Geneva, are the following notices of the lives of two literary men of that city, one of whom was for several years well known as a man of letters, and a distinguished merchant in the United States.

Extract.—After having spoken of our progress, I must also speak of our losses, and in doing this I enter upon the most painful part of the task imposed upon me. The year which has just elapsed, will long be distinguished in Europe, by mournful characters on account of the number of distinguished men who have finished their course within its narrow limits. Champollion, Cassini, Cuvier, Abel-Remusat, Göethe, Mackintosh, Bentham, &c. and although we have thus far enjoyed the favored privilege of an exemption from the scourge which has desolated so many countries, we have nevertheless, occasion to lament over the losses we have sustained.

Our regrets ought not to be restricted to those whom the chance of birth had placed within the limited verge of our Canton. From the earliest period of the republic, Geneva has afforded a hospitable asylum to all the friends of letters and science, who have desired to avail themselves of it. She has given a fraternal welcome to all those whose feelings have sympathized with her own; all those whose talents have gained the public approbation; she has been indebted to this reception of learned strangers for a portion of our literary lustre. The present age is conforming to the habits of the past, and is attaining from them analogous results: among those whom the public sentiment places in the most elevated ranks, are men born in foreign countries, and adopted by our laws and our society. Two of the most honorable have been removed from us during the present year, and I should fail in the duties which the academy has assigned me, if the names of Simond and Bonstetten were not found in the mortuary scroll which I am obliged to enrol before you.

Louis Simond was born in Lyons, in 1767; his father was a merchant, and having destined his son to the same pursuit, he gave him an education strictly conformable to his views, and placed him at an early age in a counting-room. At the approach of the revolution, Simond, then about 21, set out for the United States, and soon became one of the most considerable merchants of the city of New-York. He travelled extensively through different States of the Union, and published fragments of his observations in the *Bibliothèque Universelle.* He acquired a handsome fortune, a portion of which he lost in consequence of his benevolent efforts in favor of his fellow-countrymen. His house was a rendezvous of the most distinguished Frenchmen, who were compelled to expatriate themselves on account of the troubles of their country. In their conversation, Simond was strengthened in his taste for letters and useful knowledge, and at the the age of 35 he undertook the difficult task of revising his education. He made judicious extracts from all his readings, and took pleasure in combating the negligence of his early instruction. A character firm and persevering, and a sincere love of truth, qualified him for the vanquishment of every obstacle. In 1809, he made a voyage to England, and wrote to his brother-in-law in America,* a

* Charles Wilkes, Esq., of New York.

regular account of his observations in that country. After an abode of two years, his nephew,* the celebrated Jeffrey, editor of the Edinburgh Review, induced him to publish a collection of his letters, and this gave rise to his *Travels in England*, two editions of which, are ample evidence of its success, and served to place the author, almost without his knowledge, in the career of literature. In 1816, he returned to the continent, and left Paris on a journey to Switzerland and Italy. He remained for some time among us, and bestowed a particular notice on our Canton in his Travels in Switzerland, the success of which is also demonstrated by two editions : he afterwards published his account of Italy. In 1820, on his return to Paris, he wrote for the *Edinburgh Review*, and for the *Journal des Debats*, several articles on political economy, which indicated an original and independent mind. He had there the misfortune to lose his wife, a lady of rare merit, a circumstance which severed his attachments to the United States. He then decided upon retiring to Geneva, which he stated to be a country the most worthy of liberty, and the happiest that he had seen. He here married one of our countrywomen, and became a citizen of our Canton. A short time after he was, by numerous suffrages, called to the representative council, and in 1823, he was appointed Mayor of the Commune of Versoix : his efforts in favor of primary education in this commune, not less than his numerous benefactions, justly claimed for him the gratitude of the inhabitants, and have had a happy influence in ameliorating the condition of the schools of the Canton. He was engaged in a work upon the penitentiary system, when a sudden death removed him from a family which adored him, and from his newly adopted fellow citizens, whose esteem and affection he had thoroughly secured. Under a taciturn and morose exterior, he bore a serene mind, and a warm heart. He always disdained the mere show of sentiment as a substitute for sense and intelligence. Naturally inclined to look upon the dark rather than the bright side of things, and an enemy of all enthusiasm, he rectified, by his enlightened love of justice and humanity, the austerity which such a temperament might otherwise have produced. Having been his own instructor, he acquired the habit of judging for himself, without being controlled by the opinion of others ; but the moderation of his sentiments softened the authoritative influence of this independence. His opinions could not always

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* By marriage.

be adopted, but his language uniformly spoke the convictions of his mind, and his regard for the public welfare. He was a truly good man, a practical philosopher, a grave and striking example, which reminds us of the virtues of antiquity, and commanded our respect.

If, without departing from the ranks of the most honorable philanthropy, I had wished to seek for an example of the most striking contrast to Mr. Simond, I should have found it in the person of his friend and my own, Charles Victor de Bonstetten, of whom it remains for me to speak. He sprang from one of the most illustrious families of Switzerland, and was born on the 3d of September, 1745, in the highest of the patrician ranks. His father, treasurer of the State of Bern, and a distinguished magistrate, early perceiving the promising dispositions of his son, watched carefully over his primary education, and then sent him to our city for the completion of his studies. It was thus that Bonstetten became initiated into our society. He was intimately attached to Charles Bonnet, who always designated him in his correspondence with Haller, by the name of Telemachus. He acquired in the conversation of this able and benevolent Mentor, a strong taste for psychology, which afterwards laid the foundation of some of his works.

It may be doubted whether a direction so opposite to the natural disposition of Bonstetten, contributed to his success. Endowed with an imagination, lively, active and quite poetical, with a heart accessible to all the feelings of benevolence, love and friendship, he found himself, by his taste for metaphysics, and by the nature of the services in which he engaged, drawn into a field of labor, but little in harmony with his native feelings. He travelled, while young, into various countries, and formed connections with distinguished men, among whom he loved to name the poet Gray. On his return to Bern, he engaged in the administration, and filled the station of bailiff, at Gessenay and Nyon, magistrate of the Italian bailliages, and member of the Bernese council of public instruction. He brought into these stations a lively concern for questions of general interest, but little taste for the minute details with which the duties of administration are so often embarrassed, especially in a republic. His ardent love of justice and humanity, his amiable disposition, the gracefulness of his manners and conversation, easily obtained for him, in all good minds, a pardon for his frequent fits of absence, his disregard for the superannuated forms of etiquette, and even for the gaiety and carelessness which were so unusual a concomitant of these grave duties. His abode at Gessenay, gave rise to a description of that picturesque country; his sojourn at Nyon is impressed on the memory of the present generation, by the numerous services which he rendered to the persecuted of all countries, and all opinions.

After the fall of the ancient government of Bern, De Bonstetten, restored to liberty, renewed his travels for the purpose of enlightened observation. He passed through Italy, and especially the province of Latium, which he traversed with his Virgil in his hand, and of which he published a lively and original description. He went afterwards to Denmark, and the physical and moral contrast of these two countries was so impressed on his mind, as to give rise to a charming work, *L'Homme du nord et l'homme du midi*, and to another less known, entitled *La Scandinavie et les Alpes*. In the first, he compares the north and the south, especially in their moral relations; in the second, the worth of Europe and Switzerland, chiefly in their physical characters. The tendency of his mind naturally gave to the first of these essays, a decided superiority. At the conclusion of a journey in France, he published his *Pensées sur divers objets de bien publique*. It displays that enlightened love of prudent liberty, and that amiable philanthropy which directed his whole life. On his return from these several journeys, he took up his abode within our walls, whither he was drawn, as well by the recollections of his youth, as by the great number of distinguished friends whom he found there, gathered at that time around Mad. de Staël, Pictet, and many others, whom we shall always regret. It was in this retreat, embellished by friendship and the conversation of enlightened men, that he wrote the works above mentioned, and his two great philosophical treatises on the laws of the imagination, and on the nature of man. In rendering the justice due to the real merit of these works, we, nevertheless feel, in reading them, that the author does not shine in his native brilliancy. The grace and the freedom of his style disappear in this too didactic species of writing. His genuine triumph was in the epistolary style. He was intimately connected in his youth with the celebrated historian Müller, and there remains a collection of their letters replete with judicious and striking observations. Connected at a later period by a tender friendship with the German poet, Matthisson, and with Mad. Frederique Braun, a woman of wit and learning, his correspondence with these two distinguished persons, is also preserved, and it is in them that we discover the flexibility of his style, and the amiable diversity of his reflections. At a still later period, even when we were about to lose him, at the age of 86, he wrote, under the title of *Souvenirs*, a small work remarkably characterised by the same juvenile qualities. A few days after its publication, he was struck with apoplexy, which during ten days kept him, as it were, suspended between life and death;—deprived of the power of speech, but not of sensibility, or of reason, he exhibited the most afflictive spectacle which a family and friend can be called upon to support. His death, which happened on the 3d of February last, seemed to be, in consequence of their profound attachments, like a deliverance through the favor of heaven.

De Bonstetten furnishes, in his intellectual developments, remarkable contrasts. Born in a privileged class, he manifested, while young, the love of equality, and of a wise liberty. Born on the borders of the two languages, and consequently in a country in which neither the one nor the other is spoken with great purity, he raised himself into the rank of good writers, both in French and German, and in the latter, particularly, he shines by the grace and rapidity of his style.

The pupil of a profound metaphysician, allied in friendship to men devoted to the most serious studies, he glitters in all the charms of a poetic imagination. The greatest point which he gained by his philosophic studies, was the habit of watching over himself. No one better understood the art of happiness, even in the extremity of age. He preserved to the last the most engaging dispositions of youth. He watched, with animation the advancement of civilization, as if he had a long time for its enjoyment: his affectionate feelings sought with avidity new attachments, but never abandoned old ones, and proved, as he himself observed, that one may be easy without being unfaithful. His house was ever open to strangers of distinction, and his active benevolence contributed to render their stay among us agreeable. Nothing can ever restore to us that sustained beneficence, that touching simplicity and cheerfulness of old age, that poetry of an imagination always fresh and exuberant, that urbanity of the eighteenth century, seasoned by the philosophy of the nineteenth.

Thus, the men whom we are accustomed to love, to esteem, and to admire, are disappearing from amongst us. What can console us for so many successive privations? We who have been, also, for some time on the stage of action, we are drawing toward the conclusion of our parts. What we have been enabled to accomplish for the honor and welfare of our country is drawing to its consummation. It is upon our youthful colleagues, among whom I delight to behold so many promising hopes, that this care must devolve. They, even in their adolescence, must prepare to act their parts with honor to themselves. May the youth who hear me never remain satisfied with a barren admiration of those who have gone before them, but may those who feel within them some sparks of the sacred fire labor faithfully to restore it to us. May they remember that the literary and scientific lustre of Geneva has been one of the principal points in the interests of Europe, and consequently of our independence.

Young men, you have enjoyed in the improved state of our institutions, immense facilities for your education. May they be fruitful in your hands! your predecessors have had but one sad advantage over you, that of having labored in times of trouble, which compelled them, perhaps, to draw upon themselves for all that their strength was able to afford them. Fatal advantage which I am far from wishing you to enjoy, and the return of which must be deprecated by every friend of his country. But suffer not yourselves to be enervated by your happy condition; learn to preserve the activity of your minds, in the midst of a life, as I hope, exempt from storms; learn to pursue a course conformable to your talents and to pursue it with energy. Learn to resist the seductions with which our public and domestic habits fritter into rags the time of the most active; learn that there can be no possible success without great labor and a most willing patience; learn to withdraw from the seductive allurements of a life of pleasure, visit foreign countries, not passing through them in a hasty manner, but by studying their civil polity, bring back to us every thing that is really useful; bring back also hearts more truly Genevese, by a more enlightened sense of the liberty and happiness we enjoy. Do your best to preserve to us now and forever, that sage liberty, the friend of order, of justice, and of peace, which we now enjoy, and without which all improvements become hazardous and problematical. Young people, the country has its eyes upon you and you will not disappoint its expectations.—*Bib. Univ. Mai*, 1832.

CHEMISTRY.

1. *Combinations of carburetted hydrogen.*—Note by M. Dumas.—I published, some years since, a work on Ethers conjointly with M. Boullay, the principal object of which was to show that bi-carbonated

hydrogen may be considered as a base capable of uniting with water and acids. These results have met with some objections, not in relation to the facts themselves, but with respect to the general theory which serves to group them. I now furnish a new example in confirmation and extension of the laws then deduced.

There exists in artificial camphor a new carbonated hydrogen discovered by M. Oppermann. One volume of this body which I designate by the name of *camphogene,* includes ten volumes of carbon, and eight volumes of hydrogen.

One volume of camphogene and half a volume of aqueous vapor produce *essence of turpentine*, a combination which in this respect resembles sulphuric ether.

One volume of camphogene and one volume of hydrochloric acid produce artificial-camphor, a composition which thereby resembles hydrochloric ether.

Camphogene may be combined in various proportions with oxygen.

One volume of camphogene, united with half a volume of oxygen constitutes ordinary camphor, a combination analogous to the protoxide of azote with respect to the mode of union of their elements.

Common camphor is a base.

One volume of common camphor and one volume of hydrochloric acid form a neutral hydrochlorate of camphor.

Four volumes of common camphor and a proportion of nitric acid, constitute *the oil of camphor* of the old chemists, the bibasic and anhydrous nitrate of camphor.

Sulphuric acid agitated with camphor forms more complicated products. Chlorine exerts a strong action on camphor, but I have not been able to develop the nature of the products.

Two volumes of camphogene and five volumes of oxygen produce camphoric acid.

The form of these determinations would be somewhat changed if the analyses of MM. Liebig and Oppermann should be preferred to my own results. In researches of so delicate a nature, it is difficult to decide. The body which I name *camphogene* would be formed, according to their analyses, of twelve volumes of carbon and nine volumes of hydrogen. In this case, cholesterine would be a hydrate of that body, the *capric* and *caproïc* acids would be combinations analogous to the deutoxide of azote and to nitrous acid. If I am not mistaken, these bodies will belong on the contrary to a new series analogous to that of camphogene.

These determinations suffice to show that the time is not far distant when the greater proportion of organic substances will be methodically classed conformably to the same bases as mineral chemistry.—*Ann. de Phys. et de Chimie, Decem.*, 1831.

2. *Separation of the protoxide from the oxide of Iron;* by M. Liebig.—In certain applications, this mode of separation becomes important. Cotton printers make use of pyrolignite of iron to obtain every various effects in coloration, and it is a problem of some consequence to them, to know exactly, before they employ this salt of iron, the quantity of oxide it may contain, in order to produce with certainty, a uniform tint.

This knowledge may easily be gained by means of magnesia.—Take two quantities exactly equal of pyrolignite of iron—oxidize one of them by adding to it water charged with chlorine, or by boiling it with nitric acid—precipitate by ammonia, and thus determine the entire weight of iron in the solution. Take the other equal part and boil it with magnesia, then filter it; the protoxide of iron is afterwards changed to red oxide by means of an aqueous solution of chlorine, and precipitated by ammonia after adding a certain quantity of sal ammoniac to prevent the precipitation of the magnesia.

The relation of the weights of these two precipitates, after deducting the second from the first, will express, with sufficient exactness, the relation of the oxide to the protoxide.—*Idem, Nov.* 1831.

3. Narceine, *a new substance discovered in Opium.*—M. Pelletier, in endeavoring to obtain from one and the same portion of opium, all the proximate principles which it contains, was led from the modification which he adopted, to the discovery of a new immediate principle which he has called *narceine.*

This substance is distinguished by the following characters: crystallizes in needles which are prisms with four very slender faces, soluble in alcohol and water, insoluble in ether, taste bitter and styptic, not volatile, melts at 92° cent. Its principal distinctive character consists in the beautiful blue color which it assumes in combining with acids at a certain degree of concentration; its combinations with acid are of the nature of salts. The base can be withdrawn unaltered.

The proximate principles, separated in succession by M. Pelletier, from opium, are twelve in number, viz., *morphine, narcotine, meco-*

nine, narceine, meconic acid, brown acid, an acid fatty matter, resin, caoutchouc, gum, bassorine, and ligneux. The narceine is the only one entirely new.

Agreeably to Pelletier, of the twelve substances of which opium is composed, four are electro-positive, (that is act as bases,) morphine, narcotine, meconine, and narceine; four are electro-negative, (that is act as acids,) meconic acid, brown acid, fatty acid, and resin; and four are chemically indifferent; caoutchouc, gum, bassorine and ligneux. The active properties of opium appear to reside in the electro-positive substances. Experiment, however, has not yet confirmed this fact, in relation to narceine.*—*Rev. Encyc. Juillet,* 1832.

4. *Meconine.*—The chemical history of this substance was read by M. Couerbe, the discoverer, to the French Academy, on the 20th of August, 1832.

It was discovered in 1830, by M. Couerbe, and about the same time perceived and imperfectly described by M. *Dublanc.* The process followed, and described in details, by the former, is, in substance, the following. An aqueous solution of opium is filtered, evaporated, and precipitated by dilute ammonia—the mass formed in the ammoniacal fluid after a repose of fifteen or twenty days, is dissolved in boiling alcohol, and crystallised—these crystals are purified by solution in boiling water, and by animal charcoal—the crystals, which are again formed, are treated with boiling ether, which dissolves only the meconine, which is allowed to crystallize. *Meconine* is white, crystallizes in six sided prisms, two sides of which are larger than the others, terminated by a dihedral summit—without smell—its taste, at first insensible, afterwards becomes acrid—at 90° cent. it liquefies—melts completely at 90.50°, and remains fluid at 75°—at 155° it vaporises, and may be distilled unchanged—in cooling it becomes a white mass—soluble in 265¾ parts of cold water, and in 18.55 parts of hot water—more soluble in alcohol and ether, and crystallizes from all these solutions. Heated with water it opalises, the crystals become deformed, rise to the surface in flocculi, then assume an oily appearance, and at length disappear; dissolved in water, it is precipitated by sub-acetate, but not by neutral acetate of lead; it dissolves in most of the alkalies from which it is precipi-

* A very favorable report on Pelletier's memoir on Opium, was made to the Academy of sciences, by Chevreul and Gay Lussac.

tated by carbonate of ammonia; several of the acids dissolve it without combination, for example, hydrochloric and acetic acids—others change its nature, especially sulphuric and nitric.

The composition of meconine, deduced from four analyses, is

		Atoms.	By calculation.	Weight of Atom.
Carbon,	60.247	9	60.234	
Hydrogen,	4.756	9	4.742	1142.102
Oxygen,	34.997	4	35.023	

Rev. Encyc. Aout, 1832.

5. *Effects of the thermo-multiplicator.*—This instrument was invented by M. Nobili, (vide Am. Jour., Vol. xxii. p. 370,) and consists of a thermo-electric pile, united to a galvanometer. M. Maced. Melloni has rendered it more sensible and more applicable to radiant heat by several improvements suggested by the inventor himself. In a letter to Mr. P. Prevost, M. Melloni enumerates some interesting effects exhibited by this instrument.

Calorific rays proceeding from iron heated to a dull or to a cherry red, are completely stopped by a stratum of water of two or three millimetres in thickness. It is the same with heat from the flame of alcohol or sulphur. When the heat of the iron surpasses the above, some rays begin to pass through, and the quantity increases to white heat, conformably to the law which Laroche found for glass. The quantity of heat transmitted varies also when issuing from the flames of oil, tallow, wax, wood, resin. The greatest effect seems to be produced by an argand lamp, and by the solar rays.

A singular result is the following, which clearly proves the existence of two very distinct qualities in calorific rays. A thermometer is placed on the front surface of a layer of water, and a thermo-multiplicator, behind the same layer. An iron ball at a dull red heat is brought near—the thermometer rises from 60 to 90°, and the thermo-multiplicator remains unmoved. A double argand lamp is then placed at the distance of a few feet: the thermometer does not move while the thermo-multiplicator shows a deviation of 36°.

The rays from the former source, although endowed with great energy, are wanting in that quality which those from the latter source possess—the property of passing through water.

A slight degree of transparency seems necessary to render a body permeable to radiant caloric, and yet the calorific permeability of different media is far from being proportional to their transparency.—

The [bi] chloride of sulphur, for example, a very deep red-brown fluid, the fat and essential oils; and many saline solutions strongly colored are much more diathermous than acids, ether, alkalies, and water. The chloride and carbonate of sulphur offer the easiest passage; water, of all the substances subjected to experiment, is that which resists the most. The order of permeability does not change with the degree of heat in the radiating focus, but the differences of permeability are lessened in proportion to the elevation of the heat of the focus. The writer affirms, as he says with certainty, that the greater the refractive power of a substance, the more easily does radiant caloric find a passage through it.

These experiments of Melloni are in confirmation and extension of results obtained by P. Prevost, and published by him in 1811.—*Bib. Univ. Avril,* 1832.

6. *Oxygenated Water.*—M. Thénard announces, that having been consulted by physicians, relative to the mode of preparing in an easy manner, the oxygenated water which is supposed to be useful in the symptoms of cholera asphyxia, he has modified the common process so as to render it very simple. It is only necessary to add to the hydrochloric acid used in dissolving the peroxide of barium, a small quantity of phosphoric acid. This acid seizes the oxide of manganese, and other metallic oxides which may exist in the solution, and hinders them from decomposing the binoxide of hydrogen.

When the liquor is saturated and prepared in the ordinary way, it is sufficient to add a convenient quantity of sulphate of silver, or even an excess of sulphate of protoxide of mercury, to agitate awhile and filter.—*Rev. Encyc. Avril,* 1832.

7. *Two chlorides of sulphur.*—Thénard and Gay Lussac, made a very favorable report, (June 11,) on the memoir of Dumas on this subject.

Chemists have hitherto recognized but one combination of sulphur with chlorine, although the compounds of these elements present themselves under different aspects, some red and some yellow. M. Rose indeed suspected that the red owed its color to an excess of chlorine, but his hypothesis was supported by no fact. Dumas conceived that the two kinds were distinct compounds, and to be certain of it, he subjected them to a rigorous analysis, having obtained both the red and the yellow chloride of a high degree of purity. He has accordingly proved that the yellow kind is a protochloride, composed of one atom of sulphur, and one atom of chlorine, and that the red is a bichloride, formed of one atom of sulphur and two atoms of chlorine. —*Rev. Encyc. Juin*, 1832.

8. *Density of the vapor of sulphur and of phosphorus.*—The researches of Dumas on these points, have also obtained the approbation of the same distinguished chemists.

To determine the density of the vapor of sulphur, chemists had resorted to the known analogy of this substance with oxygen. Thus the vapor of water is formed of one volume of hydrogen, and half a volume of oxygen, whence it was concluded that sulphuretted hydrogen contained in like manner, half a volume of sulphur, and one volume of hydrogen. Now the density of hydrogen being 1.1912, that of the vapor of sulphur should be 2.24.* Such was, in fact, the number generally adopted. Dumas, however, in several experiments conducted with great care, found it to be just about three times as great, which induces him to believe that there is only one sixth of the vapor of sulphur in sulphuretted hydrogen, as in sulphurous acid.

Phosphorus was subjected by Dumas to similar trials, and the density of its vapor was in like manner, found to be different from that deduced from the density and analysis of protophosphuretted hydrogen gas, agreeably to the supposed analogy between phosphorus and azote. The density, by direct measurement, has been found to be 4.32, the double of that generally accepted.—*Idem.*

9. *Preservation of substances by means of alkalies.*—M. Payen has preserved, during many months, polished instruments of iron and steel by keeping them in solutions of potash or soda,—saturated solutions diluted with one, two or three times their weight of water. He at first thought that the preserving power depended upon the disappearance of the air and carbonic acid in the alkaline mixture, but he afterwards concluded that alkalinity acted an essential part in the phænomenon. In fact a very small quantity of alkali is sufficient; —thus $\frac{1}{2000}$ and even $\frac{1}{3000}$ of caustic potash in water, will preserve from oxidation, bars of iron, &c. immersed in it. Lime water diluted with its own weight of water, or of course without dilution, answer the same purpose. Alkaline carbonates and borax have the same effect, but they must necessarily be stronger.—*Rev. Encyc. Aout*, 1832.

* These numbers are different from those heretofore used, and we have not access to the authority.—*Ed.*

10. *Crucible for fusion.*—Persons who wish to melt or assay steel are not aware how easy it is to obtain, in the space of twenty minutes, a melted mass of one or two ounces without the least difficulty by means of the following arrangement.

Make a hole in the bottom of a Hessian crucible holding two or three quarts,—put inside of this crucible the cover of a smaller crucible so that it may rest at about three fourths of the depth. Make with a file several notches around this cover to admit the air freely, having the knob of the cover uppermost. On this knob place a little crucible containing the metal, which must be covered,—put some lighted charcoal around it, and then fill up with coke (or anthracite coal?) so as to cover entirely the interior crucible. Connect this apparatus with a blacksmith's or other bellows and keep up a constant blast, supplying the waste coal as it is consumed,—in the course of the time mentioned the steel will be melted. Other minerals, even some that are reputed infusible, will yield in like manner. This simple and cheap apparatus abridges time and labor surprisingly, and effects what with the common and costly furnaces would be impossible.—*Jour. de Con. Usuelles, tom.* 15, *p.* 143.

11. *Researches relative to the azote formed in animal substances; by* MM. Macaire and Marcet.—These judicious chemists, after remarking upon the influence of life in the transformations of alimentary materials—the importance of physiological investigations into the causes of the distinctions between vegetable and animal matter, and especially of well devised efforts to trace the origin of azote, or rather the causes of its greater abundance in the animal than in the vegetable system, proceed to remark that the fact may be accounted for on three assumptions.

1st. That the azote of animals is contained in the food by which they are nourished.

2d. That it is drawn from the atmosphere in respiration, or,

3d. That animals have the property of creating it, by transforming into azote other elements subjected to the action of the vital forces.

In the course of their inquiries they had occasion to examine the composition of chyle. As soon as extracted it was introduced into the receiver of an air pump, placed on sand slightly warmed near a vessel of strong sulphuric acid, and thus by prolonging the vacuum, reduced to a perfectly dry gray powder. This was analyzed by means of the black oxide of copper with the following results.

	Chyle of a dog.	Chyle of a horse.
Carbon,	55.2	55.0
Oxygen,	26.9	26.8
Hydrogen,	6.6	6.7
Azote,	11.0	11.0

The horse having been fed on vegetables, and the dog on various aliments, the result shows that the food had little or no influence on the composition of this animalized product.

They found, however, that the excrements of the dog were more of an animalized character than those of the horse. Being dried with the same precautions as the chyle, the results were

	Excrements of the dog.	Excrements of the horse.
Carbon,	41.9	38.6
Oxygen,	28.	29.
Hydrogen,	5.9	6.6
Azote,	4.2	0.8
Min. and earthy sub.	20.	25.

After stating the nature and offices of the blood, the authors remark that in composition, they found the blood of sheep, rabbits, horses, oxen, dogs, so nearly alike that the differences may be regarded only as errors of experiment. They then performed with the precautions before stated, the analyses of arterial and of venous blood.

	Arterial and limpid blood reduced to a fine, clear, red powder.	Black venous blood reduced to a brown-red powder.
Carbon,	50.2	55.7
Azote,	16.3	16.2
Hydrogen,	6.6	6.4
Oxygen,	26.3	21.7

It thus appears to be proved, for the first time, by elementary analyses, what had been admitted by general hypotheses, that the proportion of carbon is greater in venous than in arterial blood. But the authors state that the change which venous blood undergoes in color by being gently agitated in contact with air, is not owing to its conversion into arterial blood. It is always brownish, less limpid, and when dried, it has the same deep red-brown tinge as dry venous blood, and furnishes by analysis the same results. The conclusion, therefore, is that the vital action, as well as oxygen, is necessary to its transformation into arterial blood.

They examined the composition of fibrin, albumine, and coloring matter derived from mammiferous animals, both herbivorous and carnivorous and found it identical in each variety.

In reference to the third assumption—the creation of azote by vital action—the authors, after mentioning the experiments of Vauquelin and Majendie, inform us that they endeavored to feed a sheep upon sugar and gum, substances which contain no azote. The animal, although vigorous at first, grew meagre under this regimen, and died under the twentieth day of the experiment having diminished in in weight from fifty two to thirty one pounds. Its death and impoverishment were fairly attributed to the absence of azote in its food.

The results of the whole investigation are thus enumerated:

1. The identity of elementary chemical composition, particularly as it respects azote in the chyle of herbivorous and carnivorous mammifera.

2. That arterial blood contains as much azote and less carbon than venous blood.

3. That the blood of herbivorous and carnivorous animals is of the same composition, as well as the various substances that are secreted from it.

4. That in equal weights of the two fluids perfectly dry, the blood of mammifera, whatever the mode of nourishment, has more azote than the chyle.

5. That the excrements of carnivorous contain more azote than those of herbivorous animals.

6. That herbivorous animals cannot any more than carnivorous, be supported by food containing no azote.

7. That unless we admit that vital action may form azote, we must conclude that that which the chyle contains proceeds from the food, and that in both the classes of animals examined, respiration furnishes the complement of that which is found in the blood.—*Bib. Univ. Avril,* 1832.

12. *Process for silvering copper, so as to polish.*—Take two parts of silver powder, precipitated from a nitric solution by a solution of common salt—one part of alum, and two parts of cream of tartar; make them into a paste with a little water, and after cleaning the copper thoroughly, rub this paste upon it with the finger covered with white leather or very fine muslin; when the piece is sufficiently whitened, polish it with a buff powdered with calcined hartshorn, or a little Spanish white; red copper takes the finest polish.

For unwrought silvering, take two parts of silver (precipitated from the nitric solution by copper leaves,) two parts cream of tartar, two parts marine salt well pulverized. Apply this in the same way as above described. When the piece is perfectly whitened, put it into water containing a little potash. Agitate it well in clear water, without which it will tarnish and become yellow.—*Jour. de Con. Usuelles.*

13. *Glass syphons for transferring corrosive fluids.*—M. Collardeau has designated the form of a glass syphon, which saves the necessity of applying the mouth or even the finger to either end of the tube. Dip the end *a* of Fig. 1. into the fluid to be transferred, and pour into the funnel or side opening *b*. a quantity of the same fluid, until it flows out of the end *c*. The fluid in the vessel F. G., then rises and continues through *a d e c*. In this case, the branch *m n* remains full, while the liquid in *b n* subsides to near the bend *n*.

Fig. 1.

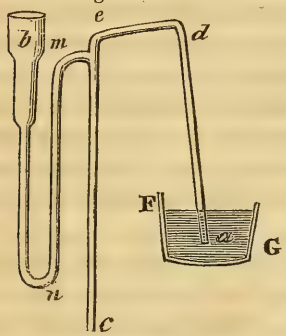
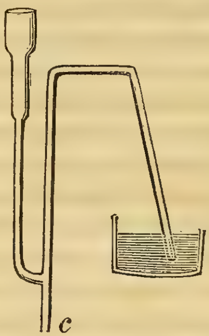


Fig. 2.



The same object is effected by the more simple form of Fig 2., provided the opening *c* is closed with a finger until the long branch of the syphon is full,—or, the application of the finger is unnecessary if the fluid be poured into the funnel faster than it can be discharged through *c*. In that case, the long branch of the syphon will fill and then act in the usual way.—*Bull. D'Encour. Fev.* 1832.

14. *Carbonate of lime and its compounds*; (M. Becquerel.)—Calcareous carbonate is found in countries of the oldest formation, where it often forms entire mountains. It is found disposed in beds of a crystalline texture, sometimes saccharoidal, and sometimes more

or less lamellar. It forms almost the whole of secondary countries, in which it presents a compact structure. In tertiary formations it is also very abundant, yellowish, loose, and more or less solid. In tufas, and concretions, which continue to be found on the surface of the globe, it is not less predominant; finally, it enters into the composition of a great number of organized bodies.

The variety of forms presented by carbonate of lime is immense, but they may all be arranged in two classes. The first, whose primitive form is a rhomboid—belonging to substances properly called calcareous; the second, whose primitive form is a right rhomboidal prism, belonging to Arragonite.

The circumstances which determine the crystallization are unknown. All we know is that Arragonite is found in particular beds, (volcanic or metalliferous regions,) which may influence its formation.

When these two substances are crystallized, nothing is more easy than to distinguish one from the other by cleavage, the measurement of the angles, and by the hardness; but when they are not crystallized we must have recourse to a particular process, which M. Becquerel points out, and by which he proves that *flos-ferri*, the concretions called *Tivoli sugar-plums and tabular white marble*, present the rhomboidal cleavage, while *fistular stalactites, alabaster of montmartre*, &c. present that of Arragonite. M. Becquerel describes an apparatus by which, with electrical forces, he crystallizes Arragonite. He obtains the form of a quadrangular prism with two dihedral summits; it is that under which nature presents it. The same apparatus serves to form the double crystallized carbonate of lime and magnesia, (dolomite,) the protoxide of copper, and the blue and green carbonates of copper. Analysis proves that the crystals of Arragonite which he has obtained, have absolutely the same composition as those of calcareous spar, and differ from it only in crystallization.—*Rev. Ency. Juillet*, 1832.

GEOLOGY.

1. *New cave of Bones.*—An account of this cave was read by *Marcel de Serres* to the French Academy on the 28th of May. It exists in the environs of Mialet near Anduze, department du Gard.

The principal cave has been long known, having served as a retreat for the Camisards, who had made a kind of fortress of it, in cases of sudden attack. It had frequently been visited by the curious, but without any suspicion, until lately, of its containing fossil bones.

This cave is in a compact dolomite, about thirty five metres above lake Gardon, which washes its base. Its opening is an arch, eight metres high, which is prolonged in a vestibule about four metres wide. This communicates with several galleries, the two largest of which, situated one above the other, grow narrower as we advance. The lower one, at about fifteen metres from the vestibule, has a floor of stalagmite, under which is found, in the midst of a bed of mud, like that of the bed of the lake, human bones, fragments of earthen ware, some of which are extremely coarse, and bones of ruminating animals belonging to existing species. In some of the recesses are found, mixed pell mell with the same remains, fragments of bones of extinct species, but that this mud is of a recent period, is proved by the fact, that in the same spots in which the antediluvian bones are found, are also found human bones, which might also have been regarded as antediluvian but for a little bronze statue found among them, evidently of Roman fabrication.—*Rev. Encyc. Juin*, 1832.

2. *Prof. Hitchcock's Report on the Geology of Massachusetts.*—The reviewer of this report, in the Rev. Encyc. Aug. 1832, observes, that those who consider the English system of abandoning scientific improvement and researches to individual enterprise, as the best of all systems, and who censure the continental governments, for devoting the public funds to such purposes, will probably be surprised to see one of the states of New England, executing at its own expense, such a work as that of Prof. Hitchcock; and that a single glance at this report, is sufficient to convince any one of the utility of such a work, to the state which has undertaken it; and to regret that there is so very small a part of the French territory, whose geological constitution is as well known to the public, as is now the state of Massachusetts. France has the greater cause to regret her being distanced in this race by America, from her having a corps of mining engineers, who *if they had the means*, would, in a very short time furnish a work of the same kind, still more complete, of each of the departments.

The same Journal, in remarking on the *Geology of Nova Scotia, &c., by T. Jackson and F. Alger*, adverts to the agreeable surprise, which Humboldt experienced, on debarking at Cumana, on finding in the Spanish Governor of that province, a man who was capable of sustaining a scientific conversation; and to his observation, that the sweet name of one's country pronounced in a distant land, cannot give more delight to the ear of one who has been long absent from it, than did the terms oxygen and azote, spontaneously uttered on that occasion. A sensation, say the reviewers, as agreeable and unexpected, was experienced by them in reading a description, printed in another hemisphere, of a country which they had considered to be divided between frosts and forests, and to find the most recent and best established principles of one of the most recent of the sciences, applied to it with precision and discernment. May we be pardoned, say they, for such an explosion of European self love ! How limited soever, may have been such labors as these, on the other side of the Atlantic, our American brethren will not be long in placing themselves in a condition to afford us the like.

ASTRONOMY AND MECHANICAL SCIENCE.

1. *Biela's Comet.*—The periodical comet discovered on the 26th of Feb. 1826, by M. Biela, of Josephstadt, which performs its revolution round the sun in about six years and three quarters, and whose return in the present year has been made the subject of elaborate calculations by mathematicians of the first eminence, has not disappointed the expectations of astronomers. It is already visible in superior telescopes, and may be expected shortly to be seen in its approach to the sun, if not by the naked eye, at least with instruments of moderate power. Its place this morning before sunrise, was about one and a half degrees S. W. of θ Aurigæ, and its actual course is directed nearly towards the star of the same name in Gemini, but its motion is rapid, and it will speedily assume a more southern direction. The reappearance of this comet, the second of short period, with which we are acquainted, has been looked for with anxious interest by astronomers, as likely to elucidate some of the most curious points in the constitution of our system, and among the wonderful verifications of astronomical theories which observation is constantly affording, it is hardly possible to imagine any more striking than the appearance after the lapse of nearly seven years, of such an all but imperceptible cloud or wisp of vapor, true however to its predicted time and place, and obeying the same laws, as those which regulate the movements of the planets.—*Slough, Sept.* 24, 1832.—*English Paper.*

2. *Observatory of Geneva.*—This institution has received the valuable acquisition of the two large instruments which were ordered of

M. Gambey, in 1829, by the city of Geneva. They were a fortnight on the route from Paris, and arrived in perfect order. They have been well adjusted, with the assistance of the maker, in the observatory; the transit instrument, in the principal hall of the ground floor, and the equatorial in the eastern tower under a hemispherical cupola with moveable roof. They are the admiration of all who have seen them, from the the beauty of their execution, their free and easy motion, and the security of their position.—*Bib. Univ. Mai*, 1832.

3. *Medal for discovery of Comets.*—The king of Denmark, to whom astronomy is under numerous obligations, offers a gold medal, of the weight of twenty ducats, to any one who shall have found the first comet whose revolution is not yet known, and which is not visible to the naked eye. The discoverer must give immediate information to the counsellor of state, Schumacher. The medal will be decreed six months after the discovery, to give time for verification and determination of just claims.—*Idem.*

4. *Maximum density of Water.*—M. Stampfes, professor of the Polytechnic Institute of Vienna, has recently published a very detailed memoir on the absolute weight of water at different temperatures. His results do not entirely agree with those of prior enquirers. He places the maximum density at the temperature of 3°.75 Centigrade = 38°.75 Fahrenheit.—*Annalen der Physik*, Vol. XXI. page 75.

5. *On the simultaneous motions of a pendulum and the surrounding air.*—A memoir on this subject was read by M. Poisson to the Academy of Sciences of Paris on the 22d of August, 1831. It was drawn up by this great geometer in consequence of the work of M. Bessel, on the same subject, in which this illustrious astronomer was the first to show the inaccuracy of the common rule by which the oscillations of a pendulum are reduced to a vacuum from those observed in the open air. It had in fact been supposed till then, that the loss of weight which a pendulum sustains, when plunged in a fluid, is the same, whether the body is at rest or in motion. Experience proves the contrary, and the theory of the motion of fluids has also led M. Poisson to demonstrate that the result ought to be different. It is the friction of the air which occasions the successive diminution of the amplitude of the oscillations. This diminution

goes on in geometrical progression, and being very slow exerts no sensible influence on the duration of each oscillation. But the pressure of the air, which does not alter the amplitude of the oscillations, influences their duration, both because it is not the same in the several horizontal sections, and because it changes in different parts of the surface, in proportion to the condensation and dilatations which accompany the motions of the air. M. Poisson obtains also, by analytic theory, a result which accords in a satisfactory manner with the direct experiments made on this subject by Captain Sabine. It results from this that the correction relative to the reduction to a vacuum ought to be increased one half, which gives rise to an augmentation of $\frac{3}{100000}$ in the length of the single pendulum which beats seconds. This length, estimated in parts of the metre, thus becomes for Paris, according to the experiments of Borda, $0^m.993856$. The expression of the gravity at the surface of the earth (measured by double the space which it causes a body to pass through in a vacuum during the first second of its fall,) is then $9^m.80897$; and the mass of the earth, as La Place determines it, must be also increased about $\frac{3}{1000000}$, which rises it to $\frac{1}{354906}$ of that of the sun.—*Bib. Univ. Avril*, 1832.

AGRICULTURE AND DOMESTIC ECONOMY.

1. *On the cultivation of Beets and the manufactory of Sugar;* by M. Girardin.—In the year 1829—30, nearly two hundred sugar manufactories in France produced fromnine to ten millions of kilogrammes of beet sugar, and it is believed that in 1830—1831, two hundred and eighteen manufactories were in active operation. This business has now become accessory to farming labor, and may be usefully combined with the work of a farm of moderate size, on which from seventy five to one hundred thousand kilogrammes of root can be raised. It is advisable that neighboring farmers unite in the establishment of a common manufactory, dividing the sugar and the remains of the beet in proportion to the quantity of roots respectively furnished.

The identity of the pure sugar of beet and of cane is now chemically demonstrated. There remains however, in all sugars, a slight mixture of foreign matters, and this furnishes the means of detecting their origin. M. Dubrunfaut points out two means of testing: 1st, Heat nitric acid at 25° on sugar until the red vapors cease, if the liquor then presents a white precipitate, which settles at the bottom of the flask, it may be affirmed to be beet sugar. The precipitate is oxalate of lime, which is not found in cane sugar.

2d. To a solution of sugar in distilled water, add a few drops of sub-acetate of lead: the foreign matters of the sugar will combine with the lead, and they are always more abundant in beet sugar than in that of cane. They are precipitated by a few hours rest in beet sugar, and remain suspended in that of cane.

Roots which grow much out of the ground, yield less good sugar than those which are well buried. Those which grow upon richly manured land run much to leaf, but their juice is less rich in sugar and more abundant in mucilage. A calcareous soil appears to be the best for the cultivation of sugar beets. The year 1829, the autumn of which was very wet, gave, contrary to expectation, a sugar harvest equal to common years.

The molasses of beets has been advantageously used in fodder with cut straw. The pulp makes a valuable manure for clayey and close bound soils.

Some sow the seeds in beds and transplant the roots, but the greater number of cultivators prefer sowing them in place.—*Bib. Univ. Mai*, 1832.

2. *Relative values of different kinds of food for sheep; by* M. DeDombasle.—Some experiments performed by this celebrated agriculturist, are well worthy of being recorded, as approaching nearer to an exact determination of the question of the relative nutritive properties of a few of the more common aliments of sheep and cattle than any which we remember to have seen. He divided forty nine sheep into seven lots, of seven sheep each, in such a manner that the total weight of each lot should be, as nearly as possible, equal to each of the rest. Each lot was kept in a separate division of the stable, the food was given to each lot in rations of equal weight, and by means of scales, the total weight of each lot was taken once a week, and the experiment was continued five weeks. The weight of each lot was four hundred and thirty six pounds.

The substances subjected to examination were 1. Dry lucern. 2. Oil cake from flax seed. 3. Oats and barley. 4. Crude potatoes. 5. Cooked potatoes. 6. Beets. 7. Carrots.

The dry lucern formed the unit of the estimate. One of the seven lots was fed exclusively on dry lucern, and each of the six others received just half the quantity of lucern, and the remainder of the ration consisted of such a portion of one of the other alimentary substances before mentioned as was found sufficient by a careful weighing during the five weeks to keep each lot in the same healthy condition. The following table shows the current progress of the experiment; the quantity of water drunk by each lot of sheep during the five weeks being also measured, by a guaged trough. The author concludes that fifteen pounds of dry lucern may be considered as a proper ration for one sheep per week, or rather more than two pounds per day. The primitive weight of each lot, as before observed, was four hundred and thirty six pounds.

Lots.	Food.	1st week.	2d week.	3d week.	4th week.	5th week.
1st,	Dry lucern,	437lbs.	433	437½	437½	443
2d,	Lucern and oil cake,	428	428	432½	439½	444¼
3d,	Lucern, oats and barley,	422½	433½	429¼	436¾	437¼
4th,	Lucern and crude potatoes,	441	440½	434	432¾	439¾
5th,	Lucern and cooked potatoes,	437	435½	447½	444½	451¼
6th,	Lucern and Beets,	435	424	436	437	444½
7th,	Lucern and carrots,	417½	407	419½	426½	427¼

The quantity of water drunk by the seven lots during the five weeks was as follows, showing the relative degree of thirst occasioned by the different aliments.

1st lot,	223 quarts.	5th lot,	108 quarts.
2nd lot,	189	6th lot,	95
3d lot,	164	7th lot,	36
4th lot,	123		

Fifteen pounds of dry lucern being considered as a proper ration for one sheep per week, or seven and a half pounds a half ration, he finds that the following quantities of each of the other aliments are equivalent in nutritive value to the half ration of lucern.

Oil cake.	Barley.	Oats.	Crude potatoes.	Cooked potatoes.	Beets.	Carrots.
4½ lbs.	3½ lbs.	5 lbs.	14 lbs.	13 lbs.	16½ lbs.	23 lbs.

Thus taking the quantity of lucern as a standard the nutritive powers of the different substances will be

Dry lucern, - - -	100 lbs.
Flax seed oil cake, - - -	57
Barley, - - - -	47
Crude potatoes, - - -	187
Cooked potatoes, - -	173
Beets, (white variety) - - -	220
Carrots, - - - - -	307

Bib. Univ. Mai, 1832.

DOMESTIC.

1. *Professor Jacob Green's Monograph of the Trilobites of North America, with colored models of the species.*—The author, in his introduction, after stating the general characters by which these fossils may be recognized, enumerates the genera established by previous authors, viz. five genera from Brongniart, one genus from Dr. DeKay and three genera from Prof. Dalman. The essential characters of all these genera are concisely given, so that those who may wish to examine this subject, may do it without resorting to the rare and expensive works of the French and Swedish naturalists. A tenth genus is here added by Prof. G. to include some curious foreign trilobites. A list of all the species heretofore described is then added and the introduction closes with some speculative remarks.

In addition to the ten genera in the introduction, five other genera are proposed by the author, all supposed to be peculiar to North America; he also noticed two others suggested by Prof. Eaton.

The species described as natives of North America are thirty three in number; twenty two of which are supposed to be now described for the first time. The work then terminates with some brief observations on the nature of the trilobites, in which there is a notice of a recent trilobite, now in the Albany Institute. It is to be regretted that that animal has remained so long undescribed.

The monograph is admirably illustrated by the colored models, done in plaster by Joseph Brano, whose success in this effort, must give full confidence that his talents can be advantageously employed on other occasions in the service of natural history.

We are happy to see this application of the art of modelling thus favorably introduced into this country; it must be of great utility to cabinets, and teachers, as well as to original investigators. Mr. Brano's models are beautifully done, and are worthy of the monograph to which they belong.

Prof. Green appears to us to have executed his work with fidelity, ability and good taste, and it cannot fail to aid in promoting our geological researches. It is worthy of being mentioned that the monograph is got up in a very neat style, and forms a very convenient, volume, either for the desk or the pocket. The minute and exact examinations and descriptions of natural history are very important in the discrimination of species and genera, as well as of their various other relations. We should be very glad to see a complete set of models of all the known trilobites, and we trust that the effort of Prof. Green will meet with the encouragement it merits, and be followed up, in Europe, until all the species shall be presented in good models. We regret that our limits do not permit us to extract the descriptions of the new species. The following section forms the conclusion of the work.

"*Nature of the Trilobite.*—Every one familiar with the history of the trilobites, is aware that a good deal of controversy has existed among naturalists, respecting the precise link in the grand chain of organized beings, these singular fossil animals, should occupy. Professor Brongniart, Dr. DeKay, Audoüin, and several other acute observers, have placed them in the vicinity of the Limuli, and other Entomostraca with numerous feet; while P. A. Latreille and others, presuming that these animals were destitute of locomotive organs, as no vestige of them has ever been discovered, fix their natural position in the neighborhood of the Chitones; or rather that they constituted the original stock of the Articulata, being connected on the one hand with these latter Mollusca, and on the other with those first mentioned, and even with the Glomeris.* It was our original intention to have closed this Monograph with a short history of these theories—and of the notion advanced by Latreille and others, that the Trilobites have been annihilated by some ancient revolution of our planet. All these matters, we think, are now put to rest by the late discovery of some living Trilobites in the southern seas, near the Falkland Islands. In the cabinet of the Albany Institute, we have examined some of these recent animals, which have very nearly the size and general appearance of the Paradoxides Boltoni, as represented on our frontispiece; the species cannot, however, belong to that genus, as the buckler is furnished with eyes very similar to those of the Calymene Bufo; its organs of locomotion are short, numerous, and concealed under the shell—but I do not feel at liberty to notice the interesting animal more minutely. It will probably be described and figured shortly, in a perfectly full and satisfactory manner, by Dr. James Eights, the enterprising discoverer, together with several other new and remarkable genera and species belonging to the Entomostraca."

We had the pleasure of seeing the specimens of Dr. Eights of what appear to be recent trilobites. If this opinion is correct, the trilobite must be regarded a being of almost all geological ages.

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* See Cuvier's Animal Kingdom, Vol. iii, pp. 135—6

See printed note attached to Errata p. viii - for Myrmecoïdes substitute

We annex, from Prof. Green, a notice, just received, Dec. 26, 1832, of a new trilobite.

Asaphus Myrmecoïdes.—Corpore depresso ; costis latis, convexis, tuberculis magnis ; cauda rotunda ?

The large fragment, by means of which this species has been identified, is in a fine state of preservation. Thirteen costal arches and fourteen joints of the middle lobe, with two or three faintly marked articulations near its extremity, can be very satisfactorily made out. The costal arches are, therefore, more numerous than the vertebral joints ; an organization not very uncommon with the Asaphs. The first eight ribs and vertebræ, as seen in this fragment, appear to have been articulated together ; after which this irregular structure commences. The costal arches are rounded on their upper surface, without striæ ; broadest near their lateral extremities, and are, most of them, irregularly nodulous ; these nodules resemble very much the protuberances on the ribs of the *Pecten nodosus.* The joints of the middle lobe are also rounded and nodulous, but on these the nodules are disposed in the form of two very obtuse paralellograms. What renders this fragment peculiarly interesting, is that the lower portion of the upper shell, along one of the lateral edges near the tail, is so fractured as to present the structure beneath the ends of the ribs which have here scaled off. At first sight the broad smooth edging round this part of the fossil, resembles very much the membranaceous expansion beyond the lateral lobes which is one of Professor Brongniart's generic characters of the Asaph. This *border* indeed is very like the hem so strikingly exhibited in the *Asaphus micrurus ;* but upon comparing the ribs on the opposite side, where they are perfect, with those terminated by the *border*, it will be seen that they are much longer ; what therefore, seems to be an expansion beyond the ends of the ribs in that place, must be occasioned by the reflection of the shell beneath the posterior portions of the lateral lobe. The inferior structure and mechanism of this part of the fossil trilobite is thus, we believe, for the first time developed. In a fine group of the Dudley fossils deposited in the cabinet of the Geological Society of Pennsylvania, a similar inferior reflected edge may be seen beneath the *buckler* of the *Asaphus Debuchii.* It is not uncommon in many of the recent *Crustacea*, and is strikingly exhibited along the lower edge of the *Limulus polyphemus.*

The Asaphus Myrmecoïdes was found in a hard ash colored carbonate of lime in Genesse County, N. Y., by Mr. J. C. G. Kennedy, and was presented by him to the Philadelphia Museum.

The perfect animal, the fossilized fragment of which is above described, must have been at least six inches in length, which is much longer than any Asaph we have ever seen. Indeed, it is somewhat doubtful whether it be a true Asaph or not. Although there appears to have been no membranaceous development extending beyond the abdominal arches, still its depressed form, and the relative proportions of the middle lobe seem to place it among the Asaphs.

2. *The Herbarium of the late Zaccheus Collins of Philadelphia.*—In consequence of the much regretted death of Mr. Collins, his herbarium is offered for sale by the administrator of his estate. Mr. Collins was so well known, that it is quite unnecessary to say that he was always esteemed an able botanist, and that, although he never published any thing, his opinion was often consulted, by a majority of our botanical writers. He was an assiduous collector, and his herbarium contains a pretty complete collection of the plants from the vicinity of Pennsylvania, New Jersey, &c., made by his own hands—including cryptogamous plants, mosses, lichens, fuci, &c. He also received large contributions from his correspondents in various parts of the United States, especially of southern plants, from South Carolina and Georgia, which, at the present time, it is extremely difficult to procure. A complete set of the plants collected in Arkansaw by Mr. Nuttall, together with many from the Missouri, and an interesting collection from Labrador, are included in the herbarium. It is probable, that no more extensive collection of the plants of the United States, if even there is a more complete one existing, will, at this day, be offered for sale.

The specimens have been neatly prepared, are enveloped in such a manner as to be secure from the attacks of insects, are arranged systematically, and carefully labelled. Mr. C. also possessed a pretty large collection of exotic plants, which is for sale with the above.

We are happy in showing, in this manner, our respect for the memory of Mr. Collins, by making known, the (we doubt not justly) reputed value of this collection, to the botanical community, and to public institutions. We are told that Mr. Collins died intestate, and that otherwise, it is not probable that his collections would have been offered for sale. His principal botanical correspondents, as we are informed by one of his friends, (who does not however, pretend to remember them all,) were Dr. Bigelow, of Boston; Mr. Nuttall, Dr. Beck, of Albany; Dr. Torrey and Mr. Eddy, of New York; Rev. H. Steinhauer, of Bethlehem; Mr. Schweinitz, Dr. Muhlenberg, Mr. Elliott, of Charleston; Dr. McBride, Mr. Le Conte, of Savannah; Dr. Boykin, of Milledgeville; Dr. Baldwin, and Mr. Rafinesque.

If desired, a more minute description of the herbarium will be furnished by Mr. Charles Pickering, of Philadelphia, to whose examination and judgment, this herbarium has been referred.

3. *The coal beds of Pennsylvania equivalent to the great secondary coal measures of Europe.*

To Prof. Silliman.—At the ninety first page of the second edition of my Geological Text Book, (published last June,) I adduced facts, in proof of the correctness of the heading of this article. Since its publication, Mr. James Hall, adjunct professor in this institution, has made probably, the most extensive collection of vegetable fossils in Pennsylvania, that has hitherto been made on this continent. It was the intention of Mr. Hall and myself to have determined the names of all which had been described by M. Brongniart, and to have given lithographic figures of the remainder. But we are prevented by other engagements.

At present, I will merely give a list of the names of those which we determined by the aid of M. Brongniart's figures and descriptions, as far as his sixth number. I have now before me twenty three ascertained species of ferns, from the coal mines of Pennsylvania, which Brongniart has described, as belonging to the great secondary coal formations of Europe, found in the secondary class of rocks *only*. Hence the absurdity of denominating the Alleghany and Catskill Mountains, *transition*. If organized remains are any evidence of the equivalent characters of rocks, *these mountains are surely secondary*. They are the upper secondary of some distinguished European geologists, the upper stratum of the lower secondary of others; while others seem unwilling to admit a division of the secondary class.

It appears to me, that the Alleghany and Catskill Mountains may be assumed, *confidently*, as the grand starting range for settling all questions relating to the equivalent strata of the Eastern and Western continents. I feel that I am fully supported in the position I have taken in view of such equivalents, and set forth in the last edition of my Text Book, by the additional collections of organized remains, made in the months of August, September, and October, of the present year, by the students and assistant teachers of this school. At the same time I reviewed the Helderberg range, and continued my examinations throughout the southern part of the county of Albany. In truth, every step I take, where organized remains are found, and every specimen brought into this school, (several thousands have already been seen in the students' lecture rooms,) strengthen my confidence in the opinion of Cuvier, and of the other great men of the East, that "organized remans are true indexes to geological strata."

The following species, found in connexion with Pennsylvania coal beds of Wilkesbarre, Carbondale, &c. by Mr. Hall, myself, and students, have been determined according to M. Brongniart; and they are all open to the inspection of the amateurs of natural science, in the natural history room of this school.

Genus Neuropteris.—*Flexuosa, gigantea, heterophylla, elegans, Loshii, Cistii, Lorettii, angustifolia, acutifolia, macrophylla, tenuifolia, auriculata, cordata.*

Genus Sphenopteris.—*Latifolia, furcata, trifoliata, artemisaefolia, Mantelli, Williamsonis.*

Genus Odontopteris.—*Crenulata, Sclotheimii.*

Genus Taeniopteris.—*Vittata.*

Genus Cyclopteris.—*Obliqua.*

We have several additional species not determined.

Note.—I hope to be able to furnish the Journal with a description of the most important remains, in the collections deposited at this school, accompanied with figures. I have about sixty species already lithographed. Amos Eaton.

Rensselaer Institute, Troy, N. Y. Dec. 1, 1832.

4. *Correction of an error in Prof. Green's Monograph of North American Trilobites; with additional explanations.*—I gave Prof. Green several proof sheets of my Geological Text Book, while it was in the press; in which the genus Brongniartia was erroneously printed, Brongniatia. As Mr. G. has adopted the erroneous printing, it is proper to correct the mistake; as it is the name of a new ge-

nus. The erroneous printing occurs once on p. 32, it is correct on pp. 90, 126, 128, and 129. It is the name of the author of the first valuable treatise on trilobites, (Alexander Brongniart,) with a Latin termination. A. Eaton.

5. *Caution addressed to manufacturers and venders of inflammable substances, especially if volatile.*—We are told that in subliming camphor, the vessel sometimes becomes stopped by the condensed vapor, thus forming a solid plug, and that explosion, with a dangerous combustion of the volatile vapor, occasionally happens.

We knew a gentleman once to set fire to his family parlor, by attempting to distil ether in it, and we have known, by experience, what it is to pass through a wide flame of ether kindled by a candle at a considerable distance on the table of a lecture room.

It is well known that the entire volume of the air, in a small room, sometimes becomes inflammable in consequence of the diffusion through it of etherial vapor, arising from open vessels from which it was poured at the time.

The obvious cautions are still more forcibly impressed by the following notice from the National Gazette, of an accident which occurred in Philadelphia, and which occasioned "a severe loss to be sustained by Mr. George W. Carpenter, the eminent chemist and druggist of Market street. On the night of the 24th of September, one of the young men of his store was agitating a bottle containing two gallons of alcohol of thirty six degrees, in which were contained gums and resins, for the purpose of making a tincture. By some chance it communicated with a lamp on the counter, and the bottle broke, throwing its contents over the counter and floor. In an instant the whole was in a flame, rising to the ceiling and spreading towards the side of the room. Unfortunately, a bottle containing spirits of turpentine saturated with camphor, which was at the end of the counter, broke, from the heat, and added double fury to the element, so that before water could be procured, the whole store was enveloped in flames, the bottles on both sides bursting and throwing their inflammable contents into the fire. The loss sustained by Mr. Carpenter amounts to ten thousand dollars, of which five thousand dollars were insured. He has also to regret the destruction of a number of accounts, several years' letters, and other papers of value, as well as various unpublished essays on Mineralogy and Medicine intended for Professor Silliman's Journal and the American Journal of the Medical Sciences, mineralogical examination of the Eastern States intended for publication, and a considerable proportion of his essays on the Materia Medica, in the loss of which the public have reason to sympathise with him. The fire had a terrific appearance, owing to the combustible nature of the contents of the store, and was seen some distance from the city. Mr. Carpenter bears strong testimony to the efficiency and zeal of the firemen, by which the adjacent houses were rescued from destruction, and a portion of his own saved when its total loss seemed inevitable."

We learn from Mr. Carpenter, that a part of his books and papers was saved; that the upper stories of his buildings filled with drugs and chemical preparations were rescued, and that his collection of minerals in a back building was entirely preserved.

6. *The Cabinet of Natural History and American Rural Sports, with illustrations; monthly; quarto; by* J. & T. Doughty, *Philadelphia.*—This elegant, interesting, and instructive magazine has now gone through nearly two volumes. Occupying a middle station between Journals strictly and drily scientific, and those which are merely popular, and being beautifully illustrated by colored engravings, not less remarkable for the exhibition of the appropriate scenery of landscape than of accurate figures of birds and animals, would seem to be entitled to an extensive patronage; a patronage commensurate not only with the heavy expences of such a work, but with the talents, taste, industry, and enterprize of its respectable proprietors. Nothing but the pressure of numerous duties has prevented us from naming it at an earlier day, and we regret, that at almost the latest moment of our present number, we can do little more than to express our mortification that it is in danger of being discontinued for want of adequate patronage. It would be little to the credit of our boastful country, that a work of so attractive and respectable a character, which exhibits and fosters beautiful and useful arts, as well as science and rational entertainment, should die of penury, when there is bread enough and to spare. We have had too many instances already of the suspension or failure of most useful and respectable periodical works for want of pecuniary support; a support which might be easily rendered adequate without any retrenchment from comforts, and with hardly a diminution of luxuries and superfluities. Good periodical journals, in literature, science, and the arts, contribute much to improve the public mind at home, and to raise our character abroad, and the nation should be slow to relinquish such works, (an important portion of national pro-

perty,) got up and sustained, as they almost invariably are, with great labor and personal inconvenience, and usually with little pecuniary reward; so that, with few exceptions, only those who love knowledge will long persevere in sustaining them. The Journal now before us has peculiar claims from its joint relation to science, arts, instruction and amusement. We trust, therefore, that the effort which we understand is about to be made, by the editors, to save their interesting work, will be seconded by some hundreds of good subscribers, who will both read and pay.

Passus graviora, miseris succurrere disco.

Each number contains twenty four pages, quarto, with double columns, equal to fifty common 8vo. pages, and "two beautifully colored plates of birds and quadrupeds, drawn from nature, and executed in the best style, with a perfect history of each object so represented, with the addition of many interesting anecdotes."—*Ed.*

Terms.—Eight dollars per annum, payable in advance, to J. & T. Doughty, No. 80, Walnut street, Philadelphia.

7. *Manufacture of Telescopes, &c.*—Mr. Amasa Holcomb, of Southwick, Massachusetts, manufactures spy glasses of every description now in use; also, achromatic telescopes of forty eight inches focal length, which will give a distinct view of Jupiter's belts, and of the eclipses of his satellites, as well as of the principal double stars. He makes also reflecting telescopes of from eight to twelve feet focal length. These are made on Herschell's plan only, and will perform more than those of the refracting kind, but are not as durable and, in some respects, not as convenient. Any of the above instruments will be made to order, and warranted to perform more than the imported instruments of the same prices. Prof. Olmsted, of Yale College, after some examination of one of Mr. Holcomb's telescopes, permits his name to be referred to, and has communicated to the editor his favorable opinion of the work.

It gives us pleasure to aid in making known an artist, self taught, and as, we believe, worthy of patronage and encouragement.

Southwick is in Hampden county, upon the Connecticut line, and is one of the towns intersected by the New Haven, Farmington, and Northampton Canal. It is five miles distant from Westfield, and twenty two miles from Northampton.

8. *Phosphate of Lime in Edenville, N. Y.*—In the month of August last, I discovered a locality three fourths of a mile west of this

village, from which I have obtained well defined six sided prismatic crystals of phosphate of lime from one half an inch to twelve inches in length, and from one eighth to one inch and five eighths in diameter. Their color is a bright asparagus green, of fine lustre, and they are variously terminated. Some have equal terminal faces, corresponding with the lateral planes of the prism ; while others have one, two, and sometimes three of their terminal faces extended at the expense of others, so as to give the crystal, in some instances, a one, two, three, four, and even a five sided summit of unequal faces. Their gangue is the white lime rock of this vicinity, in a partial state of decomposition, so that by the fingers only it may be reduced into coarse rhombic fragments, and the crystals disengaged from their native bed. J. P. Young, P. M.

Edenville, Oct. 15, 1832.

9. *Geological Map.*—A geological map of New London and Windham counties, is about being published by Mr. Wm. Lester, Jr. from the surveys of Lieut. W. W. Mather, during the late summer. It is to be accompanied on the same sheet by a very minute map of the two counties, upon a scale three fifths of an inch to a mile, handsomely colored, varnished, and mounted, from a copper plate engraving.

This survey will correct the section published in this Journal last year. A mica slate stratum, crosses that section, though not seen in place on the line of that section. It runs through Franklin, Scotland, Hampton, Pomfret, Woodstock, and into Massachusetts, and appears to be a continuation of that in Massachusetts described by Prof. Hitchcock, on his map of Massachusetts ; but which appears to run out before it comes to the Connecticut line. It terminates again abruptly in Bozrah, Conn. The granular feldspar and quartz strata of that section, are subordinate strata to gneiss, from twenty to thirty miles in length. They terminate abruptly on the north bank of Morriss river. The contorted gneiss extends from Massachusetts to Long Island sound, with a breadth from three to ten miles, and underlies the best land on the east of Connecticut river, in Connecticut, except the valley of the Connecticut. The sienite of that section forms a bed or overlying mass, covering about twenty or twenty five square miles, with greenstone, sienitic, and granitic veins, traversing the strata in every direction around.

W. W. Mather.

West Point, Nov. 20th, 1832.

10. *Fossil Shells of the Tertiary Formations of the United States, by* T. A. Conrad. No. 2. J. Dobson, Philadelphia.—We have much pleasure in announcing the second number of this valuable work, with eight lithographic plates, illustrating seventeen species of our tertiary fossils. It is really cheering to observe that this department of American geology, is now in a fair way to be fully elucidated; and we must confess our surprise that such interesting facts, such multiplied materials for geological reseach, should not sooner have called forth the talent and attention they so justly merit. Mr. Conrad's second number contains five species of Crassatella, one of Turbinella, four of Ancillaria, four of Ostrea, a Macta, and a Pholadomya. These fossils are taken indiscriminately from the upper and middle tertiary deposits, and from localities widely distant, New Jersey, Virginia, the Carolinas, Alabama, &c. Mr. Conrad is now on a tour in the southern states, collecting materials for the continuation of his work; from this cause the third number may be delayed until April or even until May. Those persons who feel interested in the geology of our country, may look forward with pleasing anticipations to the results of Mr. Conrad's journey.

11. *Anthracite in Wrentham, Mass.*—Specimens of this mineral have been forwarded to us by Mr. S. Day, in a letter dated Providence, R. I. Oct. 11. It is stated to be newly discovered—that the boring has been carried to eighty feet and the excavation or shaft, to sixty; that the coal lies in strata of different depths, interspersed with slate, and that it is proposed, should the prospect continue fair, to petition the legislature for a charter of incorporation, and in the spring to push their enterprise with vigor.

The coal appears like the European anthracite, and resembles that of Rhode Island more than that of Pennsylvania. The latter state possesses such vast resources in this mineral, and of such admirable quality and easy acquisition, that prudent men will look well to every undertaking, which must depend, in a degree, upon successful competition.

12. *Comparison of weights and measures of length and capacity, reported to the Senate of the United States by the Treasury Department in* 1832, *and made by Ferd. Rod. Hassler, M.A.P.S., &c.* (*Doc. No.* 299.) *Washington*, 1832.—On the 29th of May, 1830, the Senate passed a resolution requiring a comparison of the weights and measures used in the several custom houses in the United States,

to be made under the direction of the Treasury Department. The execution of this important commission was entrusted to Mr. F. R. Hassler, a gentleman who is well known to be fully qualified for the task. Several well authenticated foreign standards were employed in the operation, among which were an *original metre*, and an *original kilogram.* The document above cited contains two reports made by Mr. H.; the first exhibits principally the results of the operations, and the second a detailed account of the means and methods used. The report made in 1821, by the Hon. John Q. Adams, showed that great discrepancies existed among the weights and measures used in this country, but no steps were then taken to remedy the evil. We learn from the letters of the secretary of the Treasury, accompanying Mr. H's reports, that the custom houses throughout the country, are soon to be supplied with uniform and accurate weights and measures, and authentic standards, to be fabricated at the United States' Arsenal in Washington, under the personal superintendance of Mr. Hassler.

13. *Revised editions of Spurzheim's Works.*—Marsh, Capen & Lyon, Boston, have in press, and propose publishing, the following works by the late DR. SPURZHEIM.

I. Phrenology, or the Doctrine of Mental Phænomena.—Vol. I, Physiological part. Vol. 2, Philosophical part,—with plates, 2 vols. 8vo.	$4 00	
II. Elementary Principles of Education, 1 vol. 12mo. - - - - -	1 00	
III. Natural Laws of Man, 1 vol. 18mo. -	37½	
IV. Outlines of Phenology, 1 vol. 18mo.	37½—	$5 75
To be Published, provided sufficient encouragement be given.		
I. Phrenology in connection with the Study of Physiognomy.—Illustration of Characters, 1 vol. royal 8vo., with 34 Lithographic plates,	$4 00	
II. Anatomy of the Brain, 1 vol. 8vo., with appendix, 17 plates, - - - -	3 50	
III. Work on Insanity, 1 vol. 8vo., with plates,	2 00—	9 50
Phrenological Busts.		
Bust to accompany the book of Outlines,	$0 50	
Sets of 60 Heads, illustrating the principles of Phrenology, neatly encased, - -	5 50—	6 00
		$21 25.

INDEX TO VOLUME XXIII.

A.

Alkalies, preserving qualities of, 383.
Alluvial deposites of the Mohawk, 207.
Analysis, chemical, of the atmosphere, 380.
Anthracite in Massachusetts, 405.
Ash, white, effect of, on rattlesnakes, 337.
Association, British, for advancement of science, 179.
Atmosphere, chemical analysis of, 380.
Azote in animal substances, 384.

B.

Bath, Russian vapor, 295.
Bees, hiving of, 202.
Beets, cultivation and sugar of, 392.
Biela's comet, 390.
Bone cave, 388.
Bonstetten, Chas. Victor, notice of life of, 374.
Boring for water in New York, 206.
Bread, distillation of, 194.
Brewster, Dr., on polarization of light, 28, 225.
British association for advancement of science, 179.
Brongniartia, correction of *Brongniatia* in Prof. Green's Monograph of Trilobites of North America, 400.
Brunner, Prof., chemical analysis of the atmosphere, 380.
Buckland, Prof., on vitality of toads enclosed in wood and stone, 272.

C.

Cabinet of Natural History and American rural sports, 402.
Caloric, experiments in, 185.
Camphogene, 378.
Canebrakes, 50.
Carbonate of lime and compounds, 387.
Carburetted hydrogen, combinations of, 377.
Case, Rev. Wm., facts on hydrophobia, 144.
Cave of bones, 388.
Cement for glass, &c. 201.
Cetaceous animal, notice of, 301.
Charcoal prepared by M. Dumont, 346.
Cheese from potatoes, 202.
Chevallier, on uses of chlorine and chlorides, 129.
Chile, plants of, 78, 250.
Chloride of lime, action of on alcohol, 135.
Chlorides and chlorine, uses of, 129.
——— of sulphur, 382.
Coal beds of Pennsylvania, Prof. Eaton on, 399.
Comet, Biela's, 390.
Comets, medal for discovery of, 391.
Compass, microscopic, 237.
Conrad's, T. A., work on fossil and recent shells of the tertiary formation of North America, 204, 339, 405.
Copper process for silvering, 386.
Cordage, coating for, 199.
Corrosive fluids, syphons for, 387.
——— sublimate, detection of, 207.
Cotton, case of treatment by, 198.
Crucible for fusion, 384.
Cuvier, Baron G., memoir of, 303.
Cuvier and Brongniart's report on M. Deshayes tableau comparatif des coquilles vivantes, 196.
Cylindrical steam boilers, strength of, 68.

D.

Dampness, prevention of, 199.
De Candolle's, A. memoir of Cuvier, 303.
De Candolle's, A. P. memoir of Huber, 117.
Diluvial action, Hon. Wm. A. Thompson on, 243.
Dumonts' filter and prepared charcoal, 346.

E.

Earth, increase of temperature in the interior of the, 15.
Eaton, Prof., on coal beds of Pennsylvania, organized remains of, 399.

Economy of fuel, 318.
Editor, notice of a fountain of petroleum by, 97.
——— facts relating to hydrophobia by, 143.
——— reminiscences of Dr. Spurzheim by, 356.
Emmet, Prof., on solidification of gypsum, 209.

F.

Fair at Leipsic, 1831, 182.
Ferruginous sand formation, organic remains of, 288.
Field surveying, 37.
Filter of Dumont, 346.
Flowers deprived of their anthers, 45.
Follen, Prof., funeral oration on the death of Dr. G. Spurzheim, 356.
Fossil remains in the museum of Gideon Mantell, Esq., 162.
Fossil remains of strata of Sussex, 171.
——— shells of tertiary formation in North America, 204, 405.
——— and recent shells ——— 339.
Fuel, economy of, 318.
Fusion, crucible for, 384.

G.

Gases, effect of various, upon vegetation, 193.
Geneva observatory, 390.
Geological map of eastern part of Connecticut, 404.
——— of gold region of Georgia, North Carolina, and Tennessee, 1.
Geology of gold region of Georgia, North Carolina, and Tennessee, 1.
——— Nova Scotia, by Messrs. Jackson & Alger, notice of, in the Rev. Encyc. Aug. 1832, 389.
Georgia gold region, Hon. Judge Peck on, 1.
Gillet, Mr. Geo., on declination of the magnetic needle, 205.
Gold region of Georgia, North Carolina, and Tennessee, 1.
Goniometer reflective, R. Graves, Jr. on, 76.
Graves, Jr., R. on reflective goniometer, 76.
Green's, Prof. J., monograph of trilobites of North America, 395.
Gypsum, solidification of, 209.

H.

Hail storms, Dr. Jones on, 35.
Hassler, Prof., on weights and measures, 405.
Herbarium of Mr. Z. Collins, 398.
Hitchcock's, Prof., report on geology of Massachusetts, notice of, in the Rev. Encyc. Aug. 1832, 389.
Holcomb, M. H., manufacture of telescopes, 403.
Huber, Francois, notice of life and writings of, 117.
Hydrophobia, facts on, 144.

I.

Inclined planes, Prof. Thomson on, 107.
Inflammable substances, caution against accidental combustion of, 401.
Injection, venous, Dr. Mauran on, 114.
Ink, indelible, 201.
Iron, separation of its oxides, 379.

J.

Johnson, W. R., Prof., on an ancient American utensil, 65.
——— cylindrical steam boilers, 68.
——— economy of fuel, 318.
Jones, Dr., on hail storms, 35.

L.

Leather, coating for, 199,
Leipsic, fair of 1831, 182.
Leitner, E. T., on depriving flowers of their anthers, 45.
Light, polarization of, Dr. Brewster on, 28, 225.
Locke, Dr., on microscopic compass, 237.

M.

Macaire, M., on vegetable physiology, 138.
Machine, Wood's inking, 103.
Magnetic needle, declination of, 205.
Mantell, Gideon, Esq., museum of, 162.
——— works of, 176.
Mauran, Dr., instrument for venous injection, 114.
Meconine, 380.
Medal for discovery of comets, 391.
Memoir of G. Cuvier, 303.
——— F. Huber, 117.
Memory, Mr. Orr on, 278.
Microscopic compass, 237.
Mohawk, alluvial deposites of, 207.
Monument to Cuvier, 309.
Morphine, new process for, 190.

Morton, Dr., organic remains of ferruginous sand formation in North America, 288.

N.

Narceine, 379.
Natural Philosophy, by Prof. Olmsted, 351.
Necrology of Count Chas. Vidua de Gonzano, 198.
——— Geo. Crabbe, Andrew Bell, Sir James Mackintosh, Jeremy Bentham, T. Ornie, C. de Bonstetten, Naeff, Camille Borghèse, Abbé Angelo Cesaris, 370.
——— Baron Boissel de Monville, and George Cuvier, George Simon Serullas, Christian, Auguste Duvau, Evariste Gallois, Dr. Leroux, Albèric Deville, Meyranx, Jean François Champollion, Abel Remusat, Guillaume-Louis-Julien Carré, Louis Simond, 371.
Nitrogen in animal substances, 384.
North Carolina, Gold region of, 1.
Nutt, Dr. on origin, extension, and continuance of prairies, 40.
——— on geological topics relating to lower part of valley of Mississippi, 49.

O.

Obituary of Dr. Gaspar Spurzheim, 356.
Observatory of Geneva, 390.
Ocean, its temperature and saltness at different depths, 10.
Oils, action upon oxygen, 190.
Olmsted's, Prof., Nat. Philosophy, 351.
Organic remains of the ferruginous sand formation, by Dr. Morton, 288.
Orr, Isaac, Mr., on memory, 278.
Oxygenated water, 382.
Oxygen, action of oils upon, 190.

P.

Peck, Hon. Judge, on gold region of Geo., N. Car. and Tenn., 1.
Pendulum, motions of, and of surrounding air, 391.
Petroleum fountain, notice of, by the Editor, 97.
Phosphate of lime, 403.
Phosphorus, density of its vapor, 383.
Physiology, vegetable, 138.
Planes, inclined, Prof. Thomson on, 107.
Plants of Chile, 78, 250.
Poison, animal, remedy for, 168.
Polarization of light, 28, 225.
Potatoes, boiling of, 201.
Potatoe cheese, 202.
Practical tourist, review of, 213.
Prairies, origin, extension and continuance of, 40.

R.

Rattle snake, 337.
Redfield, W. C., on Am. steam boats, 311.
Report on Deshayes' tableau comparatif des coquilles vivantes, by Cuvier and Brongniart, 196.
Review of Practical Tourist, 213.
Rice, boiling of, 202.
Ruschenberger, Dr., on plants of Chile, 78, 250.
Rust, preventive of, 199.

S.

Saltness of the ocean, 10.
Sampson, Wm., Esq., notice of a cetaceous animal, 301.
Sealing wax, economy in use of, 200.
Sheep feeding, 393.
Shells, fossil and recent, 204, 339.
Silvering copper, 386.
Silver, imitation of, 195.
Simond, Louis, notice of life of, 371.
Soubeiran, on action of chloride of lime on alcohol, 134.
Spurzheim, Dr. Gaspar, Prof. Follen's obituary of, 356.
——— works republishing in Boston, 406.
Steam boats, American, W. C. Redfield on, 311.
Steam boilers, strength of, 68.
Sugar of beets, 392.
Sulphur, chlorides of, 382.
——— vapor of, its density, 383.
Surveying, improvements in, 37.
Syrups, bleaching of, by M. Dumont, 346.

T.

Telescopes, manufacture of, 403.
Temperature, increase of in interior of the earth, 15.
——— of the ocean, 10.
Tennessee, gold region of, 1.
Tertiary formation of North America, fossil shells of, 204, 339.
Thermo-multiplicator, 185, 381.
Thompson, Hon. Wm. A., on diluvial action, 243.
Thomson, J., Prof., on inclined planes, 107.
Toads enclosed in wood and stone, vitality of, Prof. Buckland on, 272.

Traill, Dr., on Russian vapor bath, 295.
Trilobites, new species, 203.
——— of North America, Prof. Green on, 395.

U.

Universal terms, by Mrs. Emma Willard, 18.
Utensil, ancient American, 65.

V.

Vapor bath, Russian, 295.
Vegetable physiology, 138.
Vegetation affected by certain gases, 193.
Vidua de Gonzano, Count Chas., necrology of, 198.

W.

Water, maximum density of, 391.
——— oxygenated, 382.
Willard, Mrs. Emma, on universal terms, 18.
Wood, coating for, 199.
Wood's inking machine, 103.
Woodruff, Judge Samuel, on rattle snake, 337.

Acknowledgments to Friends and Correspondents.

DOMESTIC AND FOREIGN.

Received.—Hon. Thomas S. Grimke's Address on Peace, before the Peace Society, New Haven, May 6th, 1832.—His Letter to Hon. J. C. Calhoun, R. Y. Hayne, G. M'Duffie, and Js. Hamilton, Jr. Philadelphia, 1832.

Treatise on Mineralogy, by C. U. Shepard, New Haven. 1 Vol. large 12mo.

Annual Report of the American Colonization Society. 1832.

Mr. Dickerson on the Apportionment Bill.

Dr. Sprague on Revivals. 1 Vol. 8vo. Albany, 1832.

Prest. Lindley's Centennial Address, on Washington's Birth Day. Nashville, 1832.

Pres. Humphrey's Inaugural Address at St. John's College. Annapolis, Md. 1832.

Applicability of the principles of the New Testament to the conduct of States, on the rights of Self Defence; by J. Dymond. London. Brooklyn, Ct. reprinted.

M. Faraday, on a peculiar class of acoustical figures, and on the forms of fluids vibrating on elastic substances. Phil. Trans. 1831.

M. Faraday on Electricity. Phil. Trans. 1832. London.

Rapport fait à la Academie des Sciences sur un Memoire de M. de Beaumont, &c. 1829. M. Brongniart and Beudant: from M. Alex. Brongniart.

Memoire sur la Peinture sur verre. M. Alex. Brongniart. 1831.

Report of the Committee on trade and manufactures, on the adulterations of potash.

Annual Report of the Regents of the University of the State of New York, March, 1832, from Jos. Henry.

Fifth Report of the Chester County Cabinet.

Mr. Sullivan and Mr. Disbrow on boring for water.

Address of Samuel A. Foot at Geneva, before certain societies.

A discourse on Language, by A. B. Johnson. Utica.

Description of a few plants near Troy, by Assist. Prof. H. H. Eaton, Trans. Univ.

Dr. William Henry on the Philosophical character of Dr. Priestley.

Report on the gold and silver coin of the United States.

Mr. Adams's Report on the Tariff.

Dr. Daniel Drake on Medical Education and the Medical Profession in the United States. Cincinnati.

History and Geography of the Mississippi Valley, and Physical Geography of the American Continent, by Timothy Flint. 2 Vols. in one. Cincinnati.

Prof. Robert Dunglison's Human Physiology. 2 Vols. 8vo. bound, from the publishers, Carey & Lea. Philadelphia.

Family Cabinet Atlas, from Carey & Lea. Philadelphia.

Universal Gazetteer, from the author, Edwin Williams, and the publisher, James Conner. New York.

Letters on the Natural History and Internal Resources of the State of New York, by Hibernicus, (attributed to the late Gov. Clinton,) from Prof. Jos. Henry.

The American Almanac and Repository for 1832 and 1833, from Mr. Jos. E. Worcester.

History of the United States, by Noah Webster, LL.D. from the publishers, Durrie & Peck. New Haven, 1832.

Geological Sketches and Glimpses of the Ancient Earth, by Maria Hack, London, 1832, to B. Silliman, Jr. from Walter Mantell, son of Gideon Mantell, Esq. Lewes, Sussex, England.

Traité de Chimie, par J. J. Berzelius. 5 Vols. 8vo. (three more to come,) from the author.

Economy of Manufactures, by Prof. Charles Babbage, of the University of Cambridge, Eng. 1 Vol. 8vo. from the author.

Revista Binestre Cubana, Avril de 1832. Tom. 2, No. 6. Habana, from the editor.

Report on Steam Carriages, by a select committee of the house of commons of Great Britain, &c. from Hon. Gideon Tomlinson, U. S. Sen.

Essay sur les Orbicules Siliceux. Par M. Alex. Brongniart, 1832.

L'Art de fabriquer le fer. Par M. Ang. Perdonnet, 1831.

Annales de L'Institute Royal Horticole de Fromont, Nos. 33, 34, and 37. Dr. Pascalis.

Dissertation on the Atonement, Boston, 1832.

President Quincy's Address at the dedication of Dane Law College, 1832, from the author, also from I. M. Bunker.

A discourse before the Hartford County Peace Society, by Rev. Leonard Bacon, 1832, from the author.

Hon. Edward Everett's Address at the introduction to the Franklin Lectures in Boston. Nov. 1832, from the author.

Young's Algebra, from the publishers, Carey & Lea. Philad.

The Trumbull Picture Gallery.

This splendid collection of historical and other paintings, is now open for exhibition, in a new and appropriate fire proof building, recently erected for its reception, on the grounds of Yale College. In a future number, we will state, more particularly, the nature of the collection, and the object to which it is so benevolently devoted, by the venerable and patriotic artist, after he shall cease to be personally interested in these fine productions of his mind and his hand.

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TO CORRESPONDENTS.

Prof. Strong's continuation of his mathematical communication, came too late for this No., but will appear in the next.

The account of the Georgia Gold Mines, came late and required so much time for the execution of the cuts, that it could not appear before the April No.

It is earnestly requested, by the Editor, that nothing may be written upon the back of drawings, especially when contained in the body of a communication.

A notice of Dunglison's Physiology, and also of Flint's Geography and other Geographical works, will appear in our next number.

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