To Doctr. Geo C Shattuck
from his friend
Amos Lawrence
Boston March 6. 1852.

F. Mooney, Pinxt. L. S. Punderson, Sculpt.

I remain very truly
your friend & servt
Joseph Henry

J. Barber, Printer.

Engd. for the Annual of Scientific Discovery, 1852.

Gould & Lincoln, Boston.

ANNUAL

OF

SCIENTIFIC DISCOVERY:

OR,

YEAR-BOOK OF FACTS IN SCIENCE AND ART,

FOR 1852.

EXHIBITING THE

MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS

IN

MECHANICS, USEFUL ARTS, NATURAL PHILOSOPHY, CHEMISTRY, ASTRONOMY, METEOROLOGY, ZOOLOGY, BOTANY, MINERALOGY, GEOLOGY, GEOGRAPHY, ANTIQUITIES, &c.

TOGETHER WITH

A LIST OF RECENT SCIENTIFIC PUBLICATIONS; A CLASSIFIED LIST OF PATENTS; OBITUARIES OF EMINENT SCIENTIFIC MEN; NOTES ON THE PROGRESS OF SCIENCE DURING THE YEAR 1851, ETC. ETC.

EDITED BY

DAVID A. WELLS, A. M.

BOSTON:
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PREFACE.

The present number constitutes the third yearly volume of the Annual of Scientific Discovery. The Editor, in its preparation, has selected from the great mass of yearly accumulative matter, such subjects as to him seem most important and interesting. The selection and arrangement of the articles have also been made with a special view of illustrating the progress of natural and physical science, in all their departments, from year to year, each volume taking up the history and narration as dropped in the preceding one, in such a way, that a complete series of the work shall present, as nearly as possible, a complete scientific history, not only of each year, but also of the whole time elapsed since the publication of the first volume.

That the Annual has imperfections, we would neither endeavor to disguise nor conceal. The progress of invention and discovery, of improvement and application, is so rapid, unceasing and continuous, that it would require a volume many times the size of the present to record, even in a summary manner, all that transpires of scientific interest in the course of a single year. Some topics of importance, from their abstruse and technical character, have been necessarily omitted. To a certain extent, also, the researches and discoveries relating to organic chemistry and mineralogy have been passed over; the limits of the present work would not suffice for their entire publication, and the interest attached to them, although great, is almost entirely confined to those engaged exclusively in scientific pursuits. If, also, in rejecting some subjects of importance, we have, in this age, when falsity and exaggeration in regard to matters of invention and discovery are so common, inserted some articles not wholly trustworthy, the Editor would plead, as an excuse, "*non mea culpa sed temporis.*" The topics, however, of this nature often contain valuable suggestions and germs of truth, and, even when their falsity is unquestioned, display an amount of ingenuity not always found in real and true inventions. Such matters belong, of right, to the scientific history of the times, and on no account ought to be omitted.

The Editor would take this opportunity to say, that he does not endorse, or consider himself responsible for, any opinions advanced in the body of the work, unless over his own signature. The selections have generally been made upon good authority, which, in most cases, is given in connection with each article. In the volume for 1851, a series of Editorial Notes, on the general progress of science during the preceding year, was given. The favor with which these have been received, leads to their continuance. As some objection has been made to certain remarks by the Editor, included in the notes for 1851, we would here say, that they are to be considered as an editorial table, in which the Editor will exercise the right of freely expressing such sentiments and opinions, relative to scientific matters, as to him shall seem proper.

Heretofore the Annual of Scientific Discovery has appeared under the editorial charge of David A. Wells and George Bliss, Jr. Mr. Bliss having left the country for a temporary residence in Europe, the work has passed entirely under the charge of the first-named Editor. While we regret the withdrawal of Mr. Bliss, whose many and varied attainments have contributed to the success of the Annual, it will be the aim of the present Editor to sustain and improve, in all respects, the character of the work.

To the friends, not only in this country, but in Europe, China, and California, who have kindly furnished scientific information, we return our most sincere thanks.

We present to our readers, in the Annual of Scientific Discovery for 1852, a portrait of Professor Joseph Henry, President of the American Association for the Advancement of Science, 1849–50, and the present Secretary of the Smithsonian Institution, at Washington.

CAMBRIDGE, February, 1852.

NOTES BY THE EDITOR

ON THE

PROGRESS OF SCIENCE IN 1851.

THE progress of science during the year just elapsed will, we think, upon examination, be found to have been no less brilliant in its results, and no less rapid in its advances, than in any single year which has preceded it. One fact must be apparent to all, and that is, that the number of persons now engaged in contributing to the advance of every department of natural and physical science is greater than at any former period. The evidence of this is to be found in the greatly increased number of patents yearly granted, in this and other countries, for new and useful inventions ; in the publication and circulation of scientific books and journals ; in the formation of new societies for the discussion and publication of particular scientific subjects ; and in the extension and endowment of educational systems and institutions, in which instruction in practical science is a principal object. In Mechanics and Physics the difficulty seems now to be, not so much to invent and improve, as to find out what new inventions are wanting, and what old ones admit of improvement. Let but the want be known, and the attempt will soon be made to supply it. That class of men, whose minds are fitted for the very highest walks of science, and for the undertaking of problems and questions apparently irresolvable and unanswerable, is greatly on the increase. The researches and discoveries undertaken and carried out within a recent period, by Arago, Fizeau and Foucault, in relation to light ; of Faraday, in relation to magnetism ; of Pierce, Mitchel and Bond, in astronomy ; and of Hofmann, in organic chemistry, are among the most brilliant, and, at the same time, most difficult of scientific achievements upon record. Many, in other branches of science, during the past year, have contributed much to the progress of general improvement ; and, if their labors have been less fruitful in important discoveries, they embrace much that is useful. With these allusions to the general course of events, we proceed to notice the various topics of interest more particularly.

The American Association for the Advancement of Science held two meetings during the past year. The first, a semi-annual meeting, was held at Cincinnati, Ohio, commencing May 5th, and continuing five days. The attendance at this meeting was as numerous as could have been expected ; consisting chiefly, however, of members of the Association from the West. An unusually large number of papers and communications was presented, most of them relating to geology and paleontology. An exhibition of fossils, collected in various parts of the West, of the most novel and interesting character, was made by several of the members. Many of the specimens shown belonged to entirely new and undescribed species, and were in the most perfect state of preservation. This exhibition seemed to indicate that the Silurian rocks of the Western United States are richer in fossil remains than any other similar deposits. The greatest hospitality was exercised towards the Association by the citizens of Cincinnati, and a fund sufficient to defray the cost of publishing the proceedings was liberally and generously subscribed. The President of this meeting was Prof. A. D. Bache, Superintendent of the Coast Survey.

The second and annual meeting of the Association for 1851 was held at Albany, N. Y., during the week commencing Monday, August 18th, Prof. Agassiz presiding. The attendance was unusually large, and upwards of one hundred and twenty papers were presented and read. The departments of geology, astronomy and physics were most largely represented; while zoology and chemistry received comparatively little attention. The Association experienced the most generous treatment from the corporation and citizens of Albany ; and, at the close of the meeting, it was announced that the authorities had voted to publish the volume of proceedings at the expense of the city. By invitation from the city of Troy, an excursion was made to that place, where a session was held at the Rensselaer Institute, after which, the members were invited to a handsome collation.

The officers of the Association for the year 1852 are as follows : Prof. Pierce, of Cambridge, President ; Prof. James D. Dana, of New Haven, General Secretary ; Prof. Spencer F. Baird, of Washington, Permanent Secretary ; Dr. Elwyn, of Philadelphia, Treasurer. It was voted to hold the next annual meeting at Cleveland, Ohio, that city having invited the Association, and generously offered to publish the proceedings. A similar invitation and offer were afterwards received from the city of Brooklyn, N. Y., and general invitations from Providence and Baltimore. It was deemed inexpedient to appoint a semi-annual session, though one at Washington was requested.

At this meeting, on recommendation of the standing committee, it was unanimously voted, that the names of all members who have not paid their assessments, and who refuse to do so after two notices of three months' interval, shall be stricken from the rolls of the Association. Resolutions, commemorative of the death of Samuel George Morton, of Philadelphia, were also adopted. The number of new members elected at this meeting exceeded one hundred.

The annual address before the Association was delivered by Prof. A. D. Bache, the retiring President ; subject, "The Organization, Condition and Progress of the American Association for the Advancement of Science, with Remarks on the Direction in which its Greatest Usefulness may be looked for." In the course of the address, some suggestions were made respecting the formation of a National Institute, somewhat similar to those offered by Sir David Brewster, at the British Association, in 1850.* In relation to this subject, Prof. Bache said as follows : — "In this connection I would throw out for your consideration some reasons which induce me to believe that an institution of science, supplementary to existing ones, is much needed in our country, to guide public action in reference to scientific matters. It is, I believe, a common mistake to associate the idea of academies and institutes with monarchical institutions. We show in this, as in many other things, the prejudices of our descent. Republican France has cherished her Institute, seeking rather to extend than to curtail its proportions. One of the most ardent republicans is its perpetual secretary — that setting sun whose effulgence shows that it is merely passing below the horizon to illumine another sphere !

"Nor does the idea of a necessary connection between centralization and an institute strike me as a valid one. Suppose an institute, of which the members belong in turn to each of our widely-scattered States, working at their places of residence, and reporting their results, meeting only at particular times and for special purposes, engaged in researches self-directed or desired by the body, called for by Congress, or by the Executive, who furnish the means for the inquiries. The details of such an organization could be marked out so as to secure efficiency without centralization, and constant labor with its appropriate results. The public treasury would be saved many times the support of such a council, by the sound advice which it would give in regard to the various projects which are constantly forced upon their notice, and in regard to which they are now compelled to decide without the knowledge which alone can insure a wise conclusion. The men of science who are at the seat of government, either constantly or temporarily, are too much occupied in the special work which belongs to their official occupations to answer such a purpose ; beside, the additional responsibility which, if they were called together, they must necessarily bear, would prove too great a burthen, considering the fervid zeal, and I might almost say fierceness, with which questions of interest are pursued, and the very extraordinary means resorted to, to bring about a successful

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* See *Annual of Scientific Discovery*, 1851, Editorial Notes, p. vii.

conclusion. If it were admissible that I should go into detail on this subject, I could prove the economy of a permanent consulting body like this. This is, however, a lower view than the saving of character, by avoiding mistakes, and misdirection of public encouragement, and by loss of opportunity of encouraging that which is really useful. I should subject the Association to some criticism, if I unfolded this subject specifically, particularizing the errors here generally alluded to, and abstain, merely remarking that the amount which would have been saved to one department of the government alone, from the application of the principle of the equality of action and reäction, would have supported such a council for twenty years, including the furnishing of means to show experimentally the applications of the principle to the case in question. Not only in new undertakings would the advice of such a body be most important, but they would be appealed to for information in regard to existing ones, and would prove most serviceable in advising on doubtful points.

"Our country is making such rapid progress in material improvement, that it is impossible for either the legislative or executive departments of our government to avoid incidentally, if not directly, being involved in the decision of such questions. Without specification, it is easy to see that there are few applications of science which do not bear on the interests of commerce and navigation, naval or military concerns, the customs, the lighthouses, the public lands, post-offices and post-roads, either directly or remotely. If all examination is refused, the good is confounded with the bad, and the government may lose a most important advantage. If a decision is left to influence, or to imperfect knowledge, the worst consequences follow. Such a body would supply a place not occupied by existing institutions, and which the American Association, from its temporary and voluntary character, is not able to supply."

The subject of the formation of a National Academy of Science was also presented to the American Institute at New York, in its anniversary address, delivered by Dr. C. T. Jackson. It was here proposed that the Academy should act as an umpire, and as the adviser of Congress in all matters pertaining to scientific invention and discovery ; the members to be nominated by the President, and confirmed by the Senate.

The twenty-first annual meeting of the British Association was held at Ipswich, England, June 2d, and continued, as usual, for one week. The attendance was unusually large, and the meeting, in interest, was not inferior to any former one. Many foreigners of distinguished scientific reputation, attracted to England by the Great Industrial Exhibition, were present at the Association, and contributed to its proceedings. The President, Prof. Airy, the Astronomer Royal, in the annual address, declared himself opposed to the plan of establishing a National Academy, or Institute, as recommended at a former meeting. The reasons urged against the plan do not, however, fully apply to the existing state of things in the United States.

The next meeting of the Association was appointed to be held at Belfast, Ireland, in June next. The President for the year 1852 is Col. Sabine.

A congress of Swedish, Danish and Norwegian naturalists met at Stockholm, on the 14th of July, 1851.

An Academy of Sciences, under the title of the Assembly of Knowledge, has been formed in Constantinople during the past year. The Academy will be composed of forty native members, and an indefinite number of correspondents in foreign countries. The statutes declare the object of the new institution to be, the publication of original scientific works, and the translation into Turkish of foreign works of importance. The first labor of the Academy will be the compilation into the Turkish language of an encyclopædia of the sciences.

An American Geographical and Statistical Society was formed in New York, on the 9th of October, by the adoption of a constitution, and the election of suitable officers to manage its affairs. The society is constituted for the collection and diffusion of geographical and statistical information. By the constitution, the society is to consist of ordinary, corresponding and honorary members. The initiation fee is fixed at $10, and the annual subscription at $5. Anniversary meetings are to be held on the second Thursday of December in each year, and ordinary meetings on the second Thursday of March, June, September and December. For the present year, Henry Grinnell, Esq., was elected President; S. Dewit Bloodgood, Foreign Secretary; John Disturnel, Domestic Secretary and Agent.

The Royal Geographical Society of Russia has displayed great energy and activity during the past year. At the annual meeting, two prizes were awarded. The first, a medal, to Col. Lemn, for a series of astronomical observations, determining the latitude and longitude of some four hundred places in Russia and the neighboring regions in Asia, as far as Mesched, in Persia. These determinations are of particular value for the geography of inner Asia. The second prize was bestowed upon M. Woronoff, for a historical and statistical survey of the educational establishments in the district of St. Petersburg from 1715 to 1828. It is, in fact, a history of the development of mental culture in that most important part of the empire. From the annual report presented, we derive the following information: — The society had caused an expedition to be sent to the Ural, under Col. Hoffman. The triangulation of the country about Mount Ararat had been completed. A map of Asia Minor had been prepared by Col. Bolotoff; a map of the Caspian Sea, and the countries surrounding it, was nearly completed by Mr. Chanykoff; the same savant was still at work on a map of Asia between 35° and 40° north latitude, and 61° and 81° east longitude; two astronomers were engaged in that region, making observations to assist in its completion. Another map of Kokand and Bokhara was also forthcoming, and the society had employed Messrs. Butakoff and Chanykoff to prepare a complete atlas of Asia between 33° and 56° north latitude, and 65° and 100° east longitude. A Russian nobleman had given 12,000 roubles to pay for making and publishing a Russian translation of Ritter's geography ; but the society had determined not to undertake so immense a work (15,000 printed pages), and had determined only to take up those countries which have an immediate interest for Russia, using along with Ritter a great body of materials to which he had not access. These countries are Southern Siberia, Northern China, Turan, Korassan, Afghanistan and Persia. In Ritter's work these occupy 4,500 pages. The expedition sent out by the society to explore the source of the Nile, had returned without effecting much of interest. A new expedition was preparing to explore the peninsula of Kamskatka. To aid in this undertaking, a Russian gentleman has given 20,000 francs per year, during the time the party may be absent.

The Royal Geographical Society of France have awarded to Lieut. Lynch, U. S. N., two silver medals, for his exploration of the Dead Sea and the Jordan.

The Paris Society for the Encouragement of National Industry have awarded a silver medal to Samuel Cornell, of Connecticut, for his invention of a machine for making lead pipes.

The liberality exercised during the past year by various public authorities and private individuals, towards the cause of science, has been most generous and encouraging.

Two appropriations of considerable interest have been made by the British government, namely : £1000 to the Royal Asiatic Society, "towards defraying the expenses of the publication of the inscriptions in cuneiform characters copied by Lieut. Colonel Rawlinson," and £500 "towards the excavations at the Mound of Susa, with a view to the discovery of ancient monuments known to be deposited there." The sum of £1000 has also been placed at the disposal of the Royal Society, by government, to be employed at discretion in assisting private scientific enterprise.

The French government has voted a credit of 33,000 francs, for the purpose of exploring the Temple of Serapis, in the ruins of Memphis, Egypt. This temple, which has been covered with sand ever since the time of Strabo, and has since remained almost intact, offers great temptations to research. This building is a mixture of the Greek and Egyptian styles of architecture, and the worship to which it was consecrated was a fusion of the Greek and the Egyptian faith. The very slight soundings in the sand, which have been hitherto made, have brought to light many curious statues and bas-reliefs.

The French authorities have also decreed the expenditure of 62,260 francs for "experimental studies" in reference to a destructive malady of the horned cattle over a large part of France. The sum of 10,000 francs will be paid to whomsoever shall discover a preventive or cure.

The sum of $40,000 has been bequeathed to the French Academy, by Dr. Jecker, of Paris, to found an annual prize for researches in organic chemistry.

A legacy of $50,000 has been left to Dartmouth College, New Hampshire, by Abiel Chandler, of Boston, for the purpose of establishing a school of instruction in the practical and useful arts of life.

For the purpose of founding a school for instruction in navigation, the sum of $25,000 has been bequeathed by Daniel West, of Salem, Mass.

A gift of a superior achromatic telescope has been made to the Observatory of Williams College, Mass., by Amos Lawrence, Esq., of Boston.

A prize of five hundred ducats has been offered by the Royal Prussian Academy, at Berlin, for the best work on the nature and mode of action, and resulting constitution, of hydraulic mortar, including the constitution of the zeolites generally, but especially of those produced in the solidification of mortar. The time allowed is till the 1st of March, 1854.

Four several prizes, amounting in all to $3000, have been offered by F. M. Ray, Esq., of New York, for various improvements relating to railroad matters; the first and largest prize, of $1500, to be given for the invention which best secures against the danger arising from collisions, and the breaking of wheels and axles. The premiums are to be open for competition until the next annual fair of the American Institute, at which time the decisions will be made by a committee. The inventions are to be such as can be adopted and put into general use, and the inventors are to retain their right, in all cases, to secure patents.

A government school of mines was opened in London, on the 7th of November, under the direction of Sir H. De la Beche, Director General of the Geological Survey of Great Britain. This institution is connected with the Museum of Practical Geology, and has for its officers the best talent in the United Kingdom. Among them are Edward Forbes, Professor of Natural History; Dr. Playfair, Professor of Chemistry; Robert Hunt, Professor of Mechanical Science; Mr. Ramsay, Professor of Mining Engineering, and others.

A project is on foot, in the southern and central portions of Illinois, for the establishment of an industrial university, in which the science of agriculture and the principles of mechanism shall be practically taught. The fund for this purpose, now at the command of the State, has accrued from the action and foresight of the constitutional convention assembled at Kaskaskia, in August, 1818, in accepting certain propositions of Congress in relation to certain lands for school purposes.

The American Institute, of New York, has issued a circular, proposing the establishment of an American school of mines, to be located in New York, under the auspices of the Institute. Dr. C. T. Jackson, of Boston, is named as the Director. The plan embraces courses of popular lectures on geology, mineralogy, mining, metallurgy, and chemistry proper, together with practical instruction in each of the above named branches of science, and also in civil engineering and nautical astronomy.

A new university, projected upon an extensive scale, has been established at Albany, N. Y., Judge Bronson, President. The lectures upon medicine, law, and various departments of science, have commenced, and are in progress. The university in plan more nearly represents the European universities than anything now in this country. It is intended that the professors shall be remunerated by the fees which they receive from those who attend the lectures. By a generous subscription of the people of Albany, four persons from each senatorial district of New York, and certain other persons, are allowed, this year, to attend upon the lectures gratuitously. Among the lecturers connected with this university, are Prof. Mitchel, on astronomy ; Prof. Norton, scientific agriculture ; Prof. Hall, geology ; Dr. Henry Goadby, entomology ; Prof. Agassiz, Guyot, and others.

Since the meeting of the American Association at Albany, active measures have been taken to secure the establishment of an astronomical observatory in that city. Twenty-five thousand dollars have already been raised, to which sum Mrs. Dudley contributed thirteen thousand. A valu able lot of land for the site of the building has also been given, by Mr. Van Rensselaer. The director of the observatory will be Prof. O. M. Mitchel, formerly in charge of the Cincinnati Observatory. The instruments are to be purchased in Europe, by Prof. Mitchel.

A resolution has been introduced in the Board of Aldermen of New York, authorizing the appointment of a committee to take immediate measures for the erection of an astronomical observatory in that city. It is to be feared, however, that there is too great an indifference among the commercial and mercantile interests of New York, to secure this important object.

An observatory is in the course of construction in Buffalo, N. Y., under the direction of Dr. Van Duzee. It is to be furnished with a refracting telescope, of eight inches aperture and ten feet focal distance, together with all other necessary instruments.

At a meeting of the photographists of New York, July, 1851, an association for the promotion of heliographic science was formed, under the name of the "American Daguerrean Association." M. M. Lawrence was elected President, and S. D. Humphrey, editor of the Daguerrian Journal, Secretary. The first annual address before this Association was delivered Oct. 31, by S. D. Humphrey, Esq.

Three vacancies in the limited number of the foreign correspondents of the French Academy have been filled during the past year ; two in the section of astronomy, and one in the section of botany. The first place in the astronomical section, made vacant by the death of Schumacher, was filled by the election of Mr. Hind, of London. To the second place, vacant by the death of Svanberg, Mr. W. C. Bond, director of the Cambridge Observatory, was chosen. Among the candidates were Messrs. Adams, Galle, Lassel, Struve, and Gasparis. To the section of botany, in the place made vacant by the death of M. Kunth, M. Blume, professor in Leyden, was elected. Messrs. Asa Gray and John Torrey, of the United States, were among the candidates in this section.

In the report of the Secretary of the Interior, communicated to Congress December, 1851, the establishment of an agricultural bureau, in connection with that department, is strongly recommended. From this report we make the following extracts : — "Agriculture is, unquestionably, the great interest of our country, whether we have reference to the number of persons employed in it, or the value of their productions. It appears, from the census of 1840, that the whole number of persons at that time engaged in this pursuit was 3,719,951 ; in manufactures, 791,749 ; and in commerce, 117,607. More than four-fifths of the entire population were, therefore, employed in the cultivation of the soil. At present it is believed that the proportion is still greater, in consequence of the change in the policy of the government, which has induced many to become agriculturists who were formerly engaged in manufactures. Respecting the duties of such a department, it should be charged with the duty of collecting and disseminating information in regard to the cultivation of the soil, in all its branches. It should investigate every proposed improvement in the tillage of the earth, or in the construction of implements of husbandry. It should collect, from our own and foreign countries, every variety of seed, fruit, plant and vegetable, and distribute them, with full and accurate information as to the soil, climate, and mode of cultivation, best adapted to each. One or more officers should be connected with it, thoroughly acquainted with the principles of geology, mineralogy, chemistry and botany, for the purpose of investigating and reporting upon the character and properties of every variety of soil, rock, mineral, and vegetable, and their adaptation to useful purposes. To this bureau should also be entrusted the duty of superintending the taking of each decennial census, and of procuring and classifying from year to year all the statistical information which can be obtained in respect to the agriculture, manufactures, commerce, tonnage, revenue expenditures, financial and banking systems, improvements by railways, canals, and roads, industrial pursuits, and general progress of every State in the Union, and of the principal nations of the world."

Such a department, conducted by competent persons, and established under the authority of the general government, would undoubtedly do much towards promoting a sound and practical system of scientific agriculture throughout the country. Many of the publications relating to agricultural science, at present circulating, some, even, of an official character, are edited by persons ignorant of the principles of chemistry, and abound in the most extravagant and fallacious statements. It is foreign to our purpose in this connection to point out the errors in any particular work; the task, however, could be easily accomplished. The researches made during the past year, in regard to the volatility of phosphoric acid in acid solutions, and the well-known difficulty of quantitatively determining this body, throw a doubt over the correctness of almost all ordinary soil analyses in this particular. It is, moreover, the opinion of some of our most eminent chemists, that very few complete soil analyses have been made in this country which can present any claims to accuracy or reliability.

A valuable report on the system of agricultural education, as pursued in the different countries of Europe, has been made, during the past year, by President Hitchcock, to the Massachusetts Board of Commissioners on the establishment of an Agricultural School, and published by the Legislature of the State. This report, the result of personal examination, embraces much information never before presented to the American public.

The report of the Regents of the Smithsonian Institution exhibits its affairs in a prosperous condition. By a judicious management, the accrued interest on the amount originally left by Smithson has proved sufficient, not only to construct the building and defray all other necessary expenses, but to allow the sum of $150,000 to be added to the principal, thus considerably increasing the yearly income. The works published under the auspices of the Institution the past year, have been, a "Report on Recent Improvements in the Chemical Arts," by Booth and Morfit; "An Ephemeris of Neptune, for 1852," by Sears C. Walker, and "Occultations visible in the United States for 1852," computed by John Downes, Esq. The Institution has also in press the "Plantæ Fremontianæ, or Descriptions of Plants collected in California by Col. Fremont," by Prof. Torrey; "A Monograph of the Fresh Water Cottoids of the United States," by Charles Girard; "Plants of New Mexico and Texas, collected by Wright," by Prof. Gray; "A Catalogue of the Coleoptera of the United States," by Dr. Melscheimer, and a "Monograph of the Marine Algæ of North America," by Prof. Harvey, of Dublin, Ireland. This last memoir consists of a description of the marine plants which are found along the eastern and southern coasts of the United States, and which are worthy of attention, not only on account of their beauty, variety, and the illustrations they present of the growth of vegetable forms, but also on account of their economical value with reference to agriculture and the chemical arts. The work is accompanied by many beautiful drawings, executed by Prof. Harvey, and is gratuitously offered by the author. The preparation of the whole work, besides the time occupied in collecting the specimens, will occupy more than a year. "This voluntary contribution to knowledge, from a man of science, may surprise those whose minds are not liberalized by philosophical pursuits, and who cannot conceive any object in labor unconnected with pecuniary gain."

The publication of a Grammar and Dictionary of the Dacotah language, a work in quarto, with special founts of type, and of immense labor, by the Rev. Mr. Riggs, of the Minnesota mission, had been commenced, under the direction of the Smithsonian Institution. By a fire, which occurred in New York in January, the type and an edition of fifteen hundred copies were destroyed. The greater portion of the manuscript copy was, however, fortunately in the hands of the author. Thus far, fifteen hundred copies of each memoir published by the Institution have been printed. The rules adopted for their distribution are as follows: they are presented to all learned societies and foreign libraries which send transactions, catalogues, &c., in exchange. To all colleges in actual operation in this country, provided they furnish catalogues and meteorological observations in return. To all States and Territories, in exchange for copies of all documents published under their authority; and, lastly, to all public libraries in this country, not included in either of the foregoing classes, now containing more than seven thousand volumes; and to smaller libraries, where a whole State or large district would be left unsupplied. The minor publications are also given to many of the most prominent Lyceums and Academies. None of the works published by the Smithsonian Institution are copyrighted; they are, therefore, free to the use of all.

Important additions have recently been made to the Museum of the Institution. A valuable collection of skins, skulls and skeletons of mammalia, together with some rare fossils from the Upper Missouri, have been obtained through Mr. T. Culbertson. A journey was made by Mr. Culbertson, under the auspices of the Institution, to the country known as the "*Mauvaise Terres*," on the Upper Missouri. Here he collected mammalian and reptilian fossils, sufficient to load a cart to its utmost capacity. These embrace many new and undescribed species, among which are the *Rhinoceros occidentalis* and *Nebraskensis*, the *Palæotherium Bardii* and the *Agriochærus antiquus*. The journal kept by Mr. Culbertson, since deceased, while on this expedition, has been published in the annual report for 1850–51. Nineteen boxes of minerals, illustrative of the geological survey of the mineral region of Lake Superior, by Dr. C. T. Jackson, have been given by the Land Office. A valuable cabinet of Natural History, embracing some thousand specimens, has been deposited in the Museum by Prof. Baird, and numerous donations have been made by officers of the army and private individuals.

Five large stone idols, from Central America, have been sent to the Institution, by Mr. Squier, who also proposes to give, under certain conditions, a valuable collection of relics, illustrative of American antiquities. The library of the Institution now numbers about ten thousand separate articles, including a large and rare collection of engravings.

A small appropriation has been made to defray in part the expenses of explorations relative to the erosions of the surface of the earth, especially by rivers ; and also for investigations relative to terraces and ancient sea margins, under the direction of Pres. Hitchcock. A full account of these investigations will soon be published by the Institution.

The Assistant Secretary, Prof. S. F. Baird, has prepared, for the use of the Institution, a small taxidermist manual, containing directions for collecting, preserving, and transporting specimens of natural history.

Among the official scientific publications of the past year, are the Reports on the Mineralogy and Geology of the Lake Superior Mining District, by Messrs. Foster and Whitney ; Patent Office Report, 1850–51, Mechanical and Agricultural, by Thomas Ewbank ; the Fifth Annual Report of the Smithsonian Institution ; Reconnoissances of Texas and New Mexico, by various officers of the army ; Report on Meteorology, by Prof. Espy ; and the Meteorology of the U. S. Exploring Expedition, by Captain Wilkes. The remaining unpublished works, pertaining to the scientific departments of the Exploring Expedition, are in a forward state of preparation. The volume on Conchology, by Dr. A. A. Gould, of Boston, is in press, and most of the beautiful folio plates finished. The volume on Ferns, by Mr. Brackenridge, one of the botanists of the expedition, is ready for the press; as is also the folio Atlas of Illustrations.

In this connection we would call attention to two other scientific publications of great value, issued during the past year, in this country, by private individuals. The first, a work on the "Terrestrial Air-Breathing Molluscs of the United States and the adjacent Territories of North America," described and illustrated by Amos Binney, and edited by Dr. A. A. Gould. This work is published in two volumes, 352 pp., with plates, under a provision in the will of the late Mr. Binney, of Boston. Some idea of the value of this work may be formed from the fact, that near ten thousand dollars have been expended upon it, and the whole edition, two hundred and ninety copies, is reserved for distribution. The work is of the highest honor to the lamented author, both as a contribution to science, and an example of private munificence seldom equalled. The second work to which we would call attention, is a Geological Chart, by Prof. James Hall, of Albany. This chart is not only a full and correct expression of geological facts and principles, but contains much original matter relative to fossils. It is particularly illustrative of American Geology, and, as a means of disseminating geological knowledge, is a most important contribution to science. A new edition of the Encyclopædia Britannica, in 21 vols. 4to., illustrated by five hundred engravings on steel, and many thousands on wood, is announced by Messrs. Black, of Edinburgh. This edition, constituting the eighth of this celebrated work, is to be entirely revised and brought up to the times. From the commencement of this work, in 1771, over six hundred thousand dollars have been expended upon it ; in the same time, also, thirty-five thousand copies have been sold.

A second volume of Astronomical Observations has been issued during the past year, from the National Observatory. The Wind and Current Charts, planned by Lieut. Maury, the Superintendent of the Observatory, and prosecuted under his direction, are being extended to the Pacific and Indian Oceans. Vessels sailing from the Atlantic to the Pacific ports of the United States, with the instructions afforded by these charts, make the voyage in forty days less, upon the average, than those sailing without them ; and there is reason to hope the time may be still further reduced. The Bombay Geographical Society, some time since, contemplated the formation of a set of wind and current charts, and collected, for this purpose, a vast amount of information relative to the Indian Ocean. The plan, however, having been given up, the society generously gave to Lieut. Maury all the information collected, embracing a large number of log-books, charts, manuscripts, &c. Lieut. Maury has, also, in the process of construction, a set of "whale charts," or charts whereon the places and seasons wherever whales have been seen are noted down. These charts, while they promise to be of great service to this branch of American fisheries, seem to show that the whales possess much more knowledge than we have usually given them credit for, and know a great deal more about the warm and cold currents of the ocean waters than we do, or have done.

The expedition, for astronomical observations, to Chili, appears, from the reports of Lieut. Gillis, to have been actively conducted, and will probably be brought to a close during the year 1852. It is expected that the first publication of the American Nautical Almanac, under the superintendence of Lieut. Davis, will be made within the present year.

The Swedish Government have determined to send out a scientific exploring expedition, for a voyage of circumnavigation of the globe. Eminent scientific men have been appointed to accompany it.

The perseverance and courage of American seamen, engaged in private enterprises, has been strikingly exemplified during the past year, in the fact, that the American whale-ship Saratoga, Capt. Harding, while cruising in the Arctic Sea, in the vicinity of Bhering's Straits, penetrated to a higher latitude, in this portion of the Arctic Sea, than had previously been reached. This vessel, Sept. 21, 1851, reached lat. 71° 50′, a point further to the north than the British Expedition, under Beechy, in 1826, was able to make.

The American Grinnell Exploring Expedition, sent out in the spring of 1851, has returned unsuccessful. Traces of Sir John Franklin, in 1845, were found, and some important geographical discoveries made. A chart, showing the course and discoveries of the expedition, has been issued by the hydrographical office, at Washington.

Intelligence from the British Exploring Expedition in Central Africa has been received up to August, 1851. Mr. Richardson, the head of the party, died in March last, at Bornou. Drs. Barth and Overweg had, however, continued on, and, at the latest dates, had succeeded in penetrating further into the interior than has hitherto been accomplished.

A plan for the exploration of Central Africa has been submitted to the Secretary of the Navy, by Lieut. M. C. Watkins, U. S. N., who volunteers to conduct an expedition. He proposes to ascend the rivers St. Paul, Niger, and Congo, by means of a small iron steamer, suitably equipped and furnished.

The mystery hanging over the interior of Africa is rapidly dissipating before the zeal of the many explorers whose efforts are now devoted to traversing the centre of that continent, and, before many years have passed, there is reason to suppose this geographical and ethnographic problem will be fully solved. The English expeditions from the Cape of Good Hope, the German missionaries on the eastern coast, with their journeys into the highlands in the south of Abyssinia, the explorations of the English on the Gold Coast and up the Niger, those of the French, starting from Senegal and Algiers, the travels of Knoblecher and others on the upper Nile, with the journeys of Barth and Overweg, must soon make us acquainted with the principal facts that have so long been the object of general curiosity, if not of exaggerated expectation. Something is also to be anticipated from the aid of Mohammedan travellers, of whom there are a great number scattered over the interior of the continent, in search of adventures, or with a view to trade. One of these has published, in Arabic, two works, containing his experiences and observations in Darfur and Waday, both of which have been recently translated into French.

In return for a set of American weights and measures, presented by the U. S. Government to the French, through the agency of M. Vattemare, a full set of the French standards has been ordered to be sent to Washington. It embraces all the articles belonging to, or illustrating, the three unities of the French metrical system of weights and measures, viz., the metre, the litre, and the kilogramme ; the series of instruments for weighing and measuring, which habitually compose, in France, a bureau of verification, together with the volumes of law pertaining to the whole subject. This system, embracing a great variety of articles, will form one of the most valuable collections in the possession of the American Government.

The Paris "Bulletin de la Societe de Geographie" of the past year contains a highly eulogistic article upon the management and results of the U. S. Coast Survey, and very deservedly compliments the superintendent, Prof. Bache. The Editor, M. Sedillot, after presenting an historical summary of the survey, says: — "The superintendent was called to his eminent post by a unanimous voice. Distinguished in the esteem of his fellow-citizens by his useful publications, appreciated by the principal academies of Europe, he has acquired a universal reputation by the services which he is daily rendering to science, and by the improvements of every kind which his skill has introduced into the different branches of the coast survey." After dwelling somewhat on the organization and results of the survey, he adds:— "In speaking of the eminent services rendered by the coast survey to science and humanity, we make known only a very small part of the results of this admirable enterprise. Directed in all its branches with zeal and activity, it cannot fail to add every year to the consideration with which it is surrounded, not only in the United States, but also in all countries where science and its application to the arts of life are duly appreciated."

The magnetic telegraph system is now rapidly extending over the whole European continent. Already a line is completed from Ostend to Trieste, a distance of more than two thousand miles. Three lines of telegraph are also in operation in the interior of Hungary. Preparations are also making, by the Turkish Government, to introduce the telegraph into that country, and a commission to make the necessary arrangements has been appointed by the Sultan. In Sweden and Norway, an American, by the name of Robinson, is engaged in the construction of a number of lines of telegraph; a privilege having been granted him by the government, to endure for fifty years. The successful completion of the submarine telegraph between England and France has led to the serious consideration of a submarine telegraph between England and the United States. This event we regard as by no means improbable, and the prediction has been hazarded, that, within ten years from 1852, the transactions in Europe and America, of each day, will be reported and published in both countries on the succeeding day. We invite the attention of those who may feel sceptical in regard to this subject, to an article in the present number of the Annual of Scientific Discovery, entitled "Thoughts on Telegraphic Communication twenty years ago."

The London Athenæum, in speaking of the transatlantic telegraph, says: "There seems nothing impracticable in such an undertaking. A conviction has been expressed, by those conversant in these matters, that a single line of communication between England and the nearest point of America might be established for a less sum than was paid for making a single mile of the expensive portion of the Great Western (English) Railway. In this estimate it is proposed to have only a single wire, covered with gutta percha, similar to that used in 1851, to prove the practicability of passing an electric current across the Straits of Dover. To this would be added the additional protection of a hempen plat, the hemp having been passed through a chemical solution to render it indestructible in salt water. Such a line, it is said, of gutta percha and prepared hemp, would, although only about three quarters of an inch in diameter, be of nearly double the strength of the experimental line laid down between England and France, in a strong sea and running tide. The proposition is, to extend it from the south-west coast of Ireland, the nearest point to the American Continent, and where the bold and rocky shore offers depths that secure its safety from anchors, to the nearest point on the American coast, a distance considerably less than two thousand miles. Choosing the months of summer, and an experienced captain, accustomed to the track, such a line, it is averred, might, with very simple machinery, be paid out night and day with perfect safety, at the ordinary speed of the steamer. The vast importance of such an object is not to be weighed against a sum of one hundred thousand pounds, which, we are assured, would more than accomplish it, if a single wire only were employed. The successful completion of one line would, of course, be speedily followed by that of others. This once accomplished, the extension of the line across the American continent, to the Pacific, would follow certainly ; and we should have the astounding fact, of a communication from the shores of the Pacific, crossing America and the Atlantic, and touching our shores, in an instant of time."

The present extent of the telegraphic system in the United States and Canada is not far from twelve thousand miles. During the past year the shortest passage ever made between England and the United States, has been accomplished, by the Baltic, (Collins' Line,) in nine days thirteen hours and forty minutes. Average time of the American steamers, from Liverpool to New York, from July 1st, 1851, to Jan. 1st, 1852, eleven days eight hours ; of the English, do., do., twelve days nine hours. Average of the American steamers from New York to Liverpool, in the above mentioned time, ten days twenty-three hours ; of the English, do., eleven days eleven hours.

In no department of science is there greater enterprise displayed than in the department of meteorology. Under the direction of the Smithsonian Institution, stations are now being established in many parts of the country, each provided with proper instruments, regulated according to one standard. Under the direction of the Regents of the University of the State of New York, a very complete system for meteorological observations has been extended, by Prof. Guyot, over the whole State. At the meeting of the American Association at Albany, a committee was appointed, and instructed to memorialize Congress, the Canadian Government, and the different State Legislatures, in regard to the immediate extension of the system now making, under the direction of the Smithsonian Institution. A letter was also read at this meeting of the Association from the Hudson's Bay Company, offering to coöperate with the Association, in regard to this subject, and to establish a system of observations, at such of the posts belonging to the Company as might seem desirable to the Association. By order of the War Department, a system of meteorological observations is maintained at all the U. S. military stations, under the supervision of the Surgeon-General of the army ; and measures are now on foot to provide for a set of observations by the keepers of all light-houses on the American coast, under the direction of the Treasury Department. The instruments supplied to many of the stations established by the Smithsonian Institution, embrace a thermometer, barometer, hygrometer, rain and snow gauge, and wind vane, all carefully compared, and of uniform construction. At some stations, hourly observations are maintained, and at all others observations three times a day. At many of the stations, the observations embrace the following particulars :—The phase of the moon, the barometrical indication, the height of the thermometer, direction and force of the wind, the plants in flower, the migratory birds first seen, the state of the psychrometer, the amount of vapor or humidity, the state of the rain gauge, the state of cloudiness, with notes on the various kinds of clouds visible.

Active measures, in relation to meteorological science, have recently been taken by various foreign governments. The government of Great Britain, having greatly enlarged its system of meteorological observations, and wishing to extend it still farther, in November last invited the coöperation of the United States therein. To this official invitation the American authorities have favorably responded, and have also suggested the propriety of including the sea as well as the land, and of enlisting in the meteorological field the voluntary coöperation of the commercial, as well as the aid of the naval marines, not only of England and the United States, but of all other maritime nations. Lieut. Maury, on the part of the United States, and Gen. Sir John Burgoyne, on the part of Great Britain, have been entrusted with the charge of the work ; and a committee of conference, composed of representatives of several nations, has also been requested to make arrangements for carrying out this universal system of observations. The English Government have determined to extend the system of meteorological observations over the whole of their vast empire, and, to aid in this movement, the East India Company and the Trinity Board have agreed to lend their influence and assistance. In addition to this, letters have recently been sent, by Lord Palmerston and by the Colonial Office, to all British Consuls, reguesting their coöperation in the collection of data in regard to a theory of storms, a work under the charge of Col. Reed. By discoveries recently made, particularly at St. Helena, it has been found that there is a tidal movement of the air, in obedience to the movements of the moon, answering to the tides of the ocean, and point-ing its apex to that luminary, thus serving to illustrate, in another aspect, the sublime simplicity of nature's laws.

The Smithsonian Institution has published, for the use of those who take part in the system of meteorological observations, a series of minute directions, prepared by Prof. Guyot. It occupies forty octavo pages, with wood-cut representations of the instruments, and two lithographic engravings, to illustrate the different forms of clouds, and to facilitate their notations in the journals, in accordance with the nomenclature adopted by meteorologists. A set of tables has also been furnished for correcting the barometrical observations, on account of variations of temperature. A series of experiments have also been made, in the laboratory of the Institution, for the purpose of constructing, from direct observation, a scale of boiling temperatures, corresponding to different degrees of rarefaction of the air. With a thermometer, each degree of which occupies one inch in length of the scale, the variations of the boiling point, corresponding to a slight change in altitude, are found to be more perceptible than those in the length of the barometrical column. A valuable collection of returns, relative to the Aurora, has also been made to the Smithsonian Institution. These are to be placed in the hands of Capt. Lefroy, of the Toronto Observatory, and incorporated with observations of a similar kind collected in British North America. An account in full, of the series, will be hereafter published by the Institution.

The progress of Astronomy, during the past year, has been very great. The Earl of Rosse has been much engaged in experiments on the best methods of supporting and using his large mirrors. The construction adopted some time since is still retained ;—namely, a system of levers, distributing their pressures uniformly over eighty-one points, each pressure being transmitted through a small ball, which permits to the mirror perfect freedom of slipping in its own plane, so as to take proper bearing in the chain or hoop which supports it edgeways. To Lord Rosse's critical eye, the effect even of this mounting, though greatly superior to that of any preceding, is not quite perfect. By the aid of his large reflector, some new instances of spirally-arranged nebulæ have been discovered ; some striking examples of dark holes in bright matter, dark clefts in bright rays, and the resolution of nebulous matter into stars, have also been made known.

The determination of the parallax of the star α Centauri is a subject of great interest. Observations made by Prof. Henderson give to this star a parallax of $0''.9187$. The parallax separately deduced by Mr. Mclear, the Astronomer Royal at the Cape of Good Hope, is $0''.9128$, showing an accordance greater than the most sanguine could have anticipated. It has been recently announced, that a continuation of the observations at the Cape fully confirm the results first obtained, namely, that the parallax of α Centauri exceeds nine tenths of a second, or that its distance from the sun is about twenty billions of miles. So far as we have the means of judging, this star is our nearest neighbor in the sidereal spaces. The attention of foreign astronomers is still directed to the irregularities in the proper motions of stars, and the opinion seems to be gaining ground that many of them are accompanied by non-luminous companions. The most remarkable astronomical discoveries of the past year have, undoubtedly, been those of the American astronomers, relative to the nature and constitution of Saturn's rings ; two new ultra-zodiacal planets, Irene and Eunomia, have also been added to the solar system, by Messrs. Hind and Gaspasis. An invention of great value has been made by Prof. Mitchel, of Cincinnati, for the observing and recording right ascension and N. P. distance ; a new lunar formula has also been constructed by Mr. Longstreth, of Philadelphia, by which an error, hitherto disregarded, is eliminated, and perfect coincidence with observation is obtained. The valuable astronomical journal, *Astronomisches Nachrichten*, the existence of which was endangered by the recent death of its editor, Prof. Schumacher, has been continued by Prof. Hansen and Dr. Petersen.

The valuable mathematical and astronomical library of the late Prof. Jacobi has been purchased during the last year, at Berlin, for Harvard University. It consists of about nine hundred volumes, many of them of great value, and was considered one of the most complete libraries of the kind in Europe.

The British Surveyors in the North American Provinces have adopted the longitude of the Observatory in Cambridge as the zero for constructing their maps and charts, being satisfied that the longitude of that point is better known than any other on this continent. To facilitate an important object, mutually advantageous to the United States and Great Britain, in determining the longitude of various places on the coast, a telegraphic communication has been established between the Observatory at Cambridge and Halifax. This communication is now complete, and is effected by a single battery, through a space of seven hundred and seventy miles, by the course of the wires, and the transit of a star at either of those places is distinctly recorded at the other. These operations are in connection with the U. S. Coast Survey, and they promise valuable results, in affording a greater security to navigators, on a long line of coast much frequented by American vessels.

Among the other topics of interest, related to astronomy, which have occurred during the past year, Foucault's experiment, on the rotation of the plane of simple pendulum's vibration, has excited universal attention. In regard to this experiment, Prof. Airy, in his address before the British Association, says, "It is certain that M. Foucault's theory is correct ; but it is also certain that careful adjustments, or measures of defect of adjustment, are necessary to justify the deduction of any valid inference. For want of these, the experiment has sometimes failed.''

The measurement of the great Swedish and Russian arc of meridian, from the North Cape to the Danube, has been nearly completed during the past year.

In Natural Philosophy, the discoveries of Faraday, relative to the magnetic properties of oxygen, and the application of his results to the explanation of all the varied phenomena of terrestrial magnetism, are among the most important of the present century. It is curious to note, respecting this great man, that while he was occupied with this most intricate subject, he was also employing his leisure time in giving juvenile lectures on the physical forces, at the Royal Institution. The discovery of M. Melsens, in relation to the production and refining of sugar, from which so much was anticipated two years since, has proved a failure. Hofmann's researches in organic chemistry, published during the past year, have thrown a flood of light upon this branch of chemical science, and lead to the hope that many of the rare and valuable vegetable alkaloids may hereafter be produced abundantly by artificial means.

Several important movements, favorable to the interests of geological science, were made in the United States during the year 1851. The Legislature of Pennsylvania, at their last session, appropriated thirty-two thousand dollars for the resumption and completion of the geological survey of that State, which was suspended some years since, on account of financial embarrassments. The survey has been again entrusted to Prof. H. D. Rogers, and during the past summer has been actively prosecuted. Considering the position and mineral wealth of Pennsylvania, this survey is, undoubtedly, one of the most important ever carried on in this country.

The Illinois Legislature have passed a law authorizing a geological and mineralogical survey of that State, and appropriated three thousand dollars for that object, each year, till the survey be completed.

A bill, authorizing a geological survey of North Carolina, has been passed by the Legislature of that State, with an appropriation for carrying the same into effect. Dr. Ebenezer Emmons, of Williams College, formerly Geologist to the State of New York, has been appointed to the superintendence of the work.

A geological survey of Indiana has been recommended, by the Governor of that State, to the Legislature.

The limits of the present work forbid a more extended review of the progress of science during the year 1851. The interest displayed in the prosecution of every department of science, and the valuable results attained to, are in the highest degree gratifying and encouraging.

THE

ANNUAL OF SCIENTIFIC DISCOVERY.

MECHANICS AND USEFUL ARTS.

THE GREAT INDUSTRIAL EXHIBITION OF 1851.

PROMINENT among the events which have signalized the progress of Science and Art in the course of the nineteenth century, has been the "Great Industrial Exhibition of all Nations," during the year 1851. The conception of the scheme might have originated in any age; its realization could have belonged only to our own. The time, the location selected, the condition of the civilized world, all were propitious to the undertaking; and its results have surpassed the expectations of its designers. A friendly confidence among rival States, a feeling of perfect security, a freedom of commercial intercourse among all nations, facility and cheapness of transportation, the perfection of inventions, and the multiplication of practical applications — all these conditions, as they exist *now*, were requisite for the success of the Exhibition. That its results have been in the highest degree beneficial, in the diffusion of intelligence, promotion of good taste, and the cultivation of friendly intercourse among different people, none can doubt.

The Exhibition has existed and passed away, but it will remain in history as an exposition and true exponent of the progress and degree of development to which the civilized world had attained, in all branches of science and art, at the close of the first half of the nineteenth century.

In the following pages we propose to present a succinct and intelligible account of the origin, plan, and construction of the Crystal Palace, with the general history and details of the Exhibition.

First Building Proposed. — The Exhibition having been fully determined upon, and a site for the necessary building chosen, the Committee advertised for plans for a suitable edifice. In accordance with their wishes, 245 designs from different architects were submitted, none of which, however, were entirely satisfactory. A design was then composed by the Committee themselves, founded upon the most approved plans submitted. The building thus proposed was to have been 2200 feet long, 450 feet wide, with a huge dome, larger than that of St. Peter's at Rome. The roof and dome were to have been of iron, and not less than fifteen million of bricks were to have been used in the construction of the walls. This design, although at one time fully determined upon, was most violently opposed, both on account of the injury it would do the location, and the almost necessary permanence of such a huge brick and mortar edifice. To such an extent did the objections to the *composite* design of the Building Committee prevail, that the practicability of the Exhibition itself was jeopardized, when, fortunately, a new design was submitted.

Paxton's Improvements in Horticultural Buildings. — Among the practical men to whom the first design appeared objectionable, was Mr. Paxton, the celebrated horticulturist of the Duke of Devonshire's princely seat of Chatsworth. Mr. Paxton had already effected many improvements in horticultural buildings, by discarding, as much as possible, all ponderous and opaque materials in their construction. He pared away all clumsy sash-bars, whose broad shadows robbed plants of the sun's light and heat during the best parts of the day ; he abolished dirty and leaking overlaps, by using large panes, and inserting them in wooden grooves, rendered water-tight by a sparing use of putty. Again, in plain lean-to or shed roofs, the morning and evening sun presents its direct rays at a low angle, and consequently very obliquely to the glass. At those periods, most of the rays of light and heat are obstructed by the position of the glass and heavy rafters ; it therefore became evident that, by placing the glass more at right angles to the morning and evening rays of the sun, would be removed the obstructions to rays of light entering the house at an early and late hour of the day. This led to the adoption of "the ridge and furrow" principle for glass roofs, which so places the glass that the rays of light in mornings and evenings enter the house without obstruction, and present themselves more perpendicular to the glass when they are the *least* powerful ; whereas at mid-day, when they are *most* powerful, they present themselves more obliquely to the glass. Upon this principle Mr. Paxton constructed a pine-house in 1833, as an experiment, which continues in successful use to this day. It next became a question of importance how far an extensive structure might be covered in with flat ridge and furrow roofs, that is, the ridge-and-valley rafters placed on a level, instead of at an inclination. Several buildings, embracing more or less of this design, were accordingly constructed by Mr. Paxton, but it was not until 1848 that the plan was fully carried out in the erection of a conservatory for the reception of the gigantic water-lily of South America, the Victoria Regia. This building was 60 feet in length by 46 in breadth, and, although a diminutive structure when compared with the Exhibition building, yet the principles upon which it was constructed are the same, and may be carried out to an unlimited extent. The lily house, however, was so built as to retain as much heat and moisture as possible, and yet to afford a strong and bright light at all seasons ; whilst, on the contrary, the Industrial Building, being intended to accommodate a daily assemblage of many thousands of individuals, and a vast number of natural and mechanical productions, many of which would be destroyed by moisture and heat, is constructed so as fully to answer that end. A sort of twofold economy characterizes the entire building: the walls and foundations are, at the same time, drains and ventilators; the roofs, besides being the most extensive of known skylights, are light-and-heat adjusters; the sash-bars not only hold the glass together, but are self-supporting; and the rafters form perfect drains for both sides of the glass, — for draining off internal as well as external moisture; whilst the tops of the girders are conduits also; and the floors are dust-traps and aid in ventilation.

Paxton's Plan for the Exhibition Building. — The peculiar structure of the leaves of the gigantic water-lily suggested, in some measure, to Mr. Paxton, the principle on which the Exhibition building was afterwards constructed. In a lecture delivered to the Society of Arts upon the details of his design for the Great Exhibition building, he exhibited a specimen of the leaf, five feet in diameter, of only five days' growth; and to prove that not only the house for the flower, but the flower itself, has a striking relation to the Palace of Glass, Mr. Paxton remarked: "The under side of the leaf presents a beautiful example of natural engineering in the cantilevers, which radiate from the centre, where they are nearly two inches deep, with large bottom flanges, and very thin middle ribs, between each pair of which are cross-girders, to keep the ribs from buckling; their depth gradually decreasing towards the circumference of the leaf, where they also ramify." Upon this "natural engineering," Mr. Paxton assured us that he first devised the self-supporting principle, which he has applied in the roof of the Great Building.

The Lily-house was scarcely completed, when the clamorous objections raised to the brick-and-mortar design of the Building Committee first led Mr. Paxton to consider the practicability of applying his novel plan to the construction of a vast Exhibition House; but the circumstance of the Building Committee having invited tenders for the construction of their design was supposed to shut out fresh competitors. The fact proved otherwise. Leave was granted to Mr. Paxton to bring in his plan, which he undertook to complete in nine days. This was on the 14th of June; other business intervened, and it was not until the 18th of June that Mr. Paxton, while presiding at a railroad meeting, first sketched the outline of the proposed building on a sheet of blotting paper. The plans and specifications were, however, completed by the 28th of June, and submitted. After some delay, and various objections, the committee abandoned their own design, and contracted with Messrs. Fox and Henderson to construct Mr. Paxton's building for the sum of £79,800. To this design was added a transept, crossing nearly at its centre, so as to avoid the removal of the largest and loftiest trees within the area. The contractors bound themselves, for a certain sum of money, and in the course of some four months, to cover eighteen acres of ground with a building upwards of a third of a mile long, (1848 feet,) and some 408 feet broad. In order to do this, the glass-workers promised to supply, in the required time, nine hundred thousand square feet of glass (weighing more than 400 tons,) in separate panes, and these the largest that were ever made of sheet glass, each being 49 inches long. The iron-master passed his word, in like manner, to cast in due time three thousand three hundred iron columns, varying from fourteen and a half feet to twenty feet in length; thirty *miles* of guttering tube to join the individual columns together, under the ground; two thousand three hundred cast-iron girders; besides eleven hundred and twenty-eight bearers for supporting galleries. The carpenter undertook to get ready, within the specified period, two hundred and two *miles* of sash-bar; flooring for an area of thirty-three millions of cubic feet; besides enormous quantities of wooden walling, louvre-work, and partition.

Details of the Building.—The celerity and rapidity of the movements were much facilitated by Mr. Paxton's original details of measurement. Thus everything in the Building is a dividend or multiple of *twenty-four*. The internal columns are placed twenty-four feet apart, while the external ones have no more than eight feet (a third of twenty-four) of separation; while the distance between each of the transept columns is three times twenty-four, or seventy-two feet. This is also the width of the middle aisle of the building; the side galleries are forty-eight feet wide, and the galleries and corridors twenty-four. Twenty-four feet is also the distance between each of the traverse gutters under the roof; hence, the intervening bars, which are at once rafters and gutters, are, necessarily, twenty-four feet long. The vertical supporters throughout the building are hollow cast-iron columns, eight inches in diameter; those on the ground floor being 18 feet high, and those between the galleries and roof 16 feet. These columns have not the ordinary circular form, but each length has four flat faces, standing in relief from its surface, at intervals of 90 degrees. This plan is not only artistically pleasing, but the several flat bands present surfaces best adapted for the connection of the girders which support the roof and galleries. The columns are hollow, and their thickness varies, according to the weight they support, from ⅝ of an inch to 1⅛ inch. The girders employed were of cast-iron and wrought-iron. The cast-iron girders are employed to span the spaces between the columns, and support the galleries. They are three feet deep, and are cast open, with four struts or standards interposed between their upper and lower flanges, which divide the rectangular space into three open frames, each of which is intersected by diagonal trusses. The introduction of wrought-iron into the construction of the roof was necessary in spanning the side aisles of 48 feet, and the nave of 72 feet, for which purpose its greater strength rendered it preferable.

Construction of the Building. — One of the peculiarities of the building was, in its being its own scaffolding, or very nearly so. As fast as the columns were raised, they were joined with the girders by connecting pieces, or lengths of columns equal to the depth of the girders, which are furnished with the projections requisite for securing them firmly in their places. These connecting pieces terminate in castings adapted to receive the girders, and consisting of perforated flanges, corresponding with those cast in the ends of the columns; and, these being paired, a bolt was passed through them, and made fast by a nut and screw. The second tier of columns was then fixed in precisely the same manner on the connecting pieces ; and thus were securely joined the girders throughout the building. The peculiar action of the connecting pieces, however, should be further explained. The projections, or "snugs," upon their upper and lower portions, act not only as brackets, but likewise hooks ; those on the lower ends bending upwards, and those on the upper ends downwards, so as between them to grasp the end struts or standards of the girder. To retain the girder in a vertical position, and prevent any lateral movement, its bottom and face have a tenon, which drops into a mortice-hole in the projection of the connecting piece ; while the top end face of the girder, over which the upper connecting piece hook extends, is grooved to correspond with the projection, and the two surfaces are keyed together by a piece of iron. This system of attaching the girders to the projections of the connecting pieces has proved very successful. The principle of the ridge and valley roof, as applied by Mr. Paxton to horticultural buildings, was well adapted from its extreme lightness to buildings of great extent, the whole roof of the exhibition building weighing only upon an average 3¼ lbs. per superficial foot. This was the result of the subdivision of surface in the light frame-work and rafters. From a roof of such light construction it became important to convey away the rain-water as soon as possible ; for it is estimated that were a quantity of water, one-eighth of an inch in depth, suffered to remain upon the roof, an additional pressure of 275 tons, for the time being, would be the consequence. This is prevented by means of cambered or curved beams of wood, which divide the roof into spaces of eight feet each, and are the gutters into which the water runs from off the glass roofs, which slope into them on either side. These cambered gutters run longitudinally, and their entire length is no less than 34 miles. These lines of gutter were made in 24-feet lengths, each cambered upwards, so that the water in the gutter has only to run down one-half its extent, and thus off the roof at one end of the furrow, where it discharges itself through a casting into a second and larger gutter lying transversely to the first, and resting upon the roof girders. The fall of the smaller gutter on either side is 2½ inches in 12 feet, or 1 inch in 4 feet 9 inches ; so that the water is at once drained into the larger gutter, and thus conveyed to the hollow columns before it can accumulate at any one point throughout the building. Not only is the roof drained externally in the manner described, but small channels are provided in the longitudinal gutters to carry off the condensed vapor from the interior surface of the roof.

The glazing of this vast roof was executed in the following manner. The sash-bars, having been painted, were received upon the roof, where both their grooves were filled with putty, as was also the rabbet in the ridge, and the sill in the furrow ; the side edges of the pane were then inserted in the bar grooves, and the glass thus framed at the sides was laid in its place, prised up by the workmen into the ridge, and fastened at the lower end by a nail driven into a drilled hole in the bar ; but the larger sash-bars were fastened into the ridge by dowels. As the glazing required to be executed in a very short time, "glazing-wagons" were used for expedition, each of which accommodated two glaziers, and travelled on wheels in the gutters, as in railway trams, and spanned a width, or one ridge and two sloping sides, of the roof. The workmen sat at the end of the platform, which they moved backward by a winch, as they inserted a pane of glass before them; and thus they travelled throughout the nave roof, their supplies of sash-bars, glass, putty, &c., being, from time to time, hoisted through an opening in the stage of the wagon. In bad weather, the workmen were protected by a sort of tilt of canvas upon hoops. By aid of these wagons, eighty men, in six days, put in upwards of 18,000 panes, or 62,600 feet superficial, of glass. The greatest number of frames inserted by a man in one day was 108, being 367 feet 6 inches of glazing.

The thickness of the glass was important, but the width was equally so. Thus, if a piece of glass of a certain thickness and width be broken by hailstones, reduce the width, and it will bear their force. Now, the panes used in the building are 49 inches long, and 10 in width. If, instead of 10-inch width, it had been 15, the glass, it is calculated, would have been broken in the first hail-storm.

In order to facilitate the great amount of labor that would be required in making the sash-bars, a machine was invented by Mr. Paxton, which accomplished the work with great rapidity. Its peculiar working feature was, that the bar was presented to the saws below the centre of motion, instead of above it, (as is usual,) and to the sides of the saw which were ascending from the table, instead of those which were descending; this arrangement being necessary to suit the direction of the teeth to the grain of the wood. It was essential that the machine revolve 1200 in a minute, to finish the work in a proper manner.

The gutters employed in this building, from their designer, have been termed the "Paxton gutters." It has also been termed a three-way gutter, from its having in its upper surface a semi-circular groove, to receive the water from the external glass roof, which springs from it on both sides; and from its having also, on each of the two vertical sides, lower down, an oblique groove to receive the condensed vapors from the inner surface of the glass; the ends of these gutters being connected by oblique cuts with the box-gutters. The Paxton gutter is of the bell-shape inverted, from that form expanding upwards, and therefore being less liable than any other to become obstructed. The gutter is cut in lengths of 24 feet, which would bend or "sag," were they not trussed by rods of iron fixed beneath the gutter, secured to its two ends by cast-iron shoes, and pressed up by cast-iron standards at eight feet intervals, with a rise of 2½ inches in the entire length; thus trussed, the gutter will support 1½ tons weight. Similar gutters were employed by Mr. Paxton in the Chatsworth Conservatory in 1837; they were then made by hand, but machinery has since been employed in their construction.

The details of the transept correspond with the other parts of the building, so far as columns, girders and galleries are concerned. At the level of the flat roof the main difference commences by the springing of the lofty and semi-circular roof, the two end faces of which are handsomely distinguished by their radiating frame-work. The transept consists of a main avenue, 408 feet long by 72 feet wide, and two aisles, each 408 feet long by 24 feet wide. The larger of these areas is spanned by the semi-cylindrical roof, formed of semi-circular ribs, the ends of which are inserted in the hollow columns; these ribs are strengthened by stout timbers, placed between the ribs, and at right angles to them, and which act as purlins, and great intermediate sash-bars. "Upon this simple and effective system," observes Mr. Saunders, "sixteen light and strong ribs have been made to span a width greater by one foot than the nave of Westminster Abbey, including its side aisles, and that at an elevation greater by six feet."

In order to provide for a ventilation of the building, the whole of the basement part, to the height of four feet, was made of *louvre boarding;* and at the top of each tier of galleries a similar provision of three feet was provided. By a simple arrangement of machinery, the whole of this louvre boarding can be opened and closed instantaneously, with the greatest facility. To modify the intensity of the light, and at the same time to aid in keeping the building cool, the inner side of the roof was painted sky-blue, and the outer covered with canvas attached to the ridges throughout the flat roof. This latter arrangement also diminishes the chances of leakage from imperfect jointing or broken glass. The method of flooring to the building was after a plan adopted by Mr. Paxton in the construction of horticultural edifices, viz., trellised wooden boarding, with spaces between each board, through which all dust, on sweeping, falls into the vacuity below.

The arrangement of galleries, which form an essential part of the building, is as follows: There are four main galleries running the whole length of the building — two on the north and two on the south side of the great central aisle, the whole being connected by two cross galleries, one at either end of the building; besides twenty intermediate transverse gangways, or crossings. The collective length of the galleries, restricted to the second tier, is 9456 feet, or more than one mile and three quarters, and the width 24 feet; so that the whole area, or surface of gallery-flooring, is equal to 210,240 superficial feet, or nearly five acres. The exposed sides of the galleries are protected by an ornamental iron railing.

Decorations of the Building. — The decorations of the building were carried out under the direction of Mr. Owen Jones, on a somewhat novel and ingenious plan. By the system of coloring adopted, every line in the building was marked distinctly, thus tending to increase the appearance of its height, its length, and its bulk. Externally the main lines are a delicate blue upon a white and stone-colored ground. In the interior, the principal portions of the roof, of a delicate blue tint, harmonize most brilliantly with the light of the sky, beaming through the crystal roof. The transept is artistically splendid; the under side of each of the twenty-four ribs corresponds in color with that decorating the square fillets of the columns supporting the ribs, viz., light blue; the part of the under side corresponding to the circular surface of the column is in deep chrome yellow; upon each side of this color is a stripe of white, dividing it from the blue; upon the smaller ribs, the "returns" are colored red, the edges chrome, and the sides blue; the diagonal tie-rods are painted bright yellow, with gilt centres; the sash-bars white, and the cross-bracings blue. The wood panelling, and louvre boarding, with which the lower story is filled in, is colored in imitation of dark oak. The whole effect of the mingling of these various colors is gay and elegant, without the least approach to tawdriness. Flags of different countries are placed upon standards, which rise from the outer edge of the roof of the nave, and thus greatly relieve the monotony occasioned by its long, flat surface.

General Internal Appearance. — The general internal appearance of the building may be thus described, supposing the entrance to be from the main portion of the structure. "Through a vestibule the visitor is admitted into the transept, with its semi-cylindrical roof, springing at 68 feet from the ground, the diameter of the vaulting being 72 feet. Its length from south to north is 408 feet, on each side of which is an aisle 24 feet wide. About midway from the transept, extends eastward and westward a nave, upwards of 900 feet in each direction; the entire length of the building being 1848 feet. The nave is 64 feet high, and 72 feet wide, and is flanked with aisles 24 feet wide, above which, at the height of 24 feet, are carried galleries extending round the whole of the nave and transept. Beyond each of these first aisles is an avenue, 48 feet wide; and, next, a second aisle of corresponding width, and in like manner covered throughout with galleries on the same level as those over the first aisles. The several lines of galleries communicate with each other by bridges, which cross the 48 feet avenues, and, at the same time, divide them into courts, each of which has a very unique effect, more especially when viewed from the galleries. The avenues and second aisles are roofed over at the height of 48 feet from the ground; the rest of the building is but one story, 24 feet high to the roof. From the ground floor of the whole building, access to the several galleries is obtained by ten double staircases."

Completion and Opening of the Building. — The first column of the exhibition building was set up on the 26th of September, 1850. On the 1st of February, 1851, it was delivered over to the committee for the reception of goods, although not entirely completed in many minor details; and on the 1st of May, the Exhibition was inaugurated with appropriate ceremonies. The work, from the commencement to its completion, was under the sole supervision of Mr. Fox. In order to show how severely this has taxed his energies, we quote the following extract from an address made by this gentleman at a dinner given him at the completion of the work. After giving a statement of the progress of the undertaking, Mr. Fox said: "Before completing our tender, and with a view to a more precise appreciation of the magnitude of a building covering 18 acres — 1848 feet long, 408 feet wide, and 64 feet high, irrespective of the arched roof of the transept — I walked out one evening into Portland Place, and there setting off the 1848 feet upon the pavement, found it the same length within a few yards; and then, considering that the building would be three times the width of that fine street, and the nave as high as the houses on either side, I had presented to my mind a pretty good idea of what we were about to undertake. Having satisfied myself on these necessary points, I set to work and made every important drawing of the building, as it now stands, with my own hand. These occupied me about eighteen hours each day for seven weeks, and as they went from my hand, Mr. Henderson immediately prepared the iron-work and other materials required in the construction of the building. On the 26th of September we were enabled to fix the first column in its place. And from this time I took the general management of the buildings under my charge, and spent all my time upon the works — feeling that, unless the same person who had made the drawings was always present to assign to each part as it arrived upon the ground, its proper position in the structure, it would be impossible to finish the building in time to insure the opening on the 1st of May; and I am confident that if any other course had been taken, or if, as is usual in the construction of large buildings, the drawings had been prepared by an architect, and the works executed by a contractor, instead of, as in the present case, these separate functions being combined by my making the drawings and then superintending the execution of the work, a building of such vast dimensions could not have been completed within a period considered by experienced persons as altogether inadequate for the purpose."

Continuance and Close of the Exhibition. — The arrangement for the exhibition of articles was effected by the division of the building into courts, or areas, of 24 feet square, included between four columns, which were appropriated to the different countries contributing productions, or to particular classes of materials. Any attempt at description of the various wonderful and curious objects exhibited, would be impossible in the space allotted to the present work. Many, which were of unusual novelty, or which displayed remarkable ingenuity, we have described elsewhere under appropriate heads. An examination, however, of the catalogue of articles exhibited, will show, that comparatively few inventions or discoveries, originating and belonging to the history of the progress of science in the years 1850 and 1851, were brought forward or illustrated at the Great Exhibition. Many of the most striking objects displayed were of a class which might have been produced equally well centuries ago, as at the present time; for example, the statuary, wood carving, ornamental work in gold and silver, etc. Other articles were the result of patient industry only, or of processes which, although not old, are yet generally familiar. All these illustrate the general progress of the race up to the present epoch, but have little pertaining to the history of advancement during the past year.

The exhibition, which opened on the 1st of May, continued until the 11th of October, when the final closing took place, accompanied with the awards of the jurors, and the distribution of medals. The number of prize medals awarded was 2918; the number of council medals, 170; of others, honorable mention was made. The prize medals were awarded for the attainment of a certain standard of excellence; utility, beauty, &c., being taken into consideration. The council medals were given for such articles as might be expected, from their originality and ingenuity, to exercise a more important influence upon industry than could be produced by mere excellence in manufacture. The whole number of exhibitors was 17,000.

The following are the awards made to exhibitors from the United States.

CLASS I.

Mining, Metallurgy and Mineral Products.

Prize Medals. Adirondac Manufacturing Company, New York, steel and iron; Morris, Jones & Co., plate iron; New Jersey Exploring and Mining Company, zinc ores, iron (Franklinite) ores, smelting process; Trenton Iron Company, iron of fine quality, ores, &c.

Honorable Mention. Adirondac Manufacturing Company, New York, cast iron, &c.; Morrell, Stuart & Co., sheet iron; Morris, Jones & Co., boiler plate iron.

CLASS II.

Chemical and Pharmaceutical Processes.

Prize Medal. Power & Weightman, Chemicals.

Honorable Mention. Wetherell & Brother, various salts.

CLASS III.

Substances used as Food.

Council Medal. Gail Borden, Texas, for meat biscuit.

Prize Medals. W. Barnes, maple sugar; T. Bell, soft wheat from Genesee; L. Dean, maple sugar; Dill and Mulchahey, cavendish tobacco; C. Duffield, ham; J. H. Grant, cavendish tobacco; Hecker & Brother, Genesee flour; E. T. Herriot, Carolina rice; B. B. Kirtland, a collection of maize, thirty-five varieties; New York State Agricultural Society, collection of wheats; Raymond & Schuyler, flour, (thirds); P. Robinson, cavendish tobacco; Schooley & Hough, ham, Cincinnati.

Honorable Mention. John Bridge, oil cake; George Dominick, lard; Hecker & Brother, farina; W. Hotchkiss, wheat; James Lee & Co., oil cake; Mookler & Chiles, cavendish tobacco; Oswego Starch Factory, fecula of maize; Oyler & Anderson, cavendish tobacco; James Thomas, cavendish tobacco; Thomas & Co., cavendish tobacco; M. White, Muscovado sugar.

CLASS IV.

Vegetable or Animal Substances used for Manufactures, &c.

Prize Medals. S. Bond, cotton; Cockerill, wool; W. Colegate & Co., starch; J. H. Ewing, wool; W. Hampton, cotton; George Hicks, tillandsia usnoides; G. L. Holmes, cotton; H. G. & L. B. Hotchkiss, oil of peppermint; J. R. Jones, cotton; J. V. Jones, cotton; A. M. Kimber & Co., wool; W. W. Macleod, cotton; The State of Maryland, collection of produce; J. B. Merriwether, cotton; Perkins & Brown, wool; J. Pope, cotton; W. Seabrook, cotton; Rev. C. Thompson, woods; J. Nailor, cotton; Oswego Starch Factory, starch.

Honorable Mention. E. R. Dix, flax, hemp, and guano; G. Dominick, lard oil; T. Emory, lard oil; E. Feuchtwanger, bleached shellac; F. Frank, lard oil; L. Goddard, whalebone; Holbrook & Stanley, lard oil; F. O. Ketteridge, corn-husk fibre; R. J. Pell, woods; Truesdale, Jacobs & Co., cotton.

CLASS V.

Machines, including Carriages and Naval Mechanism.

Prize Medals. C. Childs, a slide-top buggy or phæton, enamelled leather apron of very superior quality, the whole well got up and neatly finished; G. W. Watson, a sporting wagon, very neatly finished in all respects.

CLASS VI.

Manufacturing Machines and Tools.

Council Medal. D. Dick, various engineers' tools and presses.

Prize Medals. Blodgett & Lerow, sewing machine; T. K. Earl & Co., card clothing; W. Hayden, drawing regulator for cotton; Lowell Machine Shop, self-acting lathe and a power loom; C. Starr, book-binding machine; J. P. Woodbury, wood planing, tonguing and grooving machine.

CLASS VII.

Civil Engineering, Architectural and Building Contrivances.

Prize Medal. Ryder's patent iron bridge; Iron Bridge Manufactory, N. Y.

CLASS VIII.

Naval Architecture, Military Engineering, &c.

Prize Medals. National Institution of Washington, models of ships of war and large merchant vessels; J. R. St. John, nautical compass, purporting to show the presence of any disturbing forces upon the needle, and also to show the amount of the deflection resulting from these causes.

Honorable Mention. Samuel Colt, revolving rifles and pistols; W. R. Palmer, target rifle; Robbins & Lawrence, military rifles.

CLASS IX.

Agricultural Machines and Implements.

Council Medal. C. H. McCormick, reaping machine.

Prize Medal. Prouty & Mears, plough.

Class X.

Philosophical and Surgical Instruments and the like.

Council Medal. William Bond & Son, for the invention of a new mode of observing astronomical phenomena, &c.

Prize Medals. A. D. Bache, balance; M. B. Brady, daguerreotypes; W. A. Burt, solar compass, surveying instruments; J. Ericsson, sea lead, pyrometer, &c.; M. M. Lawrence, daguerreotype; John R. St. John, detector compass; J. A. Whipple, daguerreotype of the moon; B. F. Palmer, artificial leg.

Honorable Mention. J. E. Mayall, photographs.

Class X. (A.)

Musical Instruments.

Prize Medals. J. Chickering for a square pianoforte, and the jury think highly of his grand pianoforte; C. H. Eisenbrant, for clarionets and flutes; G. Gemunder, for a Joseph Guarnerius violin, (chiefly,) and for three other violins, and a viola; C. Meyer, for two pianofortes; N. Nunns & Clark, for a 7-octave square pianoforte.

Honorable Mention. Gilbert & Co., for a pianoforte, with Æolian attachment; C. Goodyear, for the successful application of a new material (India rubber) for the manufacture of a flute; G. Hews, for a square pianoforte; J. Pirrson, for a patent square pianoforte.

Money Award. S. S. Wood, for the expense incurred in constructing his piano violin, £50.

Class XI.

Cotton.

Prize Medals. Amoskeag Manufacturing Co., an assortment of drillings, tickings, sheetings, and cotton flannel. Willimantic Duck Manufacturing Co., cotton sailcloth.

Class XII.

Woollens and Worsted.

Prize Medal. Gilbert & Stevens, (Mass.,) flannels exhibited by Johnson, Lowell & Co.

Honorable Mention. B. T. & D. Holden, blankets.

Class XIII.

Silk and Velvet.

No medals awarded for contributions from the United States in this department.

Class XIV.

Manufactures from Flax and Hemp.

No medals awarded to the United States.

Class XV.

Mixed Fabrics, including Shawls, but exclusive of Woollen Goods.

Prize Medal. Lawrence, Stone & Co., Tartans made from native wool.

Class XVI.

Leather, Skins, Fur and Hair.

Prize Medals. B. Baker, light harness of superior workmanship; H. M. Crawford, calf-skins tanned in oak bark; Hickey & Tull, two portmanteaus; Lacey & Phillips, a case of harness; Wisdom, Russell & Whitman, specimens of curled hair for furniture.

Honorable Mention. H. Adams, a portable saddle.

Class XVII.

Paper, Printing and Book-binding.

Prize Medals. J. K. Kenrick, superior ruling of account books; S. G. Howe, a system of characters, slightly angular in form, without capitals, for the blind.

Honorable Mention. Bradley, Band & Co., book cloth binding and block gilding; H. Gassett, superior ruling of account books; J. & W. McAdams, ruled account books and circular ruling; Sibell & Mott, specimens of account books; C. Starr, binding works for the blind, with thickened margins to prevent the embossing from being pressed out; E. Walker & Co., a Bible elaborately bound and ornamented, with a recess for a family register inside the cover.

Class XVIII.

Fabrics shown as Specimens of Printing or Dyeing.

No medals awarded to the United States.

Class XIX.

Carpets, Lace and Embroidery.

Prize Medal. Albro & Hoyt, floor cloths.

Honorable Mention. A. & A. Lawrence, carpets.

Class XX.

Articles of Clothing.

Prize Medals. W. H. Addington, shoes for mining purposes; Mrs. W. Haight, shirt.

Class XXI.

Cutlery and Edge Tools.

Prize Medals. Brown & Wells, tools; North Wayne Scythe Company, scythes; D. Simmons & Co., edge tools.

Class XXII.

Iron and General Hardware.

Prize Medals. Adams & Co., bank locks;

G. A. Arrowsmith, permutation locks; Chilson, Richardson & Co., hot-air furnace; Cornelius & Co., chandeliers; S. C. Herring, salamander safe; C. Howland, bell telegraph; T. B. Lawrence, perforated zinc, &c.; McGregor & Lee, bank lock.

CLASS XXIII.

Working in precious Metals, Jewellery and the like.

No medals awarded to the United States.

CLASS XXIV.

Glass.

Prize Medal. Brooklyn Flint Glass Company, flint glass.

CLASS XXV.

China, Porcelain, Earthenware.

No medals awarded to the United States.

CLASS XXVI.

Decoration Furniture, Upholstery and the like.

No medals awarded to the United States.

CLASS XXVII.

Mineral Manufactures.

No medals awarded to the United States.

CLASS XXVIII.

Manufactures from Animal or Vegetable Substances not included in other sections.

Council Medal. C. Goodyear, India rubber.

Prize Medals. J. Fenn, comb; Hayward Rubber Co., India-rubber shoes; G. Loring, water pails; S. C. Moulton, India-rubber goods; Pratt, Julius & Co., ivory veneer.

CLASS XXIX.

Miscellaneous Manufactures.

Prize Medals. Xavier Bazin, fancy soaps; J. Hauel, soaps; M. J. Louderback, preserved peaches; J. R. St. John, soap; Taylor & Co., toilet soap.

CLASS XXX.

Sculpture.

Prize Medal. Hiram Powers, Greek Slave.

In looking back over the career of this vast enterprise, so happily originated and carried out, the consideration which most strongly impresses itself upon the mind is its unprecedented popularity. As an illustration of this, it is stated, that in the month of May, 734,782 visits were paid to the building; in June, 1,133,116; in July, 1,314,176; in August, 1,023,435; in September, 1,155,240; and in the first 11 days of October, 841,107. These figures give a total of 6,201,856, as the sum of visits to the Exhibition. The greatest number of persons ascertained to have been in the building at any one time was on the 7th of October, *when* 93,224 *were present.* On the same day the number of visitors reached its *maximum*, and was 109,915. The total amount of expenditure, from the commencement of the Exhibition to its close, including the cost of the building, was £170,743. The receipts of the Exhibition, from subscriptions at the commencement and from fees of entrance, were £469,115; leaving a large balance in the hands of the Commissioners.

Curiosities of the Great Industrial Exhibition.—In the Spanish Department was exhibited an octagonal *centre table*, with a movable top, made of rich, ivory-like, white wood, into which were inlaid designs of extraordinary beauty, composed of small quadricules of colored woods. These are so minute that it is necessary to examine the work through a powerful magnifying glass before one can have any idea of the wonderful delicacy of this monument of human ingenuity and patience. In the wreaths, scrolls, and other ornaments which cover the top and the shaft, there are three millions of these tiny cubes; the arms of England alone, which occupy a space only of three inches by two, containing fifty-three thousand! No words can do justice to the richness of these designs, in which leaves, flowers, and the most graceful arabesques are combined with admirable taste; while, in point of execution, this unparalleled mosaic surpasses all the inlayings that have ever been produced.

In the Russian Department, *shawls* of great value were exhibited; on one, in particular, the duty alone, to be paid in case the shawl was not returned to Russia, was £488. A fur robe was also exhibited, made from the skins of 1700 black foxes, only one piece of pure black, of small size, being taken from each skin. Its estimated value was sixteen thousand dollars. Two jasper vases, three feet six inches high, the property of the Emperor, were valued at £2000 apiece. The workmanship upon them, which was of the most exquisite character, alone cost £700. A huge candelabrum, representing an event in Russian history, was sent from Moscow, and contained 2 cwt. of silver.

Of grotesque objects, a collection of *stuffed animals*, (frogs, dogs and cats,) contributed by M. Ploucquet, of Stuttgard, was most ludicrous. A frog, for instance, was represented shaving his companion, another is walking with an umbrella; while a party of cats, life size, are represented as drinking tea, while another cat plays upon the piano.

Specimens of the celebrated *Toledo swords* were exhibited from Spain. The remarkable elasticity of one, perfectly straight when drawn, was tested by a circular scabbard, which actually rolls up the blade as it receives it.

In the Zollverein Department was exhibited a set of Chessmen and Board in the *Renaissance* style, the squares of the board alternately tortoise-shell and mother-of-pearl. The framework of the stand is silver and gold, inlaid with rubies; each corner, the bust of an angel, the wings in silver and blue; the sides are ornamented with silver swans, and festoons of gold and rubies. The chessmen are in gold and silver: the principal figures are costume portraits of Emperors of Germany and Kings of France — their retinue, knights, and castles mounted on elephants, and men-at-arms for the pawns. Rubies are profusely introduced upon the dresses of the principal personages and the pedestals.

A substitute for paper hanging and paper staining was shown in Clark's "*Seamless Flock Decoration*," made from the woollen flocks obtained in the cloth-finishing process; and, being manufactured on the walls of the apartment, may be extended over any given space without seam, jointing, or repetition, such as are unavoidable in paper staining.

A *Berlin Wool Carpet*, executed by 150 ladies of Great Britain, and designed for presentation to the Queen. The dimensions of this carpet are thirty feet in length, and twenty in breadth. The pattern, originally designed and painted by the artists, was subdivided into detached squares, which were worked by different ladies; and, on their completion, the squares were reünited, so as to complete the design. In the pattern, which consists partly of geometrical, and partly of floral forms, heraldic emblems are also introduced. The initials of the executants are ornamentally arranged, so as to form the external border. The whole design is connected by wreaths or bands of leaves and foliage, the centre group representing the store from whence they have been distributed.

From China, was sent a set of *Early Cups and Saucers*, with the gilding laid on — by a process unknown to English manufacturers — in solid gold plates; of these plates, each cup contains no less than 961, and of these 260 are ornamented with imitation rubies. Each cup is also enriched with 269 solid silver plates, of which 34 bear small emeralds. The saucers are still more highly enriched, each being inlaid with 1035 plates of pure gold, and of these 415 bear imitation rubies. They have also 432 solid silver plates inserted in each, in 56 of which are emeralds. This unique set belonged to a mandarin of the highest rank, and is the first specimen of the kind ever imported.

Among the novelties in philosophical apparatus, was a *gigantic Barometer*, the tube and scale reaching from the floor of the gallery nearly to the top of the building, and the rise and fall of the indicating fluid being marked by feet instead of by tenths of inches. The column of mercury supported by the pressure of the atmosphere communicates with a perpendicular tube of smaller bore, which contains a colored fluid much lighter than the mercury. When a diminution of atmospheric pressure occurs, the mercury in the large tube descends, and by its fall forces up the colored fluid in the smaller tube; the fall of the one being indicated in a magnified ratio by the rise in the other.

One exhibitor, who has great faith in a new name, sent a saucepan with a false bottom, upon which potatoes being placed, covered up, and set upon the fire, steam is generated, and thus the potatoes are cooked in the water they contain — a contrivance called the *Anhydrohepseterion.*

An unique piece of workmanship was to be seen in a miniature gun, perfect in all its parts and highly finished, its length being 4½ inches, and weight ¼ of a pound. The stock was of maple, and the barrel twisted. The lock, which was percussion, is composed of 15 separate pieces, some of them so small as to be almost imperceptible without the aid of a glass.

A glass fountain, of great size and beauty, constructed by Mr. Osler, was placed in the centre of the Crystal Palace. "This structure stands in a basin of concrete 24 feet in diameter, and rises to the height of 27 feet, composed entirely of pure flint glass, cut into the most elaborate forms. The columns of glass are raised in tiers, the main tier supporting a basin from which jets of water can be made to project, in addition to the main jet at the top. As the structure rises it tapers upward in good proportion, the whole being firm and compact in appearance, and presenting almost a solidity of aspect unusual with glass structures. A central shaft, with a slightly 'lipped' orifice, finishes the whole, and from this the water issues in a broad, well-spread jet, forming in its descent a lily-like flower before separating into spray, which in the sun-light glitters and sparkles in harmony with the fountain itself. This fountain contains upwards of 4 tons of glass, and the principal basin is upward of 8 feet in diameter."

In no one department of industry at the Exhibition was there a greater display of ingenuity than in the various contrivances for the indication and regulation of time. The following is a mere enumeration of some of the more curious products there exhibited: A clock moved by the equilibrium of water and air, very ingeniously constructed. A clock in a case, which occupied thirty-four years in completing it, with astronomical, chronological, and other movements, wind organ, &c. A geographical clock, showing the difference of mean time in all the capitals of Europe. A clock showing the days of the month, the months of the year, the motions of the sun and moon, and the state of the tide at some of the principal sea-ports of Great Britain, Ireland, France, America, Spain, Portugal, Holland and Germany, and going for twelve months. A skeleton striking clock, going 400 days, and showing dead seconds by means of a chronometer. A patent tell-tale clock, for the purpose of detecting delinquent servants, and calculated for the express purpose of "regulating" domestics. A clock called the "Perpetual Motion Clock," having no weights or chain, and most curiously made.

A number of curious watches were also exhibited, one of which goes a year, another showed the time to a *sixth of a second*, and a third (a second watch) was made of ivory, with gold screws and steel moving powers. It works in ten rubies, and weighed (glass and vase included) only half an ounce. There were some of the finest specimens of miniature watches exhibited that probably have ever been made. These tiny time-keepers were set on card cases, the frames of eye glasses, broaches, rings, &c. Some of them were scarcely the size of the gold dollar, although somewhat thicker. The top of a gold penholder richly set on rubies contained a time-piece with three dials, each one-fourth of an inch in diameter, running a week without winding up, and showing the months, days, weeks, hours and minutes.

JEWELLERY AND PRECIOUS STONES AT THE GREAT EXHIBITION.

One of the most striking features of the Great Exhibition was the display of a considerable number of gems of rare quality and great value. First in order was the Koh-i-noor, formerly the property of Runjeet Singh, now belonging to the British Crown. Its shape is an irregular oval, $1\frac{1}{2}$ inches in length by 1 inch across, weighing nearly 280 carats. Two smaller diamonds were placed on either side, one weighing $34\frac{1}{6}$ carats, and the other $19\frac{1}{2}$ carats. The value of this diamond is estimated at £662,000, but the conventional value of diamonds is one of the popular errors of the day; thus the celebrated Napuck diamond, estimated by the East India Company to be worth £30,000, realized, when sold in London in 1837, only £7,500. In the Indian collection was exhibited a smaller diamond, the Der-i-noor, which, although insignificant in value compared with the Koh-i-noor, is much more brilliant and effective, from the large surface it exposes. This diamond is set as an armlet, with ten smaller stones around it: together with it were shown a necklace, of 224 large pearls, and a shorter one of 104 smaller pearls; a necklace of four large rubies, a pair of emerald armlets, a carved emerald and diamond turban ornament, an emerald and diamond bridle and martingale; a gold mounted saddle, set with diamonds, emeralds, and rubies; a brocaded robe, decorated with pearls; and an emerald girdle, the stones of immense size, and mostly of very fine quality.

Among Messrs. Hunt and Roskell's brilliants was a Diamond Bouquet, in seven sprigs, containing nearly 6000 diamonds, the largest weighing ten carats and the smallest the thousandth part of a carat. Another fine specimen was a Ruby and Diamond Bouquet, valued at £15,000.

The third diamond in point of size and value exhibited, is the property of Mr. Hope, and weighs 172 carats. It has a delicate, bluish tinge, like the sapphire; is cut in small facets in the shape of a medallion, surrounded by twenty large diamonds of the purest water, and from its size and color is said to be unique. Its value among lapidaries is estimated at about £30,000; but it is understood that Mr. Hope obtained it for thirteen thousand guineas, the diamond-merchant, in whose possession it was, being in want of money, and finding some difficulty in meeting with a customer for so valuable a gem. Mr. Hope also exhibited the largest known pearl, together with a number of other valuable and curious stones; opals of great size; a sapphire once the property of Philippe Egalité, and to which a literary interest attaches in connection with the name of Madame de Genlis; a splendid aquamarine which formed the hilt to the favorite weapon of Murat; a cat's-eye taken from the King of Kandy, a jacinth ring once the property of Gregory VIII., and a very interesting collection of pearls, placed in the oyster shells in which they were found.

The fourth great gem of the Exhibition was a gigantic crystal of emerald, the property of the Duke of Devonshire, partially cut. A collection of jewels of great value was contributed by the Emperor of Russia. Its chief ornament was a casket of ebony, ornamented on its sides and lid with precious stones, executed in relief, and representing, with marvellous fidelity, a variety of fruits. An immense cluster of grapes is typified by amethysts, bunches of cherries by cornelians, and leaves by jasper beautifully shaded. In the Russian department, also, was a pair of folding doors, of malachite, 13 feet high, panelled and ornamented with gilt bronze, valued at £6000. The manufacture of these articles is in itself a work of art, the surface being made up of some 30,000 variously-shaped little pieces, carefully selected to produce various patterns. The doors are of wood, covered with copper, the malachite veneer being about a quarter of an inch thick.

A Jewelled Hawk, the property of the Duke of Devonshire, was exhibited: it contains a gold drinking-cup; the wings and body of the bird are chiefly covered with rubies, turquoises, emeralds, and other precious stones. The bird stands about a foot high, and cost its noble owner 600 guineas.

The jewels of the Queen of Spain, exhibited by Lemonnier, in the French collection, were very attractive. In the centre was a bouquet of large diamonds, on elastic sprigs; the buds were enormous pearls, and the green foliage were emeralds. Above were a tiara of sapphires, surrounded by diamonds, and festoons of diamonds and pearls. There were also a circlet of diamonds ; necklaces and bracelets and stomachers studded with brilliants ; and a brooch and pendant, the central ornaments of which were two enormous rubies. Near these gems was a display of jewels, prepared for the Emperor of Hayti, of great beauty ; and models of the crown, sceptre, state-swords, &c.

AMERICAN *vs.* ENGLISH LOCKS.

One of the most interesting incidents connected with the Great Exhibition, was the so-called "Lock Controversy," carried on between Mr. Hobbs, agent of Day & Newell's parautoptic bank locks, and Messrs. Chubb and Bramah, manufacturers of the most celebrated English locks. As a test of the comparative merits of the English and American locks, Mr. Hobbs proposed to Messrs. Chubb and Bramah, that an opportunity should be afforded him to try his skill in an attempt to pick or open their respective locks, which were considered and represented to be perfectly secure against the skill of all burglars ; Mr. Hobbs, on his part, agreeing to afford to any person ample time and opportunity to open Day & Newell's locks, by any means, without resorting to violence. A trial was, therefore, made, in the presence of a committee, first upon a lock recently placed by Messrs. Chubb on the door of the vaults of the State-Paper office. The lock having been examined, and found to be fairly locked, Mr. Hobbs produced from his waistcoat pocket two or three small and simple-looking tools, and proceeded to work. Within twenty-five minutes from the time of commencing, the bolt of the lock flew back, and the door was opened. It was then suggested by one of the gentlemen present, that Mr. Hobbs should turn the bolt back again, and lock the door ; it being a "detecter" lock, it was considered that he would be unable to accomplish this feat. In less than ten minutes, however, the door was again locked. No injury whatever was done to the interior of the lock, and no traces were to be seen of its having been picked.

Mr. Hobbs was then challenged by Messrs. Bramah to experimentalize on what have been styled their impregnable locks, and was promised a forfeit of £200 if he should succeed in opening it. In order that the trial might be fairly made, commissioners were appointed to decide upon it, and thirty clear days were granted by Messrs. Bramah to Mr. Hobbs for his operation. Mr. Hobbs went to work, but, in a few days, suspended his operations, alleging the weakness of his instruments. As soon as others had been prepared, he desired to continue his attempt; but to this Messrs. Bramah objected. The commissioners, however, interfered ; and Mr. Hobbs resumed his labors, and shortly picked and opened the lock.

No attempt, however, was made to pick the lock of Messrs. Day & Newell, although a reward of one hundred guineas was offered to the person who should succeed in picking it.

At a meeting of the Institute of Mechanical Engineers, of Great Britain, a paper was read by Mr. Hodge, a well known engineer, upon locks and their construction ; in which he fully demonstrated that Messrs. Day & Newell's lock was the only one which could not be picked.

Mr. Hodge stated, that the principle on which all modern locks are constructed can be traced back nearly four thousand years. The three best locks manufactured in England, during the last thirty years, are those of Barron, Bramah and Chubb, and the principle of each is based on the principle of the old Egyptian lock; the difference between each being only in the mechanical arrangement of parts to produce the same effect. Locks, similar to those of Mr. Chubb, were formerly manufactured by Mr. Andrews, of Perth Amboy, N. J. These locks Mr. Newell succeeded in picking, and, in doing this, learned the means by which he could pick his own lock, as it was made in 1841. Mr. Newell also showed by this that his own lock, and all others based on the tumbler principle, were insecure against burglars. One of Mr. Newell's locks, affixed to a safe, containing $500, the reward of the one opening it, was picked in the Merchants' Exchange, N. Y., by an engineer named Petis, and the money obtained. This led to the invention of the parautoptic lock, which is undoubtedly the most perfect ever constructed. This lock, through movable wards in the key, is susceptible of 419,000,000 changes.

SAFE FOR THE KOH-I-NOOR DIAMOND.

The great Koh-i-noor diamond, during the London Exhibition, was contained in a safe, curiously constructed by Mr. Chubb, for its protection.

It consists, first, of an octagon table, 6 feet 6 inches in diameter, by 3 feet 4 inches high, the top and sides being made of half-inch wrought iron plates, all secured together by being rebated and with angle iron. In the interior is a fire-proof safe, 12 inches square, and 2 feet 9 inches deep, the wrought plates being one inch thick. In the centre of the safe is a platform, 9 inches square, on which the velvet cushion, jewels, and setting are fixed. A hole is cut out of the table to allow the platform to descend into the safe. In order to secure the diamonds at night, a small door, 3 inches square, in one of the panels of the table, is unlocked, and, by turning a winch, the platform gradually sinks into the safe, and a sliding iron door is drawn over the opening at the top. The cage is secured to the table by L pieces at the bottom ring, dropping into corresponding holes, and these are locked by two separate detective locks. The keys of these locks are held by the crown officers, and without them, access to the jewels cannot be had. The key of the small door allows the platform to be raised or lowered only, but does not give access to the jewels. The weight of the whole is 36 cwt., and it is bolted to the floor.

ERICSSON'S PATENT CALORIC ENGINE.

This is a scheme which Mr. Ericsson tried some years since, but which, at the time, was not successful. Since then, his attention has been directed to the removal of difficulties; and in this he has so far succeeded, that the engine has been patented, both in this country and in England. A moment's reflection will show that there is *a possibility* of effecting an immense saving in the present method of employing coal as a generator of power. In our most economical expansive engines, we recover nothing of that which we employ. The heat required to convert the water into steam is delivered by the air-pump, diluted, so to speak, with so much cold water; and the problem is, to concentrate that heat, and render it again available for generating steam. Whether that problem can be ever solved while water is used as a medium, it is impossible to predict. The gases appear to offer a better chance of success; and, accordingly, Mr. Ericsson employs the expansive force of heated air in his engine, instead of steam. "The invention," says Mr. Ericsson's specification, "consists in producing motive power by the application of caloric to atmospheric air, or other permanent gases, or fluids susceptible of considerable expansion by the increase of temperature. The mode of applying the caloric being such, that, after having caused the expansion or dilatation which produces the motive power, the caloric is transferred to certain metallic substances, and again re-transferred from these substances to the acting medium at certain intervals, or at each successive stroke of the motive engine; the principal supply of caloric being thereby rendered independent of combustion or consumption of fuel. Accordingly, whilst in the steam engine the caloric is constantly wasted by being passed off into the condenser, or by being carried off into the atmosphere, in the improved engine the caloric is employed over and over again, enabling me to dispense with the employment of combustibles, excepting for the purposes of restoring the heat lost by the expansion of the acting medium, and that lost by radiation; also for the purpose of making good the small deficiency unavoidable in the transfer of the caloric."

The principal novelty of the invention appears to consist in the employment of a condenser, which, when saturated with heat, is used as a regenerator, or boiler, until it is sufficiently cool to act again as a condenser. It is proposed to have two of these condensers, to be used alternately. The arrangements consist of two cylinders, of unequal dimensions, placed one over the other, the smallest uppermost, the pistons of which are connected by a rod working through stuffing-boxes, one end of which is attached to a crank, in the usual manner. The patentee terms the upper the supply cylinder, the lower the working cylinder. The lower one has a concave bottom, forming the roof of one of the furnaces; and the piston has a chamber bolted to it with corresponding concavity, filled with fire-clay and ashes, as a non-conducting material, to prevent, as much as possible, the heat from reaching the upper part of the cylinder. There is another cylindrical vessel, called the receiver, and a fourth, called the heater, which latter has also a concave bottom, and a furnace beneath. Two vessels of cubical form are filled to their utmost capacity, excepting small spaces at top and bottom, with discs of wire net, or straight wires closely packed, or other small metallic substances or minerals, such as asbestos, so arranged as to have minute channels running up and down; these are called the regenerators. These vessels are all connected by suitable arrangements of slide valves and an exhaust chamber; and the following is said to be the *modus operandi:* — Fuel having been placed in the fire-places under the working cylinder and heater, slow combustion is kept up, until the heaters and lower parts of the regenerators are at a temperature of about 500° Fah. By means of a hand-pump, atmospheric air is then forced into the receiver, until there is an internal pressure of 8 or 10 pounds to the inch. A communication is then opened with the working cylinder, the piston rises, and the air in the upper cylinder is forced into the receiver; other valves then open, so that the air passes through the wire regenerators, and has its temperature augmented. Before the piston arrives at the top of the up stroke, the valve which first opened will be closed, and another opened, causing the down stroke, when the air passes through the cooled regenerator and escapes, deprived nearly of all its caloric. The air next passing takes up the caloric so deposited; and thus a continuous reciprocating motion is kept up. The specification goes on to say, that, after a certain number of strokes, the temperature of the regenerators will change — the cooler one gradually gaining an increase of temperature, while the hottest gradually gets cooler; and, therefore, the position of the slide valves is reversed at about every fifty strokes by a self-acting arrangement, which can be regulated as desired.

It is proper to observe that the small cylinder only receives and transmits the differential force of the piston of the large cylinder, viz., the excess of its acting force over the reäcting force of the piston of the small cylinder. This differential force imparted to said piston rod may be communicated to machinery by any of the ordinary means. It is particularly worthy of notice, that the relative diameter of the supply and working, or larger and smaller cylinder, will depend on the expansibility of the acting medium employed; thus, in using atmospheric air, or other permanent gases, the difference of the area of the pistons may be nearly as two to one; while, in using fluids, such as oils, which dilate but slightly, the difference of area should not much exceed one tenth.

An engine of the above description was exhibited by Captain Ericsson, at the Great London Exhibition, and has since, we understand, been working in New York.

HOT-AIR ENGINE.

A PAPER has been recently read before the Institution of Civil Engineers, London, respecting a hot-air engine invented by Sir G. Cayley. After entering briefly into the theoretical considerations of the expansion of aeriform bodies, and detailing the attempts made by Capt. Ericsson for employing hot air, instead of steam, as a prime mover, the author proceeded to state, that Sir G. Cayley applied the products of combustion from close furnaces so that they should act at once upon a piston, in a cylinder, similar in every respect to that of a single acting steam engine. The engine consisted of a generator of heat, a working cylinder, and an air-pump or blower — the air-pump being half the size of the cylinder, and blowing air into and through a fire perfectly inclosed within the generator. The doors of the furnace were made perfectly air-tight as soon as the fire was well got up; the first impulse being given to the engine by throwing a few jets of water upon the fire, which caused the air-pump to work immediately, and continued so for hours, the fire being replenished by stopping off the blast from the furnace, and opening the upper bonnet. After the air had passed through the fire, the gaseous products of combustion, generally at a temperature of 600° Fahrenheit, passed laterally through a chamber, used for separating them from any ashes or cinders, into the working cylinder before alluded to. The difficulty attending this description of engine was the liability of the working parts to be deranged by the great sensible heat destroying the valves, pistons, and cylinders, and carbonizing the lubricating oil.

DOUBLE PISTON ENGINE.

Mr. W. Virdin, of Maryland, has recently devised some improvements in the steam engine, which relate to the employment within the same cylinder of two pistons, entirely independent of each other, and whose piston rods pass through opposite ends of the cylinder. One piston rod connects, directly through a connecting rod, to a crank on the main shaft, and the other piston rod is furnished with a cross head, which is connected, by two long connecting rods, to two cranks on the main shaft, whose position on the shaft is diametrically opposite to that of the first-named crank. The cylinder is furnished with steam and exhaust ports at each end and the middle, and steam is admitted alternately between the two pistons and the cylinder ends, and both pistons through their connecting rods act simultaneously on the cranks and revolve the main shaft. — *Scientific American.*

IMPROVEMENTS IN THE STEAM ENGINE.

Two new improvements in the steam engine were exhibited for the first time at the Fair of the American Institute, N. Y., in October. The first was a pair of oscillating engines, coupled at right angles to one shaft, the invention of Messrs. Morris and Wylie, of New York. These oscillating engines have no valve rods, the steam box is stationary, and the cylinder, as it vibrates, cuts off and exhausts itself, thus performing the office of a slide valve; another arrangement about it is a plan, by a common slide valve, to exhaust the steam into the exhaust passages, and vice versa, and to set on and stop the engine, thus making it the best adapted oscillating engine for steamboats yet invented. The second improvement was a rotary engine, invented by Mr. Barrows, of New York. This engine is built to work the steam expansively, by fixed head plates, having eccentric grooves in their inside faces, which guide friction rollers on the end of the blade or piston bars, so as to depress them in slots, and guide the pistons out and in, to allow the steam to expand in four separate chambers on the periphery of an inside revolving drum. This engine has been in successful operation during the past season, in a small steamboat, and is decidedly one of the most perfect and effective rotary engines ever constructed. — *Scientific American.*

INTRODUCTION OF OSCILLATING ENGINES INTO LARGE AMERICAN MARINE STEAMERS.

During the past year two of the largest American sea-steamers have been fitted for the first time with oscillating, instead of beam engines. Oscillating engines have been used in large vessels of the British and French navy, for some time, with good success; but engines of this character have not hitherto been applied to large vessels in this country. The Golden Gate and Illinois, California steamers, have, during the past summer, been supplied with this form of engine. The advantages of an oscillating over a beam engine are said to be these: — less weight of machinery, per horse-power, than in the beam or side-lever engine; they have fewer working parts, are less expensive in repairs, consume less lubricating material: — they are subject to less strain, nearly all of which is direct, and not transverse and diagonal as in the beam, and their pressure on the gudgeons, when in operation, half less, requiring consequently less strength and weight in the bed plates, and in the timbers that sustain them, and they, together with their boilers, occupy but fiive eighths of the space of a *beam* engine of the same power. These advantages when segregated may not be much to each item, but they, in the aggregate, are very considerable and important. The difference in the weight of the engine and in the space occupied by them are, however, two very important items, especially in ocean steamers. The former, in an engine of seven hundred nominal horse-power, is not less than one hundred and fifty tons, one hundred of which is in movable parts of the machinery, and the latter, as we have before stated, is but five eighths of that required by the beam engines.

In the engines of the Illinois, the air-cylinders are located between the steam cylinders, directly over the condenser, and are worked by piston rods connecting with the main shaft by a crank at its centre. This centre-piece of the main shaft is wrought out of the heaviest piece of iron ever forged in this country, and cost over seven thousand dollars. Its journals are twenty-one inches in diameter. It was forged in an entire block, and the crank cut out of the solid mass. The other journals of the shaft are 19½ inches in diameter; the crank pins are 12 inches, and the piston rods of the steam cylinders 12½ inches in diameter. The cylinders are eighty-five inches in diameter, with nine feet length of stroke. The diameter of the side wheels is thirty-three and a half feet, length of float ten and a half, and depth two and a half feet. In the trial trip of the Illinois, with twelve pounds of steam to the inch, eighteen revolutions were accomplished, and a speed of eighteen and a half miles to the hour obtained, running with the tide, the velocity of which was about three and a half miles per hour, so that the vessel moved through the water at the rate of about fifteen miles an hour.

STEAM POWER USED AT A DISTANCE.

An engine has been recently set to work at the Aucland colliery, arranged on a somewhat curious plan. The boiler is placed upon the surface and the steam pipes are taken down the shaft, a depth of eighty fathoms, and then down an inclined plane about 1,050 yards, making the total distance from the boilers to the engine upwards of 1,200 yards, and the perpendicular depth about 882 feet. The engine can lift and force about 300 gallons per minute up the inclined plane, length as stated above, the perpendicular height 342 feet. — *London Builder.*

GREGORIE'S PATENT EQUALIZER, OR POWER REGULATOR.

To give the benefit of a heavy fly-wheel to a steam engine, without its incumbrance and loss, is the object and nature of this invention. It consists of a small piston working within a close cylinder situated at one side of the large or engine cylinder, and receiving two strokes for one of the engine, either way, through the motion of a bell-crank attached to and operated from the beam ; the said small piston, through a branch connecting it with the main steam-pipe, being constantly exposed to the steam from the boiler on its one face, and, through a further branch, to the vacuum of the condenser on its other (or to the external atmosphere if the engine be of the non-condensing kind). The small piston, thus connected and operating, will serve to act as a drag at the early part of the engine stroke when the steam is strongest, and afterwards to form an auxiliary, to the same amount of effect, at the closing portion of the stroke, when the steam, by expansion, has become weaker, thereby equalizing, or sufficiently so, the propelling power of the engine throughout its entire stroke.

The device is equally applicable to all engines, whether high or low pressure, and may be used with great advantage in every case where fuel is either costly or cumbrous ; it can be worked from the main or counter shaft, and so at a trifling cost be attached to any engine. — *Farmer and Mechanic.*

IMPROVEMENTS IN STEAM BOILERS.

Application for a patent has been made by Mr. Charles Allen, of Warren, Penn., for three specified improvements in the construction and arrangement of steam boilers. One is a mode of preventing explosions by securing either the head or end of the boiler by springs which will bear a certain pressure, but when the pressure exceeds this, the end will be thrust out, and prevent the boiler from bursting to pieces.

The second improvement, applicable to revolving boilers, is applying a cylinder of wire gauze in the interior of the boiler for the purpose of gathering up the water on the surface, when the boiler is rotating.

The third improvement is the placing of an alarm valve on the boiler, to be opened once during every revolution by the striking of a stationary bar or other object placed in a convenient position, to call the attention of the engineer to the boiler. — *Scientific American.*

APPLICATION OF STEAM POWER ON CANALS.

For many years scientific men have devoted much attention to the application of steam power to the towing of boats on canals. Towing by horses has been found not only exceedingly expensive, but too slow and uncertain for the wants of the present age, and hence many plans have been suggested and experiments tried, in the hope of finding some means whereby the great motive power might be safely applied to the propelling of boats heavily loaded through the narrow channels of a canal without producing such a commotion in the water as to seriously injure the banks, or endanger the safety of the works. A boat built after a plan patented by G. Parker, of Massachusetts, has been used to some extent during the past summer, on the Delaware, Chesapeake, and Raritan canals, with good prospects of success in remedying the evils above adverted to. It is a small boat, of about 100 tons burden, with two engines, rated at 15 horse-power each. It differs from an ordinary steam-boat in the peculiar shape of the wheel-buckets, and in the addition of a float back of the wheel, which is in the centre of the boat. The wheels are bent so as to form the segment of a circle, and they enter and leave the water without creating the great motion caused by the ordinary paddles. Should, however, the power required cause any swell, the waters are smoothed down and pacified by the float that follows the wheel. This float can be raised or lowered as circumstances may require. The average speed of the boat, when towing, is represented to be four miles an hour, and the cost one half that of horse-power.

WATER AND STEAM PRESSURE GAUGE.

Mr. William C. Grimes, of Philadelphia, has recently invented an instrument, which is intended to indicate continually the height of the water, and pressure of the steam in a boiler, at any required place, at whatever distance from the boiler. It consists of two metallic tubes, which are inserted, the one into the steam space, the other into the lower part of the water space of the boiler, and extend from the boiler to the place at which the indications are required to be made, where the ends of the tubes are brought side by side, and connected together by a bent glass tube, one end of which enters each of the metallic tubes. In the simplest form, (which is described for the purpose of explaining more clearly the theory of the apparatus,) the tube connected with the steam space (which may be called the upper tube) enters the boiler at the water line, and runs for some distance horizontally, or a little inclined downwards, when it again bends downwards for some inches, and then runs in any convenient direction to the glass tube. The object of this arrangement is to allow the steam to condense in this part of the tube, and to keep the water which fills it always at the proper water-level of the boiler. Each of the tubes is provided with a stop-cock near the boiler, and on each of them, immediately below the glass tube, there is a small hole, (called by Mr. Grimes the air-hole,) which may be closed by a screw. In order to put the apparatus in working order, the boiler is filled to above the water line, the stop-cocks of the tubes being closed, and a small pressure of steam raised; the stop-cocks of the upper tube being then opened a little, the water will enter the tube, and, expelling the air before it through the air-hole, will finally begin to run through this hole; the stop-cock of the upper tube is then closed, and the plug of the air-hole screwed in. The lower tube is then filled with water in a similar manner. The apparatus then contains water in the metallic tubes, and air in the glass tube, or gauge. If now the stop-cocks on the tubes be opened, and the pressure of the steam increased, the air in the gauge will be compressed proportionably, and the water will rise to an equal height in each branch of the tube; in this way the gauge may be graduated by direct experiment. But the fall of the water level in the boiler will cause the level to fall also in that branch of the gauge which communicates with the lower tube, (that is, the tube opening near the bottom of the water space of the boiler,) and this will cause the water to rise in the opposite branch of the gauge, in consequence of the necessity of the column of air retaining its bulk. While, therefore, the pressure of steam in the boiler is indicated by the mean height of the columns in the gauge, the fall of the water below its adjusted level will be indicated by the difference of the height of these two columns, provided the level of the water in the boiler end of the upper tube be maintained constant.

In practice, this construction is modified by the introduction of another vertical tube, connecting the end of the upper and lower tubes near the boiler. The upper tube is then inserted into the steam space of the boiler, and it leaves the connecting tube at the proper water level, when it runs as before described; in this way there will be left but a small portion of the upper tube to be filled by the condensed steam. The lower tube is also provided with a blow-off cock between the boiler and the stop-cock before described to prevent this tube from being choked by sediment. The level of the water in the gauge is indicated by a floating glass tube, colored and graduated in the inside, and closed in the leg communicating with the upper tube, while a glass ball floats on the surface in the other leg. The difference in the levels of the water columns is then indicated by the position of this ball on the graduated scale of the glass tube in the other leg.

NASMYTH'S ABSOLUTE SAFETY VALVE.

The chief feature which distinguishes this improved safety valve from all others hitherto proposed, consists in the peculiar and simple manner in which the motion of the water in the boiler is employed as an agent by which the valve is prevented from ever getting set fast in its seat. The swaying to and fro sort of motion, which, at all times, accompanies the ebullition of water in boilers, is made to act upon a sheet-iron appendage, attached to a weight, which weight is connected directly with a brass valve; and as the rod which connects this sheet-iron appendage and weight to the valve is inflexible, it will be easily seen how any slight pendulous motion given to it is directly transferred to the valve; and as that portion of the valve which rests in the seat is *spherical*, the valve not only admits of, but receives, a continual slight motion in its seat, *in all directions*, as the result of the universal pendulous motion of the appended weight, as acted upon by the incessant swaying motion of the water during ebullition.

IMPROVED LOCOMOTIVE.

At the Great Exhibition, a locomotive was exhibited by Messrs. Hawthorn, for which they claimed a capability of running, with safety, at a speed of 80 miles an hour, with a large express train. The cylinders are 16 inches diameter, and 22 inches stroke; the driving wheels 6½ feet in diameter, and the bearing wheels 39 inches; the heating surface of the firebox is 98½ square feet; the boiler is traversed by 158 brass tubes, giving a heating surface of 865 square feet. The principal improvements claimed by Messrs. Hawthorn for this locomotive are the following: — Instead of the six ordinary springs on each axle, the engine is fitted with double compensating beams and four springs acting simultaneously on all the journals, so that the weight assigned to the respective axles is not affected by any irregularities or imperfections on the line of railway, but is uniformly maintained throughout, securing thereby a constant weight upon the driving wheels, and consequently a constant amount of adhesion. By this direct, simultaneous connexion between the axles, great stability is given to the engine; greater safety, particularly at high speed; and a smoother and easier motion. The engine has outside framing, with outside bearings to all the axles, the cylinders being placed inside; it is supported on six wheels, the driving wheels being in the centre. The second advantage claimed, is the application of expansive link motion and slide valves, which admit of the boiler being brought down nearly as low as in engines with straight axles; and, by the introduction of the slide valves, the pressure on the valves, and consequently the friction, is considerably diminished. An arrangement is likewise introduced into the engine of the patent steam-pipe of Messrs. Hawthorn, which removes the domes and other projections on the top of the boiler. The steam-pipe is fixed into the tube plate of the smoke-box by a ferule like an ordinary tube, and extends nearly the entire length of the boiler. Being carried under the top, it is perforated with a series of small apertures or slits along its entire length, and it is arranged so as to receive the steam directly above the place at which it is generated, instead of compelling it to rush from all parts of the boiler to one or two orifices. By this arrangement, the steam is conducted to the cylinder, nearly, if not altogether, free from *priming*.

NOVA MOTIVE.

At the Polytechnic Institution is a new mode of propulsion now being demonstrated, which, under this title, consists of a series of carriages travelling along with their own motor, in the form of a tube, which is flexible and air-tight. This tube has a series of side valves, entirely under the care of a guard, who, by levers, has a perfect control over his train. The application is very ingenious, and is the invention of a mechanic. Along the whole line of railway is laid a pipe of any given diameter, in connection with which a series of pistons are fixed between the rails intended to receive the tube above mentioned in its passage. In these pistons are atmospheric valves opening into the fixed pipe, which is always kept exhausted, so that, when the train passes over the pistons, the side valves in the tube are opened by means of inclined planes communicating with other levers, which levers are raised up on the train passing. The atmosphere existing in the tube consequently rushes from the tube to supply the vacuum, and the train is impelled by external atmospheric pressure. — *London Illustrated News.*

IMPROVEMENT IN LOCOMOTIVES.

The English engineers are directing attention to the superiority of Crampton's system of building locomotives by suspending on the extremities of the frame. Mr. Crampton places the driving wheels at the end of the engine, instead of the centre, and these wheels carrying about one half of the whole weight of the engine on them, it is clear that one half will be on the driving wheels; and, by assuming four wheels at the other end to take the other half, the machine, in fact, is suspended on the extremities; but, in the ordinary machine, the driving wheels being in the centre, with half the weight on them, the other half is necessarily equally distributed on the fore and hind wheels, having the effect of a balance beam action — one of the greatest causes of oscillation. To accomplish the same result, the superintending engineers of the Great Western and Northern railways, England, have adopted the plan of applying compensating springs, which have the effect, to a certain extent, of placing the weight of the engine on the extreme ends. — *Scientific American.*

IMPROVEMENT IN RAILWAY AXLES.

An important improvement, to prevent the heating of railway axles and the bearing parts of machinery, has recently been effected by Mr. George Little, of England. His plan is to bore several longitudinal apertures, for about 15 inches, up each end of the axle, letting the same terminate by several tubes let into the axle under the body of the carriage, so arranged that the centrifugal force will impel a powerful current of cold air through the apertures, thereby keeping the journals and bearings of the axles from heating. To prevent grit, &c., getting into the grease-box, a circular plate is screwed on the end of the axle. This principle is also applicable to the shafts of stationary and marine engines, and, in fact, to all kinds of shafts used in machinery. — *Mining Journal.*

RAILROAD CHECK-SIGNAL.

The following is a description of a check-signal, invented by Mr. Richard Hollings, of Boston, designed for use when from any cause a signal is needed to inform the engineer that the train must be stopped. A cross-bar made of wood or iron, equal in length to the gauge of the road, is laid across the track, between the rails, and is there secured in place. In the centre of the cross-bar a stout plug or pin is fixed, projecting upward eight or ten inches. Beneath the engine a roller is hung transversely, through the centre of which an iron tongue is fastened, of sufficient length to strike the plug when the engine passes over it. On the upper side of the engine, over the roller, is a spring fastened to the engine frame, consisting of a trigger, a set of wheels acting on a principle similar to that of a clock, and a hammer and bell. The trigger has two arms — one extending downward, and connecting with the roller, the other extending upward, and communicating with the wheels. The spring is set by winding up, and is held in place by the trigger. Then, when the engine passes over a cross-bar, the tongue strikes the plug and is thrown back, causing the trigger to release its hold of the wheels, which, rapidly revolving, cause repeated strokes of the hammer to be given the bell. This, of course, is notice in all cases to stop the train. Instead of the wheels and bell, the trigger may communicate with a steam-cock, and the alarm thus be given by means of a whistle. The model is made to show the operation in either case. It is intended for every train to be supplied with one or more cross-bars, so that if any accident happen, not in the vicinity of a station, whereby the track is obstructed, and cannot be cleared in season for the passage of the next train, a cross-bar may be laid upon the track, on either side of the accident, at sufficient distance therefrom to notify such approaching train of the danger. So at every station, and in the vicinity of drawbridges, it is intended that cross-bars should be kept, to be used as occasion may require.

RAILROADS WITHOUT RAILS.

In the French Department of the Great Exhibition, a curious system of locomotion was represented, which is, however, only the modification of a plan exhibited in London many years since. It is a railroad without rails. In the English invention there were pairs of wheels fixed on the road at stated distances, which were to be kept in motion by stationary engines; the power being communicated by a band passing from the engine, and connected with a great number of wheels. The rails were fixed to the bottom of the carriages, and were made long enough to have always a bearing on two of the wheels at least. When the system of the wheels was put in action, the carriages were propelled by the bearing which the rails beneath had on the peripheries. One of the advantages of this plan was, that single carriages instead of trains could be started, and at very short intervals, without danger of collision. In the French modification of the invention, the principal difference consists in the means of giving motion to the wheels. Instead of connecting the series with one long endless driving band, there are numerous short endless chains connected with the axles of only two pairs of wheels, so that the motion of one pulls the chain that propels the next. The model road exhibited was on a steep incline, for the purpose of showing that this method of propulsion is applicable to the ascent of hills.

IMPROVEMENT IN RAILROAD CARS.

An improved ventilating apparatus has been recently attached to railroad cars, built by Messrs. Bradley & Rice, of Worcester, Mass. The windows are so constructed that they are made to act the part of ventilators, by having two leaves; the front one is set to stand out, with its inner end forming the apex of a cone, the outside being the base. The air impinges on this window, as it is set angularly to the side of the car, and it therefore forms a partial vacuum at its outer edge. This draws the air from the inside and thoroughly ventilates the car, allowing nothing to come in from the outside. The other leaf of the window is set behind the first leaf to sustain the current of air from the inside, to perpetuate the partial vacuum. There are ventilator cones in the roof, which prevent sparks from entering, but allow a fresh supply of air to enter the car continually. — *Scientific American.*

SELF-ADJUSTING RAILROAD SWITCH.

Mr. Amos Hodge, of North Adams, Mass., has recently invented a self-adjusting switch, which is highly recommended. The manner of accomplishing so important a result is very simple, and requires but very little addition to the switches now in use. The sliding section of the track is moved by springs, and is kept in its place by a spring bolt. When the train approaches the main track from *any* side track, the first car or engine passes over an inclined plane, on the section preceding the slide, which pushes forward a connecting bar, on the end of which is a cam, which moves the slide to that track, and by a simple attachment keeps it there until the last car leaves the slide, when it returns to the main track. Mr. H. has also designed that by placing a wheel or bearing on each side of a locomotive, the engineer can run to any side track he chooses, by depressing the wheel (or bearing) on the side he wishes to turn out. One single feature in the invention is worth remembering — it never will run a train off the track from being placed wrong. — *North Adams Transcript.*

RAILROAD IMPROVEMENT.

The American Railroad Journal furnishes the following description of an improvement of Mr. J. S. French, whereby a locomotive was enabled to ascend and descend a grade of 200 feet to the mile. The ends of the sills are cut off square with the string-pieces; the rail, six inches wide and three fourths of an inch thick, is placed upon the string-pieces, and extends outwards two and a half inches, thus affording an under surface against which a pair of rollers [the simple principle of the whole invention] are pressed. These rollers or wheels are suspended from the engine, a little in advance of the driving wheels, and are pressed against the extended rail by a lever, by the regulation of which any amount of adhesion may be obtained. This mechanical adhesion has the advantage of being graduated to circumstances; for on running on a level but little adhesion is required, and on reaching any inclined surface, it is put on in a quantity requisite for ascending, and no more. Thus are avoided the effects of weight in a great measure; whereas, on the ordinary principle, much dead weight is put on, only to be made use of at certain points, and destroying the road on every passage over it.

In an experiment made at Richmond, Va., an engine, constructed on the above principle, weighing three and a half tons, drew a passenger car, with 100 passengers, up a grade of 200 feet to the mile, at the rate of ten miles per hour.

PROGRESS OF RAILWAYS IN THE UNITED STATES.

A correspondent of the *American Railway Times* furnishes a statement of the progress of railways in the United States, from 1830 to 1851, which, with a correction or two, we here subjoin: —

Years.	Miles.	Years.	Miles.	Years.	Miles.
1830	13	1838	1,389	1845	3,518
1831	19	1839	1,986	1846	3,885
1832	176	1840	2,226	1847	4,369
1833	305	1841	2,505	1848	4,574
1834	456	1842	2,688	1849	5,583
1835	542	1843	2,965	1850	6,783
1836	839	1844	3,474	1851	11,471
1837	1,155				

The Baltimore and Ohio Railway was opened a distance of thirteen miles December 28, 1829; the South Carolina Railway, a distance of six miles, November 1, 1830; the Lake Ponchartrain, April 16; the Camden and Amboy, a distance of seven miles, July 1st; and the Mohawk and Hudson, throughout, September 24th, 1831.

It is difficult to prepare a table, which, when published, will give the precise number of miles of railways in operation, as every day adds to the number, and swells the grand total of miles completed or in operation.

NAVIGATION AND SHIP-BUILDING IN THE UNITED STATES.

The following statistics of the foreign and inland commerce of the United States, are derived from the report of the Secretary of the Treasury, for 1850. In 1815 the tonnage of foreign shipping was 854,254 tons; of inland navigation tonnage, 513,813 tons. In 1850 the foreign tonnage had arisen to 1,585,711 tons, and the inland tonnage to 1,949,743. In 1815 the foreign tonnage exceeded the inland 60 per cent. Now the inland exceeds the foreign 25 per cent! The "registered tonnage" has increased 700,000 tons; but the "enrolled and licensed" tonnage has increased 1,400,000 tons. The whole increase from 1820 to 1850, (a period of thirty years,) is 175 per cent. Now the growth of population in that period is 130 per cent., proving the growth of commerce and navigation to be faster than that of the people. Among the most obvious causes of this fact is the introduction of steam navigation on the western rivers. The steam tonnage on all the western rivers exceeds 300,000 tons; but this had no existence in 1815, the period of comparison in the above table.

THE "WAVE" PRINCIPLE OF MARINE ARCHITECTURE.

The term "wave principle," often used, is little understood, except by those who have studied naval architecture as a science, although all the fastest ships, whether propelled by sails or steam, have adopted the principle. According to the old principle, it was considered that vessels should be built with the water line nearly straight, the run of the vessel a fine line, and that there never should be a hollow line, except a little in the run of the ship, and that there should on no account be any hollow line in the bow, but that the water lines should be either straight, or rather convex. Some years ago, at the request of the British Association for the Promotion of Science, Mr. Scott Russell and the late Dr. Robinson, of Edinburgh, undertook a series of experiments, with the view of ascertaining the form which would enable a vessel to move most quickly through the water. These experiments lasted for years, and established a set of facts which were reduced into new rules, the majority of which were decidedly the reverse of the old rules in ship-building. They began by upsetting the old rule that the length of a vessel should be four times its breadth, as they found that the greater the speed required, the greater should be the length, and that the vessel should be built merely of the breadth necessary to stow the requisite cargo. The second great improvement was, that the greatest width of the water line, instead of being *before* the middle, should be *abaft* the middle of the vessel — in fact, two fifths from the stern and three fifths from the bow. The next great improvement was, substituting for broad, bluff, or cod's-head bow, hollow water lines, called wave-lines, from their particular form ; and, also, instead of the old fine run abaft and cutting it away, you might, with advantage, have a fuller line abaft, provided it was fine under the water. By these improvements the form of the old vessel was nearly reversed. All the fast steamboats, accomplishing from 16 to 17 miles an hour, are built on this principle. — *English Journal.*

FAN PADDLE-WHEEL.

Mr. Lee Stephens, of England, contributed to the Great Exhibition a model of a new, and, it is thought, effective system of surface propulsion for steamers, which has been denominated the "fan paddle-wheel." It consists of a series of blades, or segments, connected together from their common centre (the boss which attaches them to the shaft) to their common periphery, in such a manner as to constitute a complete rotatory fan. Each blade is an isosceles triangle, every two blades forming at their outer extremities two sides of an equilateral triangle, occupying the full width of the paddle-box, the united action of the whole being necessarily continuous, although the blades, alternately, compress or divide the water right and left, yet entering and leaving it so obliquely as to avoid unpropulsive disturbance, or any lifting of back-water ; of course, the propulsive effect is precisely the same forward or backward. Without a diagram we cannot more particularly explain the invention, but we venture to believe that none of our readers can fail to comprehend its ingenious simplicity, when they keep in mind the fact that the constructive principle may be correctly defined as that of a rotatory fan. It is applicable to all surface propelled steamers, of whatever size ; and its advantages are — simplicity, strength, and economy of construction, even compared with the common paddle-wheel ; avoidance of vibration by *continuity*, and of back-water by *peculiarity* of action ; decreased retardation when deeply immersed ; and increased speed with the same amount of power, consequent upon the saving in that power by continuity of action, and by the entrance and egress of each segment of the fan obliquely, instead of horizontally. In action each segment assimilates to the motion of a fish's fin, or to that of a scull or oar, and the entire action very closely approximates to that of a screw applied to surface propulsion. The invention is highly recommended by competent authorities, the increased velocity derivable from its use being estimated at from one sixth to one eighth. — *London Mining Journal.*

IMPROVEMENTS IN THE CONSTRUCTION OF SHIPS AND STEAMERS.

The following extract from the last report of the Secretary of the Navy furnishes a striking illustration of the rapid advances recently made in this country in the construction of ships and steam-vessels : —

" In everything pertaining to the building, armament and equipment of vessels of war, the scrutinizing and active mind of the present age has not been idle. Merchant vessels of large draught have recently been built and rigged in our country, which have sailed, by the force of the winds alone, one thousand statute miles in three days, and with an approach to the like rate of speed in long voyages. Improvements and discoveries in ordnance and gunnery have been introduced, by means of which, in the opinion of well-informed officers, a ship of inferior rating — say of 32 guns — may be so built and rigged and armed as to prove more than a match for the stoutest line-of-battle-ship of the old construction and armament. How far the power of steam may be added to increase the superiority of the modern vessel in speed, destructiveness, and other points of a man-of-war, is also a fruitful theme of speculation and experiment. In illustration of one of the improvements in war steamers, it is represented to the department that the boilers of the Mississippi, planned fifteen years since, and with the best intelligence of the day, may be reduced nearly one half in their dimensions and weight ; and, at the same time, made to double the power of the vessel, with about the same expenditure of fuel as at present."

SCREW *vs.* PADDLE

An interesting experiment took place recently, at Copenhagen, between two steam-vessels of equal size, 800 tons and 260 horse-power. Each vessel's engines were made by Maudsley, of London. The Holgerdenser (paddle), carrying two 60 pounders and six 24's, and the Thor (screw), carrying fourteen 32's, were lashed stern to stern, when the Thor towed the paddle at the rate of $2\frac{4}{5}$ths knots per hour through the water, in spite of her full power applied to her paddles. Being disconnected, they were then tried against a strong breeze, when the screw again had the advantage over the paddle ; but when they were put before the wind (no sails set) the paddle had the advantage of the screw to the same extent. Both vessels were of similar model, the paddle being a little longer, narrower, and sharper than the other. Both had their armaments, as above, and a full complement of coals on board ; the paddle drawing 12 feet 3 inches aft, and 12 feet forward ; the screw, 15 feet 6 inches aft, and 14 feet forward.

NOVEL RUDDER OF A SHIP.

The ship Warren, bound from Glasgow to New York, having encountered severe weather, lost her rudder on the outward voyage, and there being no timber on board of sufficient size to construct a new one, and none of the requisite machinery to connect it, even if made, to the tiller, a most ingenious device was hit upon by Captain Lawton, which was successfully carried out by the crew, by which means the ship, with a valuable cargo and 150 passengers, was safely steered to her port of destination. The Warren drew about 16 feet of water, and a sufficient number of ropes being fastened so as to form a sort of hempen plank, very similar to a close door mat on a gigantic scale, the whole was bound together with transverse pieces of wood, thoroughly lashed throughout, and secured with iron rods at the edges. For the hinge, a series of chains were substituted, and two more with blocks and connecting ropes, running under the quarter, and fastened to the windlass, gave the steersman almost as complete control as the ordinary wheel. This truly ingenious piece of mechanism has elicited the warmest expressions of admiration from many nautical veterans.

METALLIC RUDDER.

The rudder of the United States steamer San Jacinto, recently constructed at the Brooklyn Navy-Yard, is something of a mechanical curiosity. It is about 24 feet in length, composed of a centre wrought-iron spindle weighing 2,249 lbs., turned and finished; upon this spindle is cast, for nearly the entire length, a composition casting of copper and tin, of 1,940 lbs.; to this casing flanges project nearly the entire length of the spindle, to which are riveted the copper plates which form the rudder. The object of the casing is to prevent rust on the iron. The whole weighs about 6,350 lbs., and was manufactured at the Washington Navy-Yard.

THE DUPLEX RUDDER AND SCREW-PROPELLER.

An invention, entitled as above, has recently been patented by Captain Carpenter, of England. It consists of two rudders and two screw-propellers, fitted in new positions for improved steering and propelling. From the midship section of the vessel to the stem, no alteration is introduced into the form of the hull; but abaft this point they commence. First, the keel, with the dead-wood, stern-post and rudder, are removed, and the flooring above receives a suitable form for strength. Two additional keels lie in a line parallel with the former keel, but placed at a distance of two or more feet, according to the size of the vessel, on either side of it, terminating at the midship section in the fore-part, and in a line with the former stern-post in the after-part. Framework is carried down to these keels, leaving a free channel for the water to run between them in the direction of the midship keel. A stern-post is placed at the end of the additional keels, and upon each of which hangs a rudder. A screw-propeller works in an orifice in each framework, on the common arrangement. One of the propellers is a little more aft than the other, to allow full play to both, and yet economize space in the mid-channel. The appearance of the vessel in the water is not altered in the side view, neither is it much changed in the stern view. The consequence of this new arrangement is, that the rudders and propellers are acting with double effect in each case. The rudders are receiving an increased power, because the impact of the water upon them takes place at an angle which is constrained by the situation of the keels, and which is the most favorable that can be had. The two propellers, also, revolving as they are in water confined in a limited space, are working to considerable advantage. The effect actually produced is, that, when required, a vessel can be turned about in nearly half the space that a single rudder can turn it, and the two propellers will give a proportionate increase of speed.

The advantages gained by the new construction of the vessel are also considerable. There will be more strength, more bearings in the run, more breadth for cabin room. The rolling and pitching will be reduced very considerably. The vessel will not make lee-way as formerly; the vibration, or tremulous motion, will be lessened. The safety of the vessel will be very much increased, because the duplex rudder will have the effect of instantaneously changing the direction, should she be running into some unexpected danger; also, if one rudder should be damaged, the other can be used to steer with. The propellers also can be used separately when required.

STATIC PRESSURE ENGINE.

Considerable discussion has taken place in several New York journals, relative to a supposed new motive power, devised or invented by Messrs. Sawyer and Gwynne, of that city, and which is denominated the "Static Pressure Engine." In the scheme set forth, the compression of atmospheric air is proposed to be made effective by the introduction of centrifugal force as an auxiliary agent or power, the initial moving force, or atmospheric pressure, and the auxiliary force both acting on non-elastic fluid or water, which is used as the medium of motion.

The machine consists of a covered cylindrical basin, 26 inches in diameter and two inches deep, to which is attached a vertical tube four inches in diameter, and of any required length. A spiral groove runs the whole length of the tube, and this, together with the basin, is supposed to be filled with quicksilver. The whole is to be rapidly revolved about a vertical axis, when the centrifugal force of the mercury in the basin drives the mercury out through a valve on the edge of the basin, and leaves a vacuum behind. The mercury, as it escapes from the basin, falls into a reservoir communicating with the bottom of the spiral groove, through which it is forced by the pressure of the atmosphere with such velocity that the reäction of the sides of the groove causes the tube and the attached basin to revolve with great momentum, evolving new centrifugal force by which the vacuum is perpetuated. Mr. Sawyer supposes that the centrifugal force of the revolving mercury is sufficient to maintain its own revolution unimpaired, and leave a large surplus capable of being applied to any useful purpose.

In Cincinnati, a Mr. Solomon has constructed an engine, for the employment of carbonic acid as a motive power, which is said to work successfully.

THE LARGEST SHIP IN THE WORLD.

The Oriental Steam Navigation Company, England, are now constructing an iron steam-ship, of the following dimensions and power: viz., length between the perpendiculars, 325 feet, breadth of beam, 43 feet; depth, 32 feet. She will measure about 3060 tons, and will be propelled by four engines of the collective working power of 1200 horses; will have feathering paddle-wheels, and a guaranteed average speed of 14 knots, equal to sixteen statute miles per hour. Some idea may be formed of the size of this gigantic vessel, when it is compared with that of some of the existing steam-ships most celebrated for their large size. She will be 51 feet longer than the *Great Britain*, 60 feet longer than the largest of the Cunard mail-steamers, the *Asia* and *Africa;* and 150 feet longer, and 500 tons larger, than a ship of the line of 120 guns. She is to run between Southampton, England, and Alexandria, Egypt, a distance of 3100 miles. It is estimated that she will make the passage in nine days.

GIGANTIC RAILROAD BRIDGE IN GERMANY.

One of the most gigantic and colossal bridges ever constructed, was recently opened for travel on the railroad between Leipsic and Nuremburg, Germany. In the construction of this road it was found necessary to carry the track directly across a deep valley, near the town of Hoff. As it would have required a mountain of dirt to form an embankment, only a bridge was found practicable. One thousand dollars were offered to architects and engineers, as a premium for the best plan. As none of the plans sent in were found practicable, the committee made up one from them, and divided the premium among the competitors. One engineer proposed to build the bridge in such a way that it would afford comfortable dwellings for 6,000 people. The foundation of the bridge was laid in May, 1846. It is built principally of brick, sandstone being used in the foundations. There is a succession of arches one above the other, having the appearance of colonnades when viewed from a distance. The bridge is 2050 feet in length, and in the centre nearly 300 feet high. At the centre, only two arches, of nearly 150 feet in height, spring one above the other — while upon the sides there are four smaller arches. Part of the time, 2000 men were employed upon it, and the work has continued five years, costing over $3,000,000.

GREAT BRIDGE AND VIADUCT OVER THE WYE.

A gigantic bridge and viaduct is now in the process of construction over the river Wye, in Wales, which bids fair to rival in fame the

Britannia, or Menai bridge. The whole will be made of wrought iron, and will combine the principles of the suspension with those of the tubular bridges. Including the viaduct, the bridge is 623 feet in length; the span or suspended part being 290 feet. There are two separate roadways, each being perfectly independent of the other, and their height is 70 feet over the river Wye at high water mark, so that vessels can pass under. The roadways of the bridge are formed of iron, put together in plates, and in form they are similar to the tubes forming the Conway and Britannia tubular bridges; but, instead of being roofed in with cellular divisions of iron, there is for each roadway, and suspended above it, and at some distance, a strong cylinder of iron. It is suspended on piers, and from the extremities of this cylinder a looped chain runs under pins placed on each side of the roadway, in order to brace and support it. Likewise strong iron braces pass from the cylinder to each side of the tube, and from the top of each of these side supports to the bottom of the other, chains are placed for additional strength. On one side, the roadways rest on six upright iron cylinders, which have been filled with concrete, and driven firmly on a foundation of rock. The roadways on this side are continued in the form of a viaduct for about three hundred feet more, resting upon these upright cylinders filled with concrete, and firmly imbedded. On the other side, the roadways rest upon solid rock. — *London Times.*

THE WHEELING SUSPENSION BRIDGE.

Ex-Chancellor Walworth, who was appointed by the U. S. Supreme Court a Commissioner to take testimony in the Wheeling Bridge case, on the issue whether the bridge did or did not obstruct the navigation of the river, has recently made a report on the subject, from which, with the account published by Mr. Elliot, the engineer, it appears that the length of the bridge, from centre to centre of the supporting towers at each end is 1,010 feet, and the height of the flooring at its greatest elevation, is 97 feet above the low water surface of the river. The highest freshet ever known on the river at this point was in 1832, when it rose 44½ feet above its lowest level. There is, therefore, sufficient height to permit a steamboat, with a pipe fifty feet above the water, to pass under the bridge at the top of the flood of 1832. The testimony taken by the commissioner, however, shows an increase in the height of the chimneys of steamboats to 84 feet in some instances. The passage-way of the suspension bridge is 62 feet above the water zero on Wheeling bar; the highest chimneys would, therefore, strike when the water was above 8 feet. It appears, from observations made at Wheeling, that the Ohio is in good navigable order more than two thirds of the year, and that it is the extreme of high and low water only five days in the year. It being evident that the chimneys must be lowered or the bridge elevated, and as the speed of steamboats is a great public convenience, Mr. Walworth pronounces in favor of the latter course. The bridge must, therefore, be elevated "twenty-eight feet above the highest point of the present bridge, and sixty feet above the elevation of the bridge at the water abutment, on the eastern side." The estimated cost of this elevation is $208,000.

MACHINE FOR BLOOMING IRON.

At a late meeting of the Birmingham Institution of Mechanical Engineers, a paper was read, "On a new machine for blooming iron," accompanied by a model, illustrating the invention. The working portion of the machine consists of three eccentric, cuspidated, semilunar-shaped cams, working simultaneously, and all kept rotating in one direction by wheels and pinions, firmly connected together in a strong frame, and set in motion by a steam engine. The convex sides of these semi-cylindrical cams are deeply grooved and serrated, and their peculiar form is such, that, on dropping a bloom of iron into the concavity of the upper cam, as it presents itself, it is immediately drawn into the vortex, or centre of motion, of the three cams, at the instant when that opening is the largest. As they rotate, the convexities, in consequence of the eccentricity of the centres, approach nearer and nearer — the ridges and rough surfaces squeezing, rolling, and kneading the iron in all directions, like squeezing a sponge in the hand. The cinders and impurities are thus ejected, and fall out beneath the machine; and the cams, in the latter part of their rotation, having closed the space between them to the smallest dimensions in the revolution, the bloom is elongated and ejected in the form of an iron cylinder. The paper stated that the machine was the invention of Mr. Jeremiah Brown, and that its use was calculated to form a new era in the iron trade. For the production of superior iron, it had hitherto been considered that the hammer was indispensable; but for all purposes of efficiency, rapidity of action, and economy, this machine, it was assumed, would come into general use. From its strength and simplicity, it would not cost in repairs £20 a year; while a hammer involved expenses of ten times that amount, and the cost of replacing a broken hammer was well-known in the iron trade to be a serious *item*. It turned out a finished bloom, entirely free from cinder, in twelve seconds, the engine working moderately; while under the hammer it could not be completed under eighty seconds. Thus, by the machine, the cylindrical bloom, when ejected, was still at welding heat, and could be at once passed through the rolls, while, from the hammer, it had again to pass through the furnace.

In the discussion which followed the reading of the paper, Mr. Beazley, the author of the paper, stated that, from some comparative experiments he had made, as to the strength of the same iron finished by hammer and by the machine, he considered the quality about equal; on different sized bars, in some cases, they were a trifle in favor of the hammer, and in others of the machine; but he considered the economy highly important. In labor there was a saving of 1*s*. 3*d*. per ton; in tools of 1*s*. per ton; and the saving in time was equally worthy of consideration. That a more perfect ejection of the cinder was effected by the machine than by the hammer, was clear from the fact that the same quantity of iron weighed less after passing the former than from the operation of the latter; and Mr. Beazley said that he had taken two blooms direct from the machine successively, and passed them together through the rolls; and the result was a perfectly welded joint.

Mr. Adams bore testimony to the efficiency of the machine; but he had seen a bloom passed through the rolls from it, and noticed that a considerable quantity of cinder still oozed from the ends. He thought, after leaving the machine, the iron might be subjected to a few blows of the hammer with advantage, and thus aim at the production of a highly superior article, rather than at the saving of 1*s.* a ton. Mr. Beazley thought the hammer would be superfluous, as the rolls effected what the machine had left undone. Mr. Cowper had often seen the machine in operation, and had not noticed the cinder in the iron at the rolls, as represented by Mr. Adams. Mr. Williams said, if iron was imperfectly puddled, the hammer would knock it to pieces and show the defect; but he feared the machine would roll the iron up, whether good or bad. From the rolling action, the cinder would be lapped up in the iron. He considered the cost of the machine and repairs would be an important consideration. Mr. Beazley assured Mr. Williams he was in error; it had been repeatedly proved that if the iron was imperfectly puddled, the machine instantly tore it in fragments; that, as to complexity, it was as simple as the ordinary rolls, and no more likely to get out of repair. It had worked four months with only one trifling accident, which arose from faulty construction at first. — *London Mechanics' Magazine.*

MALLEABLE IRON.

The manufacture of this article, which was introduced only a few years since, is already extending over various parts of the country. The process of manufacture, which is not generally understood, is thus explained in the New York Farmer and Mechanic.

To make iron malleable, the common pig, reduced to a state of fusion, is submitted to a melting heat for many successive hours, by which it is refined. From this refining furnace, the iron is poured into moulds, and thus given various forms, according to the wishes of those who use it, just as common pig is fashioned by moulds. When taken from the sand, each piece is carefully examined, and, if found perfect in form, it is, with other articles, submitted to the *annealing* furnace, where, for six or eight days and as many nights, the iron is kept in a state of red heat. The time during which the annealing process is continued, varies, according to the quality and size of the articles desired. If the articles to be annealed are large, or are desired of an extra quality, the time of annealing is prolonged to nine or ten days; but, if the articles are small, and the quality is not a matter of much importance, they are taken from the annealing furnace in a shorter time. Such is the process of making malleable iron, which is fast coming to be used instead of wrought iron, in the manufacture of many utensils. For making iron garden rakes, for culinary utensils, for patent wrenches, and especially for the manufacture of pistols and guns, malleable iron is used for purposes for which wrought iron was formerly used. Malleable iron, by a process of refining and annealing, has become tough, and thus answers the ends, in many cases, of wrought iron.

SHEET-IRON PIPES.

Sheet-iron pipes, of a new manufacture, have lately been introduced into England from France, where they have been in use for several years. They are made of sheet-iron, which is bent to the required form, and then strongly riveted together, after which they are coated with an alloy of tin, and the longitudinal joints are soldered, so as to render them both air-tight and water-proof. In order to give them more stiffness, they are next coated on the outside with asphalte cement, and if they are intended to be used as water-pipes, the inside is also coated with bitumen, which resists like glass the action of acids and alkalies. They are so elastic, that they will bear a considerable deflection without injuring the pipes, or causing any leakage at the joints. The vertical joints screw together in the same manner as cast-iron gas pipes. These pipes have been used for water, for gas, and for draining, and are found to be more economical than cast-iron, besides being less liable to leak, and, for water-pipes, they are more healthy than the common ones. — *Railroad Journal.*

ILLUSTRATION OF THE TENACITY OF IRON.

The Birmingham Journal (England) says : — A singular illustration of the tenacity and ductility of iron has been produced at an iron establishment in this city. It is in the form of a book, the leaves of which are of iron, rolled so fine that they are no thicker than a piece of paper. The book is neatly bound in red morocco, and contains forty-four of these iron leaves — the whole being only the fifteenth of an inch thick. This curious book was rolled in the ordinary sheet-iron rolls.

CAST-IRON BUILDINGS.

The applicability of *cast*-iron to the construction of buildings was first discovered in this country by Mr. Bogardus, of New York, who, after trying, without success, to interest capitalists here in the matter, went to England, where he was equally unsuccessful. In that country *wrought*-iron had been used for building ; but, although the advantages of cast-iron were obvious, it was thought that Mr. Bogardus had over-estimated the strength of the material. He returned to the United States, and eventually succeeded in obtaining the necessary capital to carry out his plan ; and is now doing a very large and increasing business in New York. The discovery of gold in California was literally the circumstance which crowned the invention of Mr. Bogardus with its present success. The sudden demand for large houses there, the want of ordinary building materials, and the high prices of labor, forced the people of that State, and those from the Atlantic States, speculating in California property, to look favorably on the plan for the substitution of cast-iron for brick and wood in house-building. New York merchants first sent such houses thither, which, being put up in a day for each month required for the erection of an English wrought-iron building, and answering better in many other respects, caused so many orders to be returned for similar houses, that the inventor was soon compelled to increase his force so as to make his factory one of the leading industrial establishments of New York. A cast-iron building from this establishment has been put up in Baltimore, for the office of the Baltimore Sun, which ranges for 150 feet on two streets, and is five stories in height. During the past year, a tower of cast-iron has been erected in New York, to sustain a fire-bell, weighing 20,000 pounds. This tower is ninety feet in height and twenty feet in diameter. Some three years since, when the first iron building was erected in New York, consent was very reluctantly given by the authorities to its construction, on the ground of danger to firemen from bursting in case of fire.

TUBULAR WROUGHT-IRON MASTS AND SPARS.

This invention, by Capt. C. F. Brown, of Warren, R. I., consists in the employment of masts, yards, and other spars of wrought-iron tubes fitting within one another in a manner similar to the joints of telescopes, the larger tubes forming the larger part or parts where the greatest strength is required, and the innermost or smaller tubes forming the ends, the whole number being secured together by a screwed rod or rods, made secure to the larger outside tube or tubes, and passing through nuts in the inner ones. The several tubes can be set in any position by setting-screws, so that the length of each mast, or spar, may be varied at pleasure. The upper masts are to be made in the same way as the lower ones, and to fit into them, and be secured by other screw-rods secured to the upper joints of the masts immediately below them. The gradual diminution of the size of the tubes gives the necessary taper to both the mast and yard, and each may be formed of any number of joints necessary for the purpose intended. The masts and spars, when stowed away, can be screwed into one another, or the screw-rods may be taken out, and the tubes slipped into one another, thus enabling them to be stowed away in very little space. Any spars may be made in the same way. — *Scientific American.*

WROUGHT-IRON TUBULAR CRANES.

The same principle adopted in the formation of the Britannia Tubular Bridge, has been applied by Mr. Fairbairn, to the construction of a crane for lifting heavy goods. This crane is entirely composed of wrought-iron plates, firmly riveted together, and so arranged that the upper side is particularly well adapted to resist tension, and the under, or concave side, embodying the cellular construction, to resist compression. The form is correctly that of the prolonged vertebræ of the bird, from which the machine takes its name. It is truly the neck of a crane, tapering from the point of the jib, where it is two feet by 18 inches wide, to the level of the ground, where it is five feet by three feet six inches. From this point it again tapers perpendicularly to a depth of 18 feet, under the surface, forming a cone, the bottom of which terminates in a cast-iron shoe, which forms the toe on which the crane revolves. The lower or concave side, which is calculated to resist compression, consists of plates forming three cells, and varying in thickness in the ratio of the strain ; and, on the other hand, the convex or top side, which has to bear the pull, or tension due to the suspended weight, is formed of long plates, connected together by the system of chain riveting, which Mr. Fairbairn first applied in the great tubular bridges of Wales. The sides of the crane are of uniform thickness throughout, the joints being covered with T iron, and externally with strips four and a half inches wide. This arrangement of materials constitutes the elements of strength in the crane. From the closest calculations made, it appears it would require a weight of 63 tons to break the crane. With 20 tons, the permanent set or deflection of the jib was 3.33 in., and after remaining suspended 16 hours, the further deflection was, 0.64 in. The advantages peculiar to this construction of crane are its great security, and the facility with which bulky and heavy bodies can be raised to the very top of the jib without the least risk of failure. — *London Mining Journal.*

CHINESE METHOD OF REPAIRING BROKEN CAST-IRON VESSELS.

It is well known that the Chinese are accustomed to repair cracked or broken cast-iron vessels by means of a solder of melted iron. An explanation of this process. as performed by the Chinese tinkers, is furnished by Mr. Balestier, U. S. Consul at Singapore, in the following letter to Thomas Ewbank, Commissioner of Patents :

"Macao, Feb. 6, 1850.

" *Sir*,—According to your desire, I have carefully observed the Chinese method of reüniting or joining together cracked or severed cast-iron vessels, so as to make them useful as ever after an accident. Specimens of utensils so mended have been forwarded to the Patent Office. Among them is a cast-iron pan, measuring twelve inches in diameter by four inches deep. A crack of three inches was made in it in the first place, and, in the second, a piece was entirely broken off, giving rise to two distinct operations.

" The operator commenced by breaking the edges of the fractures slightly with a hammer, so as to enlarge the fissures, after which the fractured parts were placed and held in their natural positions by means of wooden braces. The pan being ready, crucibles made of clay, were laid in charcoal, and ignited in a small portable sheet-iron furnace, with bellows working horizontally. As soon as the pieces of cast-iron, with which the crucibles were charged, were fused, it was poured on a layer of partly charred husk of rough rice, or paddy, which was previously spread on a thickly doubled cloth, the object of which is to prevent the sudden cooling and hardening of the liquid metal. Whilst in this liquid state it was quickly conveyed with the right hand to the fractured part under the vessel, and forced up with a jerk into the enlarged fissure, whilst, with the left hand, a paper rubber was passed over the obtruding liquid, inside of the vessel, making a strong, substantial and neat operation. You will thus remark that the art of the Chinese for reuniting cracked or severed cast-iron vessels, of all sizes, consists in cementing them with cast-iron, whilst in the liquid state.

The weight of the vessel sent by Mr. Balestier, is three and a quarter pounds. Except at the centre, where a part, two inches over, is left thick and flat for a base or foot to rest on, the thickness does not exceed, and in fact scarcely reaches, one tenth of an inch. The handles are cast on, but appear to have been first formed and inserted into the mould. This does not seem to have been of sand, as the inner and outer surfaces are smoother, and of a different appearance, from iron cast in that material. Of the metal used for repairing this pot, Mr. Balestier has forwarded a lump that was not melted. It is part of an old kettle, and differs but little, if any, from our pot metal. The crucible, not much larger than a thimble, is made apparently of the same material as our common sand crucibles; except the shape, it could not be distinguished from one of them. The amount of one fusion seems not to cover more than half an inch of the crack, and hence, in the piece inserted, no less than nine distinct applications of the melted metal are seen — resembling in the inside so many ragged wafers touching each other, while on the outside, where the metallic plaster was applied, there are the same number of rude protuberances. Dr. Gale, one of the examiners of the Patent Office, has made a chemical examination of a portion of the basin, and finds it a very pure white cast-iron, containing scarcely any foreign matter, except a little carbon and silex, ingredients always present in cast-iron. —*Patent Office Report*, 1850–51.

IRON PAVEMENTS.

The use of iron plates, as a pavement for streets, has been introduced, during the past year, in some parts of the city of Glasgow, Scotland, with great success. The pavement consists of plates about three quarters of an inch thick, three feet long, and eighteen inches broad. The upper surface is grooved, so as to resemble in some measure the interstices between paving-stones, only that the grooves are not in continuous straight lines, but a sort of zig-zag, so as to prevent most effectually horses' feet from slipping. The plates are rabbeted on the edges, the one resting on and supporting the other throughout the whole series. The joints are so close that none of the material forming the bed or substratum can ooze upwards, as is the case with ordinary pavement, and which causes not only the irregularities of the surface, but most of the dust and mud which disfigure the streets and annoy passengers. The plates are laid upon a bed of sand, with some lime intermixed, but not sufficient to give it the coherence of concrete. The surface being levelled, the plates are laid on it with great facility and rapidly, and being pressed down with a wooden hammer until a solid uniform bearing is attained, the operation is complete. As compared with the best stone causewaying, there is much less noise, jolting, and materially diminished friction or resistance; while the footing for the horses is fully more secure than on the best granite paving. At the present price of iron, the iron pavement would cost from 7s. 6d. to 8s. 6d., according to thickness, per square yard; whilst granite paving costs in Glasgow from 8s. to 9s., and in London from 12s. to 14s. 6d. the yard. The cost of laying and preparation will be certainly not more, if not less, for the iron than for the stone paving, and the probable increased endurance, apart from its other tested advantages, will, we should think, throw the preponderance of economy vastly into the iron scale. — *Glasgow Journal.*

ON THE LAMINATION OF IRON.

We derive the following remarks, in reference to the lamination of iron, especially when used for railroad bars, from an article by H. L. Damsel, Esq., in the Journal of the Franklin Institute for August:—

Various attempts have been made to remedy the tendency of best iron to laminate. An ingenious apparatus has been patented in this country, and also in England, for twisting the rail bar, while it is in the course of manufacturing. By means of powerful machinery, the bar is twisted while in its rough state, until the fibres of metal encircle the rail, instead of lying in a direction parallel with its axis. But it is found that the twisting of the bar alone is insufficient to retard the laminating process, while the fibrous character of the metal still exists.

An English manufacturer has patented a process for manufacturing what appears to be a near approach to an anti-laminating rail. His plan is to construct the upper or wearing part of the rail from puddled charcoal iron in the unwrought state, and the lower part from the iron ordinarily used in manufacturing rails. This arrangement materially reduces the formation of fibre; yet the high price at which these rails have been sold in England, has hitherto limited their employment to a few isolated experiments on some of the leading railroads in Great Britain.

To discover means whereby wrought rails might be rolled from common metal, and yet be free from the laminated structure attendant on its employment, experimental trials were made with rails rolled from variously constructed piles, built up of common puddled iron, with and without the admixture of superior qualities. This was done with the view of ascertaining if the present system of piling could not be advantageously altered for one which, with little or no additional expense in the manufacturing over that now incurred, would result in the production of a perfectly non-laminating rail. The object aimed at, therefore, was one which, if attained, would be of incalculable benefit to railroad companies. The plan usually adopted is to arrange the bars, whether these are of milled or puddled iron, side by side, and one on the other, till a pile is built of the required dimensions. By thus arranging them, the grain or fibre of all the bars runs in the same direction — longitudinally. This parallelism is maintained in the subsequent process of rolling, when the pile is distended from its original length of about three feet, into a finished rail of from 24 to 20 feet long, but is reduced laterally and vertically from seven inches wide and nine inches high, equal to 63 sectional inches, to a bar, averaging, perhaps, six square inches. The fibres of the metal are thus distended longitudinally to nine times their original length, and, to meet this elongation, they are compressed into one ninth of their original sectional area. The fibrous character of the metal continues and is multiplied at each successive rolling, until, as is not unfrequently the case at iron works, it is no longer available for manufacturing purposes.

The remedy which Mr. Damsel proposed for this prevailing tendency to laminate, consequent on the disposition of the plates or bars in parallel layers, was to withdraw a few of the long bars, which ran the whole length of the pile, and replace them with a number of short ones, which were to be laid crosswise to the others, and whose length would consequently be equal to the breadth of the pile. The first piles constructed on this plan were wholly composed of puddled iron disposed in parallel layers, with the exception of the two upper layers, which were of the best metal. The top layer of best metal was of the usual length, and was placed along the pile in the usual manner; but the one under it, resting on the puddling bars, was composed of short pieces laid across the pile, with their fibres at right angles with that of the others. Apparently, this simple alteration in the disposition of the bars of metal composing the unwrought pile, could not affect the structural arrangement of the manufactured bar, but in reality it occasioned a most important change. The rails rolled from these piles were placed on cast-iron blocks, standing three feet apart, and broken by blows from a heavy ram falling freely between fixed guides. The appearance presented by the fractured ends was very different from anything previously observed in rails. For a depth of full half an inch from the surface, the fractured metal presented the crystalline appearance of fine white cast-iron, while the remainder of the rail exhibited the usual coarse fibrous character commonly observed in rail-iron. Yet, although the contrast between the two metals was striking in the extreme, the line of junction was not discernible, and the union of the two qualities appeared to have been effected in the most solid manner.

The alteration thus effected in the structure of the metal, by the single layer laid across the pile, led to further experiments on piles with two cross-laid layers, having a thickness of long bars between them; and in subsequent experiments the number was increased, till every alternate layer was thus disposed. The effect of a second cross layer of best iron was to double the depth of the fine crystalline metal, but when this second layer was of puddled iron, the metal, when broken, appeared to be formed of large crystals, not unlike coarse white pig iron. The metal in the bars rolled from piles built up with layers laid alternately along and across the pile, could scarcely be distinguished in its appearances from cast metal, so great had been the change which the altered mode of piling had effected in the structural arrangement of the iron. By placing a cross layer of short bars at the head and foot of the pile, the rail, when broken, exhibited the crystalline structure at the top and bottom, with a centre mass of fibrous metal, and on placing cross layers in the middle of the pile only, the rail was found fibrous at both top and bottom, but crystalline in the middle. It is possible, therefore, to produce rails with non-fibrous metal in any desired proportion, and occupying any desired position.

The experiments on the conversion of fibrous into crystalline iron at pleasure, by merely altering the system of the piling, satisfactorily demonstrated that by disposing a moiety of the bars across, instead of along the pile, as was heretofore the universal practice, a rail perfectly void of lamina could be manufactured from highly fibrous metal. The additional expense from using the short cross-bars over that incurred in the usual way, amounted to about ten cents per ton on the rails experimented upon; but in the event of the plan being generally adopted, as it is presumed it will be, there being no patent right to contend with, the additional expense from the extra labor in shearing will probably not exceed three or four cents per ton. These experiments developed the fact that the existence of fibre is caused by the rolling being in one continuous direction; and, therefore, fibre may be produced in any required direction; or, if it is desired to have iron free from lamina and equally strong in every direction, it is only necessary to roll the bars alternately at right angles with the former axis. Apart from the great advantage of a non-laminating metal, the rails prepared under this plan of cross-piling display qualities which render them peculiarly valuable for railway purposes. When tested by a heavy weight falling freely on them from a height of fourteen feet, the indentation occasioned by the impact was very much less than that on rails manufactured in the usual way; and, tested by supporting them at the ends, and suspending a weight of two tons for a few minutes on their centre, the permanent deflection was also found greatly in favor of the cross-piling. The mechanical action of the rolls in neutralizing the previous structure appears to have condensed the particles of metal, and to have violently expelled the cinder and other extraneous matter with which it was combined. The increased rigidity appears also to have resulted from the increased density of the metal in the upper portion of the bar, offering a greater resisting medium to compression.

This neutralizing the tendency of bar-iron to resolve into the fibrous structure, is partially understood in the manufacture of boiler, plate and sheet iron. The plan followed in these instances consists in alternately presenting the end and side of the plate to the action of the rolls, whereby the expansion of the metal is equal in each direction; but this procedure, though well adapted to neutralize the formation of fibre, when the object operated on is a plain iron plate, is inapplicable in the case of rails, by reason of their angular section and great length — circumstances which render it essentially necessary that their movements be in the same plane.

The beneficial application of the principle of cross-piling is not limited to the manufacture of non-laminating rails; it may be advantageously extended to various descriptions of wrought-iron for engineering and building purposes, where a partial or total absence of lamina is desired.

RYDER'S PATENT FORGING MACHINE.

Various attempts have been made to supersede the costly hand labor of the smith by machinery, but generally without success; a result which, we believe, may be attributed in a great measure to the projectors attempting too much. In practice, it will not do to feed iron in at one end of a machine, and bring it out finished at the other. For many kinds of engine-work it is now cheaper to leave the forging rough, and take off the superfluous metal with a slotting or planing machine, than to allow a smith to spend his time in attempting to work exactly to drawing. In textile machinery, however, there is an immense quantity of work to be done, of a slight character and uniform dimensions. To suit this kind of work, a forging machine has been invented by Mr. W. Ryder, of Bolton, Eng., and was exhibited at the Great London Exhibition. The machine consists of a strong cast-iron frame, carrying a driving shaft. On this shaft are forged eccentrics, which give motion to swage-holders situated above it. These swage-holders are guided vertically by the frame, while the motion required by the eccentric is allowed for by *pieces*, the toes of which work in the hollow on the top of the swage-holder. Each swage-holder is provided with a spiral spring, which bears on a key fixed in the frame, and raises the swage after the eccentric has depressed it. A slot is cut in the swage-holder to allow it to slide on the key. Machines of this class are always liable to breakage from a bar of too large a size being put between the swages. This can only be remedied by allowing some elasticity, which in this case is ingeniously effected by inserting a piece of cork in the lower swage-holder, which can be compressed by a screw to any degree of hardness. By another screw, also, the lower swage can be lowered bodily, whenever it is required to vary the size of work to be executed. One of the tools forms a pair of shears to finish the work to a proper length, and by moving a handle which acts upon an eccentric, the lower tool can be raised to meet the upper one. This arrangement is necessary, as, from the rapid motion of the tool, which makes 600 to 700 blows per minute, it would be impossible to introduce the work without bruising it. A series of rests are placed opposite to each pair of tools, which can be adjusted both in height and horizontal distance; the table carrying the rests can also be moved along the frame to facilitate the adjustment. In using the machine, the swages are adjusted so that, by placing the rod of iron successively between them, it is drawn down to the size required, whilst the length of each part is accurately determined by placing the end of the rod in the rest. The machine cannot, therefore, turn out the work too small, whilst, at the same time, it is so near the finished size, that very little has to be taken off in the lathe. As an example of its economy over hand labor, it is stated that a man with the machine will make 17 dozen spindles per day, 15 inches long, and tapering from ⅝ to ½ inch, at a rate, piece-work, of 5d. per dozen, whilst by hand he could only turn out six dozen, for which he would be paid 10d. per dozen. In some kinds of work the economy is still greater. All kinds of files may, it is stated, be forged by this machine at one third the cost of hand labor.—*London Artisan.*

ON THE STRENGTH OF IRON EMPLOYED IN THE CONSTRUCTION OF IRON VESSELS.

Mr. W. Fairbairn, at the British Association, presented the results of some experiments made by him, with a view of obtaining some knowledge of the strength of the iron generally used for the construction of boilers, pipes, &c. In order to acquire satisfactory data, a variety of plates, manufactured from the best quality of iron, of different localities, were submitted to direct experiment; first, by tearing them asunder in the direction of the fibre; second, across it. The mean tensile strength per square inch, in tons, was found to be 22.16, in the direction of the fibre; 22.29 across the fibre. From this it will be observed, that there is no difference in the strength of iron plates, whether torn in the direction of the fibre or against it, and this uniformity of strength probably arises from the superior manner in which that article is now manufactured. The experiments would, however, be imperfect as regards construction, if they had not been extended to the process of riveting; and on this point our information has been of the most meagre description. Until of late years, many of our numerous constructions have been conducted under the impression that the riveted point was not only strong, but absolutely stronger than the plate itself; whereas, more than one third of the strength is lost by that process. To prove the fallacy of these views, it was ascertained by experiment, that the strength of iron plates, as compared with their riveted joints, was not only weakened to the extent of the quantity of metal punched out to receive the rivets, but that in the following ratios, viz., as 1000 to 700 in the double riveted joint, and 1000 to 560 in the single riveted joint. From the above facts, practical formula have been deduced to show that the maximum resistance of single riveted plates does not exceed 27,000 lbs. to the square inch; and taking into account the crossing of the joints, and other circumstances peculiar to sound construction, 34,000 lbs., or 15 tons to the square inch, has been found to be the maximum strength of riveted plates, such as those used for boilers and similar constructions. In conclusion, attention was directed to several important improvements in connection with the construction of steam-boilers, by the introduction of gussets to strengthen the flat ends and retain them in shape. After noticing that all boilers should be of the cylindrical form, Mr. Fairbairn observed, that where flat ends are used, they should be composed of plates one half thicker than those which form the circumference. The flues, if two in number, to be made of the same thickness as the exterior shell, and the flat ends to be carefully stayed with gussets of triangular plates and angle-iron, connecting them with the circumference and the ends. The use of gussets is earnestly recommended, as being infinitely superior to, and more certain in their action than stay-rods. They should be placed in lines diverging from the centre of the boiler, and made as long as the position of the flues and other circumstances will admit. They are of great value in retaining the ends in shape, and may safely be relied on as imparting an equality of strength to every part of the structure.

COMPARATIVE STRENGTH OF PLAIN AND CORRUGATED METAL.

Some experiments have been recently made in Philadelphia, to test the comparative strength of plain and corrugated metal. Two pieces of copper, of equal surface and thickness, were formed into arches of about

15 inches in length; the one had a flat surface, and the other two corrugated arches. The arch with the flat surface gave way under a weight of a few pounds, while the corrugated arch withstood the weight of two men, who violently surged upon it, without making the least impression. In another experiment, made upon a larger scale, and under equal conditions, the plain arch gave way with 3,126 lbs. of pig iron upon its crown, while the corrugated arch bore the weight of 16,094 lbs. of the same metal for 48 hours, without the least perceptible deflection. This was afterwards increased to 27,000 lbs., which also remained for 48 hours, without the least deflection perceptible to the eye.

IRON-WORKS AMONG THE HOTTENTOTS IN 1849.

The Bakatlas work a great deal in iron. The ore is smelted in crucibles, a great deal of the metal being wasted, and only the best and purest preserved. They use a sort of double bellows, consisting of two bags of skin, by which the air is forced through the long tapering tubes of the two horns of the oryx. The person using the bellows squats between the two bags. Their hammer and anvil consist of two stones. They, nevertheless, contrive to turn very neat workmanship out of their hands, such as spears, battle-axes, assagais, knives, sewing-needles, &c. — *Cumming's South Africa.*

WROUGHT-IRON RAILROAD CARS.

The Railroad Journal states that a company has been recently formed for the purpose of manufacturing wrought-iron railroad cars. The sides, roof and bottom of the car are made of wrought boiler and Russia Iron — thus presenting what may truly be termed a *Safety Car.* No broken axle, bar, tie or rail can pierce the floor, and, in case of a collision, the frame may become *dented*, but cannot break up into dangerous splinters. These cars are not only rendered more durable than the ordinary wooden car now in use, but they are a lighter article, lower in price, and are perfectly fire and weather proof. They may be rendered highly ornamental also.

METALLIC CASKS.

Mr. R. Clare, of Liverpool, has, within the year, patented a plan for the manufacture of metallic casks. The invention consists in making casks from staves made of sheet metal, the object being to render them conveniently portable when not required for use. The staves are formed with the requisite bulge and taper to produce a cask of the desired form, and are provided with flanges at the edges for securing them to each other, which may be done by bolts and nuts, or any other convenient method. The hoops may be made of wood or of iron, being provided in the latter case with a screw to tighten them. The heads of the casks may be formed of wood or metal, and retained in their places between knees of angle iron. When the casks are employed for containing fluids, it is recommended to introduce a slip of India rubber between the abutting flanges of the staves.

THE STEEL MANUFACTURES OF SHEFFIELD, ENGLAND.

The London Patent Journal furnishes the following statistics relative to the steel manufacture of Sheffield: —

Judging from the state of trade, the production of steel in Sheffield, in 1850, could not have been less than 23,000, probably 25,000 tons, though the average produce of the last five years would probably not exceed 17,500 to 19,000 tons. We have no means of ascertaining the quantity of steel used in the home manufactures, but, judging from the annexed statement of the exports of steel, we feel convinced that we are not far short of the mark in the above calculation. The following table shows the progress of the steel trade, at quinquennial periods, during the last thirty years; the second column showing the quantity exported, and the third column the export to the United States, which is our principal market.

Years.	Tons.	Tons.
1820,	326	85
1825,	533	130
1830,	832	397
1835,	2,810	1,886
1840,	2,583	1,202
1844,	5,121	2,376
1849,	8,085	5,216

The quantity exported in 1850 was 10,587 tons, of the declared value of £393,659.

COMPARATIVE ELASTICITY OF WROUGHT AND CAST IRON.

The mean ultimate resistance of wrought-iron to a force of compression, as useful in practice, is 12 tons per square inch, while the crushing weight of cast-iron is 49 tons per square inch; but for a considerable range under equal weights, the cast-iron is twice as elastic or compresses twice as much as the wrought-iron. A remarkable illustration of the effect of intense strain on cast-iron was witnessed by the author at the works of Messrs. Easton & Amos. The subject of the experiment was a cast-iron cylinder, 10⅝ inches thick, and 14½ inches high, the external diameter being 18 inches. It was requisite for a specific purpose to reduce the internal diameter to 3½ inches, and this was effected by the insertion of a smaller cast-iron cylinder into the centre of the large one; and to insure some initial strain, the large cylinder was expanded by heating it, and the internal cylinder, being first turned too large, was thus powerfully compressed. The inner cylinder was partly filled with pewter, and, a steel piston being fitted to the bore, a pressure of 972 tons was put on the steel piston. The steel was *upset* by the pressure, and the internal diameter of the small cylinder was increased by full three sixteenths of an inch; that is, the diameter became $3\frac{11}{16}$ths of an inch. A new piston was accordingly adapted to these dimensions; and in this state the cylinder continues to be used and to resist the pressure. The external layer of the inner cylinder was thus permanently extended $8\frac{1}{50}$ths of its length. In fact, it can only be regarded as loose packing, giving no additional strength to the cylinder. Under these high pressures, when confined mechanically, cast-iron, as well as other metals, appears, like liquids, to exert an equal pressure in every direction in which its motion is opposed. — *Clark's Britannia and Conway Tubular Bridges.*

A NEW METHOD OF OBTAINING ELABORATE METALLIC CASTINGS.

A NEW method of obtaining elaborate and delicate castings has been devised by Mr. Dircks, of London. The most intricate and curious castings we are acquainted with are those obtained in moulds, from nature's own works, by imbedding a leaf, plant, &c., in a semi-fluid medium, which, when hardened, can be dried and raised to a temperature sufficient to burn the enclosed object to ashes. But, if it were desired to produce, by this method, a casting, as a wreath, bouquet, group of animals, &c., the artist would find himself unable, or else be obliged to make as many separate moulds as there were involved parts in the object to be cast. To obviate this difficulty, Mr. Dircks employs a layer of wax on a sheet of glass; the wax is engraved in the manner desired, and a plaster cast made on the top of the engraved wax. On slightly warming the glass, the plaster and wax leave its surface together, presenting a perfectly uniform appearance. The plaster is now to be heated gradually before a fire, when the wax sinks into it like snow into the earth before the sun, leaving the now engraved plaster, quite sharp, pure, and unsullied, having no waxed or oily appearance, even where the wax was a sixteenth of an inch in thickness. In this way any figure may be modelled in sheet wax, and afterwards cast in plaster. A metallic casting is then made in the usual manner from the plaster. In order to economize wax, a mixture of stearine, Burgundy pitch, and resin, may be substituted. In this way metallic castings may be obtained, which in delicacy exceed any before produced. An electrotype may, if desired, be taken from the plaster, instead of a casting. — *London Athenæum.*

INCRUSTATION IN BOILERS.

DR. BABBINGTON, of London, has taken out a patent for preventing incrustation by voltaic agency. For iron boilers he recommends a plate of zinc, 16 oz. the square foot, to be attached to one of its edges by solder to the interior of the boiler; and both sides of the plates being left exposed to the action of the iron and water, voltaic agency thus excited is said to have the desired effect. For large boilers, two, three, or more plates may be used, as necessary.

IMPROVED METHOD OF DRIVING A TILT-HAMMER.

A NEW invention for the driving of tilt-hammers has recently been introduced into the United States Armory at Springfield, which will be of great importance to every large forging establishment in the country. The old method of driving a tilt-hammer is by a water-wheel to each hammer, or to every two hammers. The necessity of compelling this arises from the fact that if the hammer were driven by a belt, from a regular moving power, the speed of the hammer could not be increased or decreased suddenly at will. The new invention consists of a loose driving belt — so loose that when it is not tightened by bearing against it the driving drum has no action upon it. A pulley is attached to a compound lever half way between the drum and the pulley where the power is applied to the hammer, and, by acting upon the lever, the pulley presses upon the belt, until it is so far tightened as to drive the hammer at the utmost speed of the drum. When a smaller speed is required, the lever is partially released, allowing the belt to slip; and in this manner, by increasing or diminishing the tension of the belt, any required speed is attained. The result of this simple and beautiful invention is that a thousand tilt-hammers, if necessary, may be driven by one water-wheel, or by a steam-engine. — *Springfield Republican.*

IMPROVED SPIKE MACHINE.

Mr. Mark Ison, of Georgia, has patented an improved method for making spikes and nails by machinery. The invention is different from the roller spike machines and the vertical reciprocating cutting nail machines. There is a horizontal table, nearly the form of the segment of a circle, having a hollow space within it, in which works a revolving cam on a shaft concentric to the table. The iron plate to be made into spikes is fed in along the upper surface of the table, and is cut off in strips, of suitable size, across the edge of an opening in the top of the table, by a vibrating shear-arm working above, and these are pointed afterwards between the said shear-arm and the table. The cam spoken of has an intermittent motion, and is made to carry the spike within the hollow space of the table, and allow it to stop under a holding die which receives it, when a heading tool comes down and completes the operation.

MACHINERY FOR COOPERAGE.

The London Times furnishes the following description of a new method of constructing casks and barrels, recently put in operation in that city. The staves of the cask are first cut with straight sides, the circular saw being placed at a right angle with the oak plank. The stave is then placed horizontally and bent into a curve by a powerful machine, and brought into contact with a circular saw on each side of it, placed at an angle. This process gives the proper shape to the stave, the sides being gradually tapered at the ends, and being made to bulge in the middle. The jointing and backing machine, the new invention, is also used for this purpose, and is more rapid in its execution than the angular saws; it in fact works with the most marvellous rapidity and precision. The staves and one end of the cask are then placed in a machine formed of iron rods, called a trussing machine; each rod acts upon a separate stave, and the whole of the staves being equally compressed into a circle, the hoops are placed around them and the cask is complete. The neatness and finish of the work is equal to what a good cabinet-maker can produce, every part being true and accurate. The calculation is that fifteen workmen, with the use of this machinery, can make 150 casks a day; whereas the same number of persons, using only manual labor, could scarcely produce a seventh part of that number. The importance of the invention, and the application of steam-power to it, may be imagined from the fact that the great brewing firms of the metropolis alone expend many thousand pounds annually in cooperage, and the expenditure of the navy is still greater, and that the demand of the vintages of the Continent is so great that a great deal of wine is lost from the difficulty of furnishing vessels to hold it.

NEW ROOFING.

A PATENT has been recently granted, in England, to Mr. Cowper, for improvements in coverings for buildings, by means of tiles, or plates of sheet-iron rendered applicable for that purpose by coating it with an enamel or composition capable of enduring and protecting the metal from the weather. Tiles, according to this manufacture, may be of any suitable form, with a view to render them more or less ornamental, combined with utility. The body of the tile, which is of thin sheet-iron, is cut or stamped of the proper shape. It also has a raised head formed round the edge, to prevent the water running off the tile, with the exception of the lower end, where it drips on to the next. Two holes are also punched for fixing the tiles to the wood-work. The upper or narrow end of the tile is bent at right angles, which is introduced in an opening between supporting laths or strips of wood. The hook, or right-angled portion, sustains the tile, while two nails, introduced at the holes, steady and keep it in its place. In lieu of the nails before referred to, to fix the tiles, the patentee sometimes rivets a hook so as to project on the under side of the tile; the stem of the hook is riveted through a hole in the metal plate before it is enamelled, which, when so coated, is impervious to water, and obviates the necessity of an India rubber washer under the head of the nail, which is required when fastened by nails through the holes. The coating of these tiles is applied in two separate compounds, the one as the body, and the other as a glaze for the surface of the composition. The coating for the body consists of sand or silica. The glaze, or second coating, is applied in the shape of a fine powder, which is dusted on the wet coating until the entire surface is covered. The powder, adhering to the moist coating, causes it to set in some measure, when the tile is deposited in a drying-room, previous to baking or firing. The tiles may be rendered ornamental by the application of coloring matters, according to any design or pattern, which are burnt in, and thereby rendered indelible, as well understood in porcelain manufactures. — *London Mining Journal.*

ON THE APPLICATION OF CHILLED CAST-IRON TO THE PIVOTS OF ASTRONOMICAL INSTRUMENTS.

THE following paper was read before the British Association, by Mr. May:—

"It has long been known that if a mould for casting iron in be made of iron, or partly of iron and partly of sand, that portion of the casting which has run against the iron becomes what is technically termed 'chilled,' and is indicated by a white crystalline structure to a depth depending upon various conditions of temperature of the mould and the metal run into it, as well as of the chemical composition of the iron. The practical utility of chill-casting depends on the fact that the part thus rendered crystalline is of extreme hardness, nearly equal to that of hardened steel, whilst the remainder of the casting may be as soft as iron cast in the ordinary sand mould. The rationale of the effect thus produced is not well understood. Cast-iron is a compound of iron with variable proportions of carbon, and these proportions have not, as I believe, been yet reduced to anything like atomic order; some statements give as much as 15 per cent. of carbon in very soft pig-iron, and such iron exhibits very little or no tendency to chilling. Practical experience is at present the only guide to the production of the desired effect; in some cases a very thin hard stratum is desired, in others a considerable depth; and this stratum may be varied from an almost imperceptible white line to half or three quarters of an inch in depth; this latter being required in the larger rolls for making the finest thin sheet-iron. Chemically speaking, cast-iron and steel are of the same composition, viz., iron with a proportion of carbon; the proportion of the latter in cast-iron being infinitely greater than in steel. Here I would point out a remarkable difference between chilled cast-iron and steel. If the latter is heated red-hot, and plunged into cold water, it becomes extremely hard; if, in this state, it be again heated, it resumes its original softness; but if chilled iron be so treated, it still retains its hardness. Whether this is caused by mere mechanical arrangement or by the chemical combination of the atoms, whether there be a metallic base of carbon in one case and not in the other, or by whatever these differences are caused, is far too little understood. The whole subject is one deserving the close attention of those whose pursuits enable them to study chemical analysis. Indeed, when we reflect on the fact, that, without the peculiar properties of iron and carbon, civilization could not have been carried on, it does appear strange that the master minds of the age have not acquired more knowledge of the relative action and combination of these two substances. It would be foreign to our present object to enter upon the mode of manufacturing steel; but I may state the fact that it is extremely difficult to procure any masses that are of uniform density, whilst chill cast-iron is easily produced with large homogeneous surfaces: and this brings me to the main subject proposed for your attention, viz., the application of it to pivots of astronomical instruments. About four years since, the Astronomer Royal applied to my partners and self respecting the construction of the mechanical parts of a new meridional instrument, the size of which so greatly exceeded anything of the same kind, that it became a serious question of what material the pivots should be made; it was requisite that it should be both hard to resist wear as much as possible, and homogeneous to insure that whatever wear took place should be uniform. The extensive use we make of chill cast-iron suggested that if the pivots were so cast with the body of the axis in sand moulds, and all run together, an instrument might be produced combining all the requisite qualifications. This has been successfully accomplished, and the great transit-circle or meridian instrument is now at work in the Royal Observatory, to the satisfaction of the Astronomer Royal, on whose designs the whole has been constructed."

A full-sized model of the telescope was in the room, by which it was shown that the pivots are six inches in diameter, and the axis about six feet in length. The object-glass is eight inches aperture, and about 11 feet focal length; and, after a rigid examination of the form of the pivots, the Astronomer Royal has concluded that no correction for the shape of the pivots is required.

JENNING'S PATENT RIFLE.

This rifle is by far the most terrible implement of modern warfare yet invented. It is designed, principally, to be an almost endless repeater, and also to avoid the difficulty of capping or priming at each load. In appearance the rifle is of the ordinary size, without encumbrance of any kind. Its weight is no greater than the ordinary weight of a common gun, and it only differs from the latter externally in having an iron breech with a wooden stock, which breech is handsomely finished and engraved. By a simple contrivance within this stock, the breech-pin is withdrawn as the gun is cocked. A cartridge (of which we shall speak) is placed in this opening, and, on pulling the trigger, the pin closes the barrel tight, a strong block of steel falls behind it, and the gun primes itself and is discharged at one motion. There is nothing complicated in the machinery, but, on the contrary, it is so simple that it can hardly by any accident get out of order, and, in case of such accident, any worker in iron can repair the break. By this contrivance a rifle is made capable of being loaded at the breech as often as it is fired off, and as rapidly as a man's hand can move to throw in the cartridges. This is at the rate of twelve shots per minute for a person not acquainted with the gun; a velocity sufficient to make one man fully equal to a dozen armed with ordinary rifles.

Another variety of the same gun is now completed, and nearly perfected by the patentees, which differs not at all from this in external appearance, except that, in place of a ramrod, is a tube of the same size, capable of containing thirty cartridges, which, by a very simple contrivance, are so arranged that they are placed in the barrel one by one, and fired successively without any interruption. The moment that the thirtieth ball is fired, this gun may be used as the first one, loaded at the breech, and be fired at the rate of fifteen in a minute. But the chief strength of this formidable weapon rests on the cartridge which is used. This cartridge, which is also patented, is simply a loaded ball. A bullet, elongated on one side to a hollow cylinder of about an inch in length, is filled with powder, and, at the end, covered with a thin piece of cork, through the centre of which is a small hole, to admit fire from the priming. As each ball goes out of the barrel, the cork cap remains in the barrel, and is carried out in front of the next ball, sweeping thoroughly all the dirt with it. The gun may thus be discharged from sixty to seventy times in good weather without needing a swab. The barrel may be detached at a single blow of a hammer or stone, and a swab run through it in a moment at any time, the operation of cleaning occupying no longer than the ordinary loading of a common gun. The priming of the rifle is in small pills, of which one hundred are placed in a box, from which the gun supplies itself without fail. These rifles are now extensively manufactured at Windsor, Vt.; and, from their long range, will, it is said, completely destroy the efficacy of light artillery.

MAYNARD'S SELF-PRIMING RIFLES.

In this rifle, the invention of Dr. Maynard, of Washington, D. C., no caps are used; but the priming consists of a patent preparation of percussion paper, made into a coiled ribbon, placed inside a small box adjoining the vent or nipple. This strip of priming paper passes over the top of the nipple, and, by means of a notch in the hammer, a small portion of the paper is cut off each time the hammer descends. When the hammer strikes the prepared paper, it being percussive, the powder is ignited, and the gun discharged. The question may now be asked, "How is the paper fed over the nipple for a new priming, after having been cut off by the hammer?" This is done by a small flat steel spring, secured on the periphery of the ring of the hammer joint. When the hammer is drawn back, the flat spring is moved forward, pushing the priming slip over the orifice of the nipple for the next discharge. When the hammer falls down on the nipple, the spring is drawn back for a new feed of the paper: this would draw back some of the paper, were it not for another small stationary spring, which holds the paper so as to allow it to be fed only up and along the metal incline to cover the nipple.

This invention has been examined by an army commission, and the right of use purchased for the United States.

IMPROVEMENT IN GUN BARRELS.

A new method of manufacturing twisted gun and pistol barrels has been introduced in England, which is thus described: — An iron or steel rod, or a mixture of both, of sufficient length and thickness to form a gun or pistol barrel, is wound into a compact coil, and then placed in an anvil having a semi-circular groove, where it is submitted to the action of the tilt-hammer. The coil is then submitted to a welding heat in an air furnace, then hammered and rolled, a stream of water being used in both cases to wash away the scale.

The tilt-hammer has a groove on its face, corresponding with the anvil, to act upon the coil, before the welding.

ANTIQUITY OF REPEATING FIRE-ARMS.

In the museum of the United Service Club, London, there is a pistol, supposed to be two hundred years old, which, with the exception of the lock, is constructed upon principles similar to the pistols known as Colt's Revolvers. The following is the description of this weapon, as given in the catalogue of the institution: — "1160. A Snaphaunce self-loading petronel, probably of the time of Charles I. The contrivance consists of a revolving cylinder, containing seven chambers, with touch-holes; the action of lifting the cock causes the cylinder to revolve, and a fresh chamber is brought into connection with the barrel. Six of the seven chambers are always exposed to view, and the charges are put in without the aid of a ramrod."

COLOSSAL INDIAN GUN.

A very curious and colossal piece of Indian ordnance has been lately discovered in the bed of the Bhagretti river, in Bengal. Unlike any cannon of the present day, this piece consists of two separate portions — the huge cylinder that forms the barrel, and the smaller piece, or breeching, which alone was loaded, and, when required for use, was lashed on with ropes or chains to the hinder part of the large cylinder, and fired. The hollow cylinder (for it is open at both ends) is of wrought-iron, and of very coarse workmanship, being constructed of iron hoops, embracing longitudinal bars, but, by rust and age, all appearing to be one and the same uneven mass. The cannon has been vastly strengthened by eleven powerful and massive rings, that encircle the cylinder at the distance of ten inches apart. An attempt has been made to ornament the face of the vent and last muzzle ring; the former by a rude Vandyke edging to the vent, the latter by a row of round, bead-like excrescences. Between the muzzle and the last vent-ring are a quantity of bronze or copper longitudinal small bars let into the iron of the gun, probably for side sights, perhaps for ornament.

As no attempt ever appears to have been made to bore the gun, the cylinder is anything but smooth, the bars rising and falling in some places a full perpendicular half inch. How a cannon ball would behave passing over or out of such a bore, it is hoped experience never informed the maker, as nothing but the most disastrous consequences could possibly result from firing such a dangerous machine. Many large guns exist in India, that have, at different periods, been cast by kings and princes, but have never been fired; the present gun may be one of the many. The whole length of the hollow cylinder is 12 feet 2 inches; bore, 18½ inches; length of detached breeching, 4 feet 3 inches. No interest is attached to the gun, but it is believed by some to have been manufactured and intended to be used against the Mahrattas, who, in days gone by, after having traversed nearly the whole of India, were in the habit of making descents upon the city of Moorshedabad.

SCIENCE OF GUNNERY.

In the new edition of Sir Howard Douglass' work on Naval Gunnery, he attributes the success of the Americans at sea, during the last war, not to better firing, but to superior guns. He says: — "When we came into collision with the Americans, our equals in seamanship and courage, and, at the period alluded to, our superiors, perhaps, in gunnery, and certainly in ships, we speedily discovered that headlong, uncalculating courage was not alone sufficient to insure success. In the action between the United States and Macedonian, Decatur, conscious of the superiority of his long 24 pounders over the 12 pounders of the Macedonian, pelted the enemy at a long-shot distance for an hour; and the British court-martial on Capt. Carden found that the Macedonian was very materially damaged before close action commenced."

Sir Howard Douglass regards with distrust the introduction into British ships, to the extent to which, in some instances, it has been carried, of Paixhan and other French shell guns, as yet untried in actual combat in broadside batteries. This description of guns he considers not well adapted for action, either at great distances or at close quarters, and is of opinion that ships chiefly so armed will stand little chance against a distant cannonade of solid shot guns, owing to the superiority of the latter in respect to power of range, accuracy in distant firing, and penetrating force. — *Scientific American.*

MACHINE FOR THE MANUFACTURE OF PERCUSSION CAPS.

A most ingenious machine for the manufacture of percussion caps has recently been invented by Mr. George Wright, of Washington. It occupies a comparatively small space of about three by four feet, and is supplied with copper in sheets, fourteen by forty-eight inches; the fulminating powder being deposited in a small hopper for distribution in the caps as they are formed. The machine, being supplied with the material, it is put in operation by steam power, and the sheet of copper is fed from right to left and left to right, alternately, rolling in at the proper interval. The star or blank, for the cap, being cut, it is quickly transferred to the forming die, where it is pressed into the required form. The cap is then lifted from the die by means of a punch beneath, and lodged in the periphery of the charging plate; it is then carried around by the plate, passing under the hopper containing the powder, where, receiving its proper charge, (half a grain,) it passes on under the charging punch, where the powder is firmly pressed in the bottom of the cap. The cap is then thrown from the plate, falling into a drawer beneath, prepared to receive them. It then continues its operation of cutting, forming, charging and pressing, in rapid succession, until the whole sheet, as if by magic, is transformed into caps in a finished state, ready for use. One man or boy, only, is required to superintend its operation, producing 5,000 caps an hour, or 50,000 per day. — *Scientific American.*

MANUFACTURE OF MUSKETS AT THE NATIONAL ARMORY, SPRINGFIELD, MS.

We derive from the Springfield Republican the following facts relative to the manufacture of muskets in the Armory at that place, for the year ending June, 1851: —

The total expenditures of the Armory for the fiscal year, ending June 30th, 1851, were $271,308.33. Of this sum, $179,216.29 were paid out for labor alone. To show the extent and variety of the stock and materials used, we give the items consumed last year : — Refined iron, 446,628 pounds ; cast-iron, 41,298 ditto ; inferior iron, 3,977 ditto ; wire iron, 1,079 ditto ; cast-steel, 63,146 ditto ; shear-steel, 651 ditto ; nails, 2,326 ditto ; wood screws, 163 gross ; sand paper, 326 quires ; sulphuric acid, 2,823 pounds ; boards and plank, 145,013 feet ; timber, 32,204 ditto ; bricks, 20,000 ; leather, 1788 pounds ; sperm and whale oil, 2380 gallons ; assorted files, 8613 ; grindstones, 52,634 pounds ; charcoal, 46,598 bushels ; anthracite coal, 2,438,924 pounds ; pit coal, 53,700 ditto ; fire-stone, 4,480 ditto ; furnace clay, 134 bushels ; and wood, 200 (2 feet) cords.

The result of the operations of last year is as follows :

Percussion muskets, complete,	21,000
Percussion musketoons, complete,	2,000
Muskets altered from flint to percussion,	57,272
Extra cones for issue with muskets,	119,757
Compound screw-drivers, for issue with ditto,	90,908
Percussion hammers, (for other posts,)	41,682
Arm-chests and packing-cases,	295

Col. Ripley, the commanding officer at the Armory, received an order to alter the flint lock muskets to percussion, if practicable, at a cost not exceeding $1 per musket. This work was commenced in July, 1849, and the whole number, 113,406, were completed by February, 1851, at a cost of 50½ cents each. At the close of the year there were on hand a grand total of two hundred and fifteen thousand nine hundred and fifty muskets. The manufacture of a single musket is effected by four hundred different operations, and the majority of the men employed engage in only one of the operations. A larger number of muskets were manufactured last year, than any year previous ; and a calculation, based upon the number turned out, shows that, throughout the year of 318 working days, of ten hours each, a musket was completed every eight minutes and fifty-six seconds. The various parts of the musket pass, during their manufacture, through the hands of inspectors, who, with their gauges, determine the exact dimensions of every piece, and reject every one that is not exactly what is required. Thus, a hundred thousand muskets might be taken to pieces, and thrown promiscuously into a pile, and the whole taken up and put together again without the mis-fit of a single component to its appropriate place. Thus, too, when the arms are in use, there is never need of sending them to the Armory for repairs.

The smallest piece value of a component of a musket is one mill ; the highest $3.50.

The following is the weight of a musket, in detail and total, expressed in pounds and hundredths of a pound : —

Weight of barrel,	4.25
Weight of locks and side-screws,	0.85
Weight of bayonet,	0.68
Weight of musket without bayonet,	9.14
Weight of musket, complete,	9.82

This weight is less than that of the old flint musket.

The exact cost of a single musket, of the number manufactured last year, cannot be stated, the inventory being uncompleted; but the cost in the year 1850 was $9.03½. The cost for the last year will be less. In ten years, the cost of manufacture, per musket, has been reduced nearly one half, it being in 1841, $17.44.

The process of manufacturing the musket-barrel is one of the most important and difficult in the whole range of the Armory operations, and one which is guarded with multiplied tests, at every step of its progress, from the bar to the finished tube. The bar, which is of the best Salisbury and Ancram iron, is first cut into lengths, weighing 10¾ pounds each. These are rolled into shapes, and then the edges rolled up, lapped upon each other, and welded. They are then inspected, and the imperfect ones rejected. As they pass along through turning, boring, and grinding, they are subjected to inspection at each step, and the workmen are held responsible for the full value of any barrel they may spoil, at the stage in which it is spoiled, and the amount is deducted from his earnings; and we say here, that the same course is adopted in regard to every component of the musket. The barrel having been reduced to the dimensions required for proof, (by powder,) which dimensions are three hundredths of an inch greater in the exterior diameter of the barrel, and three hundredths of an inch less in the diameter of the bore, than the finished barrel, leaving an ounce and a half to be worked from each barrel in finishing, it is then subjected to the powder test. Fifty-five barrels are usually loaded and discharged at the same time, in a building made for the purpose. Each barrel is discharged twice, the first consisting of one eighth of a pound of powder, one ball and two wads, each wad occupying three-fourths of an inch of the bore, and each ball one fifteenth of a pound. The second charge consists of one twenty-second of a pound of powder, one ball and two wads, and each charge is well rammed. The barrels are laid on a cast-iron, grooved bed, and the balls are discharged into a bank of clay, which is occasionally washed for the lead it contains. The inspection of the barrels is so rigid before they come to the proof, that very few of them burst. After proof they are again inspected as before, to see that there are no flaws, or cracks, or defects of any kind that will not disappear in the finishing. The number of condemned barrels, in the last year's operations, was, for defective workmanship, 451, and for defective material, 5,323.

In the polishing shop connected with the Armory, an ingenious contrivance has been recently introduced for sparing the lungs and lives of those who would otherwise live (or die) in a constant atmosphere of emery dust. A long box runs the length of the room, by the side of which are stationed the polishing wheels. Tubes with mouths opening upon each wheel proceed from this long box. In the room below a blower is arranged in such connection with the long box as to exhaust the air within it, and, of course, there is a strong current of air passing from each wheel into its appropriate tube. The consequence is, that all the dust of the room is drawn into the box, and delivered out of doors in a constant cloud.

NEW WATER METRE.

The necessity for a perfect self-acting metre for measuring water, in cities supplied with water-works, has long been felt and acknowledged. This want has at last been met by an invention of Mr. Samuel Huse, of Boston, who has constructed a machine which is not only simple, but wonderfully efficient. It consists of a hollow cylinder, 10 inches wide and 16 inches in diameter, inside of which is a flange cylinder, about six inches in diameter. This inner cylinder has flanges, on which are four valves, extending from one end to the other of the cylinder, and attached to it by hinges. These valves, when folded or shut into the cylinder, form a little more than half its surface. Upon one side of the metre the space between the inside of the hollow and the surface of the flange cylinder is so filled as to occupy something more than the width of one of the valves. This filling is made to fit so exactly as to prevent the water from passing. Upon one side of this filling the water enters the metre, and upon the other side the water is discharged. The metre is so placed that the valves will, by the force of gravity, open as they reverse from under the solid filling, and shut upon the opposite side previous to coming in contact with it. When thus arranged, the water is let into the cylinder, and comes in contact with the open valves; the inner cylinder revolves until the water escapes upon the opposite side; and, of course, for every revolution of the interior cylinder, a given quantity of water must pass through the metre. This is carefully marked by means of a clock which is attached to the cylinder, and which will indicate the precise quantity of water which has passed through the machine in any given time.

Upon the application of this machine as a water-measurer in Boston, it was found that, owing to the great head which the Cochituate has in most parts of the city, it was well adapted as a motive power, and that to a most unexpected and extraordinary extent. This new property has been turned to advantage by the proprietors of the Boston Daily Traveller, who now use the metre exclusively for driving one of Hoe's large cylinder presses. The manner in which this is effected is as follows: through a two-inch lead pipe, a stream of Cochituate is introduced into a metre, which only occupies 24 square inches. The fall of water between the Boston reservoir and this metre is about a hundred feet. This two-inch stream will discharge 80 gallons of water each minute, and passing through the metre will give a motive power equal to what is called three horse-power.

The revolving flange cylinder is connected, externally, with cog-wheels, a shaft, and pulley; and from the pulley a belt extends to the driving-wheel of the printing machine. The flow of water is regulated by means of a screw-gate near the metre. This machine, where it is capable of application, has many advantages over the steam engine. It is less hazardous, requires no attention, and is always in readiness. It can be used in buildings and neighborhoods where a steam engine would not be allowed. The water passes into the sewer, and will thus perform a sanitary mission in scouring out the drains. As a measurer of water it is also of great value.

ERICSSON'S WATER METRE.

The following is the specification of a patent granted to Mr. Ericsson for an improved water metre:—"The principle which distinguishes my invention from all other things before known, in an instrument having two cylinders provided with pistons, connected with cranks at right angles, or such other angles as will enable the pistons alternately to act on the crank shaft to rotate it, consists in connecting the two pistons with their cranks, so that while the shaft is impelled by one piston the other shall remain at rest at the end of each stroke, until the shifting of the valves is completed, for the purpose of insuring the accurate measurement of the fluid passing through and acting as the motive force. My invention in the above apparatus also consists in determining the range of motion of the pistons, by means of stops at each end connected with the cylinders and pistons, instead of doing this by the cranks; by reason of which I am enabled to measure the fluid passing through with the utmost accuracy,—a result which could not be obtained if the motions of the pistons were determined by the crank, for the least wear of either the crank-pin or the journals of the shaft, or the boxes in which these work, or the slightest change in the position of the cylinders relatively to the parts with which the pistons are connected, occasioned by strain or wear, would of necessity vary the amount of water discharged at each stroke. My invention in the before-mentioned apparatus also consists in attaching to the instrument an outer casing, through which the fluid to be measured passes, and from which it enters the cylinders, which casing incloses the valve and valve gear, as also the other moving parts, and the upper ends of the cylinders, that the various moving parts may work in the fluid, to be lubricated thereby, whilst at the same time the various joints are protected by being pressed with a nearly equal pressure on all sides by the fluid; and also avoiding the use of packing-boxes for the sliding parts of the mechanism. What I claim as my invention, is, connecting the two pistons with the two cranks of a crank-shaft, in manner substantially as described, so that at the end of each stroke of either of the pistons it shall remain at rest, while the crank-shaft is being impelled by the other piston, so that the valves shall be shifted whilst the piston is at rest. I also claim, in an instrument for the purpose herein specified, determining the range of motion of the pistons by means of stops connected with the cylinders and the pistons, in combination with the connection of the pistons with the crank, or cranks, by means of a joint having sufficient play to permit the pistons alternately to remain at rest while the crank-shaft continues to rotate. I also claim inclosing all the moving parts of an instrument in the surrounding casing through which the water, or other fluid, passes to be measured, constructed, and operating in the manner and for the purpose substantially as described."

IMPROVEMENT IN APPARATUS FOR BORING FOR WATER.

Mr. John Thomson, of Philadelphia, has invented an improvement in machines for boring for water, for which he has taken measures to secure a patent. The improvements consist in employing a series of springs, which are placed around and work loosely on the shank or rod to which the boring tool is secured, and which, by their elastic action, press against the sides of the hole, and keep the rod of the borer in a true vertical position ; these springs descend as the boring chisel descends, and thus the hole of the well is bored with vertical precision. This is an important consideration when pipes have to be inserted afterwards in the hole ; but, above all, it allows the boring action to be carried on without loss of labor by the angular action of the chisel. The boring-chisel or auger receives a systematic rotating motion by means of a forked cap placed on the shank of the tool and worked loosely thereon. Small diagonal chains are attached to the springs and the cap, a pin attached to the shank catches into one of the forks of the cap as the shank ascends, and forces the cap upwards ; the cap (and consequently the shank of the boring-tool) is turned by the chains assuming their own right line of tension. — *Scientific American.*

HURD'S CENTRIFUGAL SUGAR MACHINE.

THIS invention, known as Hurd's Centrifugal Sugar Depurating Machine, is represented to have the same relation in value to the sugar-maker as the gin has to the cotton-grower, effecting a saving of time and sugar, as well as improving the quality of the sugar. The apparatus is propelled by steam, and its method of operating is as follows : — The dark mixture of sugar and syrup, just as it is taken from the sugar-house coolers, is placed in a cylindrical tub, made of iron, the bottom of which is tight ; but the sides or circumference is pierced full of small holes, which are covered over by fine wire-gauze. The cylinder is so arranged that it can be made to revolve on a stationary axle with great rapidity, making from one thousand to fifteen hundred revolutions in a minute. The sugar, as soon as the machine begins to revolve, gradually leaves the bottom of the cylinder and attaches itself to the circumference. The motion continues ; and if the wire-gauze were not strong enough, the sugar would break it and escape. The crystals, however, are retained by the fine net-work of the wire, but the molasses or syrup is driven by centrifugal force through the wire, and is projected with great power and rapidity into an outside case, arranged to retain and collect it. In the course of a short time, varying from five to ten minutes, the molasses has been thrown off, and the sugar is drained and fit for shipping, being much drier than when usually put on board. The syrup is now ready to be boiled a second time, before the air or heat has had any influence upon it, and another crop of crystals obtained, which can be subjected to the action of the machine ; and the syrup coming from this second operation can be treated a third time, until its strength is exhausted. Each machine is capable of purging from 8 to 10,000 lbs. of sugar per day, and the sugar is ready for market the day after it is boiled. The actual yield is from 20 to 25 per cent. more sugar from the same quantity of cane-juice ; it improves the quality from $\frac{3}{4}$ to 1 cent per lb. over the present method, and leaves the sugar so thoroughly free from molasses that no loss is made by drainage in shipping.

APPLICATIONS OF CENTRIFUGAL ACTION TO MANUFACTURING PURPOSES.

It is well known that a centrifugal machine has been hitherto employed with much advantage for the drying of textile fabrics and for clarifying sugar; but these are not the only purposes to which it is adapted; for every day new applications of this apparatus suggest themselves, and important problems are solved by its means. We now learn that one of the most important operations of brewing may be wonderfully simplified by the use of a centrifugal apparatus. It has been hitherto considered extremely difficult to reduce the temperature of beer to the degree of coolness requisite; it has been necessary to make use of refrigerators for this purpose, and, notwithstanding all precautions, mistakes not unfrequently happen. It occurred to some English brewers that this difficult cooling process might be effected by means of a centrifugal machine. This idea has been put in practice with complete success. The beer was reduced to the desired temperature by merely passing it through the machine; and this was effected not only with great rapidity, but also with considerable economy. Some time back, M. Touche, of Paris, endeavored to produce ice by means of a hydrofugal apparatus. He did not succeed in reducing water to the freezing point, but he cooled it to a degree far below that required in brewing beer. It would be superfluous to explain these results, for every one is acquainted with the effects of a very rapid ventilation, and the centrifugal machines are made to rotate at the rate of 3000 revolutions per minute, and even quicker. We are further informed that in certain manufactories in Alsace a hydrofugal machine is used for making starch. When the flour is stirred about in water, the different substances range themselves according to their specific gravities, unless prevented by some peculiar circumstances. Now, this is precisely the result obtained by the centrifugal machine; starch, being the heaviest substance, separates itself from the others, and is first precipitated. The centrifugal machine may also be advantageously applied for classifying grain, seed or ores, according to their respective densities, whether liquid or solid, provided that they are not of a cohesive nature, or that whatever cohesiveness they possess may be easily removed. In fact, the centrifugal apparatus may be applied to so many different manufactures, that it may justly be looked upon as one of the most fortunate and fruitful inventions of modern times. — *Moniteur Industriel.*

GWYNNE'S CENTRIFUGAL PUMP.

In this pump, the discs of the piston are of concave form, the hollow parts being placed immediately opposite to each other. An impeller, radiating from a boss or hollow axis, is fixed between the two discs, and mounted on a shaft, which may be placed at any required angle; the narrowest part of the impeller is at the outer edge of the piston, increasing gradually in width, until its edge intersects the inner surface of the opening in the suction side of the piston; from which line to its extremity at the boss its edges are parallel to each other, and at right angles to the axis of the shaft. An annular opening is left all round the circumference of the discs, the area of which is equal to that of the opening for the admission of water to the piston through a circular aperture in one of its sides. The piston is enclosed in a case of circular form, in one side of which is a circular opening, through which passes the suction-pipe, its end tightly secured by a collar to a corresponding projection in the side of the piston. The discharge-pipe is placed vertically on one side of the receiver; and in an opening opposite the suction-pipe is fixed a hollow nut to equalize the lateral pressure on the piston. The main journal of the shaft is attached to the hollow balancing-nut, passing through a proper stuffing-box and gland, to render the whole properly water-tight. In cases of fire, a pump on Mr. Gwynne's plan, with a discharge-pipe of nine inches diameter, will throw 4000 gallons per minute; and with a piston of 48 inches diameter, (the pump making 400 revolutions per minute,) the water would be raised from mines to a height of 120 feet.

SYPHON FILTER.

THE *Syphon Filter* is, perhaps, the most convenient kind for general purposes, as it may be readily carried about and used by any ordinarily available pressure. The shape of the filter is that of an elongated bell. It is made of white metal; and, at the top of the well-shaped vase, there is inserted an inflexible metal tube, furnished with a stopcock near the end. The vase is filled with powdered quartz, of various degrees of fineness, and the mouth of it is closed with a perforated cover. When required to be used, the vase is inverted in the water to be filtered, and the tube is allowed to hang below it. When the air is withdrawn, the water rises through the powdered quartz, and fills the tube; and, by syphonic action, the water is drawn down by its superior gravity. The lower the tube the greater the pressure, for the weight of water flowing down operates on the filtering surface as directly as if the same column of fluid were placed above it. The amount of pressure is, however, limited to that of the pressure of the atmosphere; for were the tube lengthened beyond 30 feet, the column of water would separate and leave a vacuum. This filter renders the muddiest water beautifully clear when acting with the pressure of not more than two feet at the rate of four gallons an hour. — *Report on the Great Exhibition.*

PNEUMATIC PILE FOUNDATION.

THE Civil Engineer and Architect's Journal, for December, furnishes the following description of a system of foundation extensively used in Great Britain, but little known or appreciated in this country. The method in question is known under the name of Potts' Pneumatic Process, and consists in employing as piles, hollow iron cylinders, to the head of which a powerful air-pump can be connected. The pile is placed in the proper position, the air from the interior exhausted, and, a stream of water, sand, shingle and gravel, rushing up from below, the pile sinks gradually into the displacement made to any required depth. It is, therefore, a kind of sub-aquatic excavation, the lower end of the hollow pile being converted into a kind of scoop worked by the air-pump on the platform above. In this way, hollow iron piles, three feet in diameter, have been sunk to the depth of 78 feet, through a material that would not admit the penetration of a screw, or of a wooden pile, to a greater depth than 20 feet. After the piles have been sunk any required distance, they may be exhausted of their contents, and filled with concrete, which, before the decay of the exterior iron shell, will form an artificial stone pile of great strength and durability.

In the recent construction of a bridge across the Shannon, for the Midland Great Western Railway, cylinders ten feet in diameter were used successfully, in the place of hollow piles, by the method described. Hitherto the piles employed for Potts' process for sea-beacons and other structures, have been of very small diameter, so that the proceedings we have just described are of the greatest importance. A cylinder of ten feet diameter gives a large bearing, and four such cylinders will carry a large tablier or platform for a pier, and which can be put down without coffer-dams or other preparatory works, thereby greatly reducing the expense of submarine foundations. Here neither cofferdams, caissons, steam engine pump, nor diving-bells are wanted, only an air-pump of adequate power, which can be easily carried about and rigged anywhere. It will be obvious that unless sunk from the inside, (when there would be as much trouble for pumping as by the pneumatic process, and very much labor and expenditure of time,) any external application of power would, if it could be employed, exercise a very unfavorable effect upon the material of the cylinder. Indeed, a force of much less than 13 lbs. to the square inch would smash a hollow iron cylinder to pieces. Then, again, it is to be observed, that ten feet is by no means the limit of the diameter to which the cylinders can be carried, so that it is open to engineers to design works in situations and under economical conditions, where hitherto the resources of art were insufficient to meet the emergency.

NOVEL METHOD FOR SINKING PILES.

The following is an abstract of a paper recently read before the British Institution of Civil Engineers, by Mr. G. Hughes, C. E., on a novel method of sinking piles. It was proposed to construct the piers of a bridge over the Medway, on hollow cylindrical iron piles, seven feet in diameter, each composed of two, three, or more cylinders, nine feet in length, bolted together through stout flanges; the bottom length of each pile being also bevelled, to facilitate the cutting through the ground. The bed of the river was originally presumed to consist of soft clay, sand, and gravel, overlaying the chalk, and, accordingly, the application of Dr. Potts' pneumatic method for forcing the cylinder piles into the ground, which had been successfully carried out in similar positions, was contemplated; but, after a few trials, the ground was found to consist of a compact mass of rag-stone, so that the mere atmospheric action upon the piles, induced by a partial vacuum, would be ineffective in such a situation. It was, therefore, decided that the pneumatic process should be reversed, so as to give each pile the character of a diving-bell; for which purpose one of the cylinders, seven feet in diameter, and nine feet in length, had a wrought-iron bolt securely bolted to it, through which two cast-iron chambers, D shaped in plan, with a sectional area of six square feet, appropriately called air-locks, projected two feet six inches above the top of the cylinder. The top of each air-lock was provided with a circular opening, two feet in diameter, with a flap working on a horizontal hinge, and an iron door, with vertical hinges, below the cover; each air-lock was also furnished with two sets of cocks, the one for forming a communication between the cylinders and the chamber, the other between the chamber and the atmosphere. Compressed air was supplied to the cylinder pile by a double-barreled pump, driven by a six horse-power steam engine. At first the expelled water was made to pass into the river, from beneath the lower edge of the pile; but when the stratum became so compact as to oppose a high degree of resistance to the passage of the air, an outlet was formed through the side of the uppermost cylinder, by the introduction of a pipe, having the form of a syphon, the long leg of which reached to the bottom of a pile, and was subject to the pressure of the condensed air on the surface of the water within, whilst the short leg, leading into the river, had the effect of relieving the amount of compression, providing a vacuum was once obtained in the body of the syphon. Such an effect was readily produced by connecting the summit with the exhaust side of the air-pumps, by a pipe which could be opened or closed at pleasure. To insure the downward motion of the pile, and to give it a weight which should be at all times superior to the upward pressure, two stout trussed timber beams were laid on the top of the cylinder, in a direction suitable for bringing the adjacent piles into action as counterbalance weights, by four chains passing over cast-iron sheaves. Two light wrought-iron cranes were fixed inside the cylinder, the jibs of which swept over the space between the air-locks and windlasses, inside, for the purpose of hoisting the loaded buckets and lowering the empty ones.

The method followed in working the apparatus was found to be so simple in detail as to be perfectly intelligible to all the workmen employed. The pumps being set in motion, the flap of one of the air-locks and the door of the other were closed; a few strokes compressed the air within the pile sufficiently to seal the joints, and whilst the pumping was in progress, the men passed through the air-locks to their respective stations. When the water was shallow, the pile descended, by scarcely sensible degrees, as fast as the excavation by hand permitted; but when the water was deep, the excavation was carried down full 14 inches below the edge of the pile, which then descended at once through the whole space, as soon as the pressure was eased off.

SUSTAINING POWER OF PILES.

The following rule for calculating the weight that can be safely trusted upon a pile, driven for the foundation of a heavy structure, is communicated to the Journal of the Franklin Institute by Major Sanders, U. S. Engineer: —

A simple empirical rule, derived from an extensive series of experiments in pile-driving, made in establishing the foundation for Fort Delaware, will, doubtless, prove acceptable to such constructors and builders as may have to resort to the use of piles, without having an opportunity of making similar researches. I believe that full confidence may be placed in the correctness of this rule; but I am not at present prepared to offer a statement of the facts and theory upon which it is founded.

Suppose a pile to be driven until it meets such an uniform resistance as is indicated by slight and nearly equal penetrations, for several successive blows on the ram; and that this is done with a heavy ram, (its weight, at least, exceeding that of the pile,) made to fall from such a height that the force of its blow will not be spent in merely overcoming the inertia of the pile, but, at the same time, not from so great a height as to generate a force which would expend itself in crushing the fibres of the head of the pile. In such a case, it will be found that the pile will safely bear, without danger of further subsidence, "as many times the weight of the ram, as the distance which the pile is sunk the last blow, is contained in the distance which the ram falls in making that blow, divided by eight." For example, let us take a practical case in which the ram weighs one ton and falls six feet, and in which the pile is sunk half an inch by the last blow; then, as half an inch is contained 144 times in 72 inches, the height the ram falls, if we divide 144 by 8, the quotient obtained, 18, gives the number of tons which may be built with perfect safety, in the form of wall, upon such a pile.

DESTRUCTION OF THE MINOT ROCK LIGHT-HOUSE.

This celebrated pile light-house, erected upon Minot's rock, the outermost of the Cohasset rocks, distant 20 miles from Boston, was entirely destroyed, by a terrific storm, on the 17th of April, 1851. The gale which swept away the structure was one of the most violent and long-continued ever known upon the New England coast. The light on the Minot was last seen from Cohasset on Wednesday night, the 16th. At 1 o'clock, Thursday morning, the 17th, the light-house bell was heard on shore, one and a half miles distant; and this being the hour of high water, or, rather, the turn of the tide, when, from the opposition between the wind and the tide, — the former blowing on shore, and the latter receding from the shore, — it is supposed the sea was at its very highest mark; and it was at that hour, it is generally believed, that the light-house was destroyed: at daylight nothing of it was visible from the shore. The two assistant keepers were lost: the principal keeper had left the light-house before the commencement of the storm, and escaped the fate of his companions.

The following description of the plan of this light-house was given by the engineer who constructed it — Captain W. H. Swift. The rock upon which the light stood is bare at low water only; and the utmost extent of surface exposed at the very lowest tide is an area of about 30 feet in diameter, but, in general, 25 feet is all that is uncovered; and, even of that extent, the sea must be very smooth and the wind off the land. The nearest point to the shore is distant one and a quarter miles only; but, seaward, it is entirely open to the Atlantic, and, of course, exposed to all its violence in an easterly gale.

The structure was composed of nine piles or shafts, made of the best description of wrought-iron, from 60 to 63 feet in length, each pile inserted five feet deep in the solid part of the rock. All of them were eight inches in diameter at the foot, ten inches in diameter at a point five feet above the foot (at the surface of the rock); the middle pile was six inches in diameter at top, and the outer piles four and a half inches. These piles stood in the periphery of a circle of 25 feet, with one in the centre. They were united or connected at five different points, to wit; at the rock, where each pile was secured in its place by means of iron wedges, and a cement of iron filings. 2d. At a point 20 feet above the rock, by means of 16 wrought-iron horizontal braces, three and a half inches diameter, radiating from the middle pile to each outer pile, and extending, also, between each pair of outer piles. 3d. By a similar series of braces, at a point 40 feet above the rock. 4th. By a like series, at a point 47 feet above the rock, forming the support of the store-room, or cellar. 5th. By means of a cast-iron cap, or spider frame, 14 feet in diameter, and weighing five tons, to which were united and secured all the pile-heads. This frame formed the base or support of the keeper's house, eight feet high. Upon this was placed the lantern, of iron and glass, six feet in height, thus making the entire elevation of the structure, above the rock, about 70 feet, standing upon a base of 25 feet. In addition to the horizontal braces, a series of wrought-iron vertical tie-rods, 32 in number, were introduced between the first and second series of braces. The object of these ties was to stiffen the piles and prevent vibration.

From the preceding description it will be seen that there was a series of braces, 40 feet above the rock. Upon these, the keeper had improperly built a sort of deck or platform, for the stowage of heavy articles. This deck, in addition to the weight placed upon it, was fastened to the piles and braces, thus offering a large surface for the sea to strike against. In addition to this, the keeper had attached a five and half inch hawser to the lantern deck, 63 feet above the rock, and anchored the other end to a granite block, some fifty fathoms from the base of the light. The object of this was to provide means for running a box, or landing-chair, up and down. It is clear that so much surface exposed to the moving sea had the same effect upon the light-house, as would have been produced by a number of men pulling at a rope attached to the highest part of the structure, with the *design* of pulling it down. Since the destruction of the light, it has been ascertained that the rock to which the hawser was attached, was washed in shore 400 or 500 feet. This rock was estimated to weigh seven tons. These two ill-judged arrangements of the keeper had undoubtedly much influence in contributing to its destruction. The following conclusions, respecting the manner of the destruction of the light, are thus stated by Capt. Swift, after a minute inquiry into all the circumstances connected with it. "Ten hours before the light fell, the platform, which the keeper had placed on the second series of braces, 40 feet above the rock, was washed off and came ashore. This platform was 43 feet above the line of low water, and 28 feet above high water, spring tides. Without undertaking to speculate upon the probable shock which the structure must have received from the effect of the sea upon a platform fastened to the piles 40 feet above the rock, it is enough to know that at that time the sea had reached within seven feet of the body or solid part of the structure. The sea was still increasing (the effect of the continued gale) ; the next tide was full about midnight, and it required but a slight increase in the height of the wave or sea, after having reached the second tier of braces, to bring it in contact with the main body of the structure. When this took place, it is plain to perceive that such a sea, acting upon the surface of the building, at the end of a lever, 50 or 60 feet long, must be well nigh irresistible ; and I doubt not that the light-house was thus destroyed. The conclusions I arrive at, therefore, are these : 1st. That the sea did reach the main body of the structure. 2d. That the platform placed by the keeper on the second series of braces, contrary to the design of the builder of the light-house, contributed to the overthrow. 3d. That the five and a half inch hawser, attached to the top of the light, and extending 300 feet north-west, or in a direction directly at right angles with the direction of the sea, north-east, had a most injurious tendency, and that it was enough in itself to cause the overthrow of the light-house, had the sea not reached the body of the structure. It is easy to perceive that the force of such a sea upon 300 feet of a hempen rope, of five and a half inches, must have been immense, when the rope was attached to the weakest part of the building, 60 feet above the rock."

It is the opinion of Capt. Swift, that a stone structure, like the Eddystone, for want of sufficient base, cannot be made to stand upon the Minot, and that the pile light destroyed was as firmly constructed as circumstances would admit.

STONE AND IRON CONGLOMERATE FOR LIGHT-HOUSES, ETC.

One great item of expense in the erection of light-houses, in exposed and difficult situations, as the Bell-Rock and Skerryvore edifices, has been the peculiar form to which it was found necessary to shape the blocks of stone, in order to make them self-sustaining, and to prevent lateral motion or lifting. Without going into the details of the various devices for connecting the blocks, it may be stated that each was of a double dove-tailed form, so as to interlock with those within and outside of it in the same course. In order to materially reduce the expense of such arrangements, the following plan has been proposed by Mr. George Knight, of Cincinnati :

By filling broken granite into a mould of any desired form, and pouring in molten iron — which fills every interstice between and around the stones — a conglomerate block can be formed at an expense of about two dollars per cubic foot, and of any required shape for interlocking; while, by means of cores, it may be furnished with all treenail holes, recesses for joggles, grooves for wedges, and for any species of band or attachment that can be devised. The granite not being disintegrated by the contact of the metal, which latter has a continuous honey-comb structure, the conglomerate has great power of resisting compression, and also great tensile strength, the two qualities which give it value in this connection; its strength being as a cellular block of iron, with its cavities so filled with granite as to preserve its chambers from being crushed in. The cost of the conglomerate will vary in different places; the refuse of the granite quarry is what is required, and iron of sufficiently good quality for this purpose may be had at low rates. The proportions of the materials may likewise be varied according to the purpose to which it is applied. They may be as follows:

Granite . .	150 lbs. . .	occupying	$\frac{3}{4}$ of a cubic foot.
Iron, . . .	150 "	"	$\frac{1}{4}$ " " "
	300 " . . .	"	1 cubic foot.

Estimating the iron at twenty dollars per ton, and the granite at six dollars sixty-six cents per ton, the cost of the conglomerate would be two dollars per cubic foot. There are 13,147 cubic feet of stone in the Eddystone, and 28,530 cubic feet in the Bell Rock; the cost per cubic foot in the former being about six dollars, and in the latter, seven dollars and fifty cents per cubic foot. — *Appleton's Mechanic's Magazine.*

A MACHINE SUBSTITUTE FOR THE RAYS OF THE SUN.

The London Mining Journal for December 8th contains drawings and descriptions of a machine, which, for novelty of purpose, has not, we think, been surpassed. This invention is intended to be a "substitute for the rays of the sun," by burning the stubble, roasting the soil, and mixing together the ground thus heated with ground not heated. The inventor, M. Hartrig Von Blucher, proposes to effect this by means of a cylinder, composed of iron ribs, at the axis of which is suspended a semi-cylinder. The latter serves as a stove to warm the large cylinder and keep up the heat in it. This cylinder, acting as a wheel or roller, is to be drawn over the stubble, which, by the heat communicated, will be consumed, and the ground roasted. For the mixture of the roasted soil with the deeper strata, it is proposed to have a second cylinder, attached to the same frame, follow the first cylinder. The ribs of this second cylinder have curved spades attached to them, in order to dig into and mix the earth. A coal-box, to supply fuel to the stove, is attached to the top of the digging cylinder, and, by increasing the weight of the cylinder, the spades work more effectively. The stove referred to, being freely suspended from the axis, constantly maintains an upright position as the cylinder revolves.

IMPROVED ANTI-FRICTION BOX.

Mr. Henry Stanley, of New Hampshire, has recently invented, says the Scientific American, a good improvement in journal-boxes. It relates to the employment, around a journal or axle, of anti-friction rollers, which are allowed to roll around the cylindrical interior of the box. The manner in which said rollers are applied is different from that in other journal-boxes; the rollers, in this case, consisting of hollow tubes, which fit easily on a series of spindles extending between the two rings, or plates, which fit within the box and around the shaft, without touching either. This allows the rollers to keep rolling round the shaft, and keeps them at a proper distance apart, and at the same time they take the whole weight of the shaft on their peripheries. In other roller journal-boxes the rollers are generally fitted with their spindles into end plates, and they do not revolve round the shaft or axle, but revolve on their own fixed spindles, and, as they do not touch the inside of the box, their spindles take all the weight upon them, and they soon wear untrue, and do more harm than good. In some boxes, rollers are put in loosely, and sometimes balls have been so put into journal-boxes: both rollers and balls, thus arranged in journal-boxes, foul — as it is termed — one another, and wear unevenly on their surfaces in a very short time. This improvement is designed to obviate these difficulties.

NEW BRICK-MACHINE.

A new brick-machine, invented and patented by Woodworth and Mower, of Boston, is now in successful operation, manufacturing the brick from dry clay, near that city. The machine is of iron, simple, compact, and massive, weighing seventeen tons. It works with great steadiness and precision, and turns out *three thousand bricks per hour*. The machine and the clay-pulverizer are operated by a steam-engine of twenty horse-power. The clay is first dried, then ground, by passing between heavy rollers, then screened or sifted, and passed into the machine in a uniform state, where it is subjected to the immense power of the machine, and a beautiful, perfect face-brick is produced, almost as smooth and dense as polished marble. The bricks are taken from the machine and immediately set in the kilns ready for burning, thereby obviating the necessity of spreading on the yard to dry before burning, as well as injury or loss from wet weather. By this process, a superior face-brick can be produced, at *less expense*, than the coarsest common brick by the old process. — *Boston Journal.*

SINGER'S SEWING-MACHINE.

A new sewing-machine has been invented by Mr. Isaac M. Singer, of Newark, N. J., which is claimed to have superior merits. The machine sews not only straight seams, but curves of any kind, angles, and even ornamental stitching. The work is done at the rate of from one to two yards per minute. The way in which the stitch is performed is by two threads, one supplied by a shuttle, the other by a needle. The shuttle is below the cloth, and the end of the thread extends up through the cloth and through the eye of the needle, which is only a quarter of an inch from the point. Now, to form the stitch, which is just like the lock or link of a chain, the thread in the needle, after having passed through the cloth, opens, and the shuttle passes through this loop; therefore, when the needle is drawn back, and the shuttle also to the end of its raceway, the two threads are drawn tight, forming a link drawn on the cloth, and thus link after link of these threads form the seam. The cloth then moves on the required distance for another stitch. When a curve or angle is to be made, the cloth is turned by the hand of the operator precisely as a board is turned before a saw which is to cut any required figure. The machine is moved by the foot of the girl tending it, like a spinning-wheel; or a large number together may be moved by steam, leaving the girls nothing to do but thread the needle, put on the cloth and manage the direction of the seams.

RIVETING-MACHINE.

Among the most important recent inventions at the Great Exhibition, were two riveting-machines, constructed on different principles; the first by Mr. Fairbairn, the second by Mr. Garforth. The machine of Mr. Fairbairn does its work noiselessly, with an increased gain of work at the rate of twelve to one. The riveting dies are of various descriptions, adapted to every species of flat or circular work; even corners are riveted with the same care as other parts, so that vessels of any shape may be constructed without recourse to the old process of hammering. Mr. Garforth's machine is, however, superior to this. The principle of the two inventions is as follows: — In Fairbairn's machine the riveting is produced by levers acting like a knee-joint; when the joint becomes straight it gives a deadly squeeze to the rivet, and brings the plates together; — here the dies have to be set to suit the thickness of the two plates which are being riveted. In Garforth's direct-action machine, this adjustment is rendered unnecessary; it simply consists of a cylinder with its piston and piston-rod; when the steam is admitted at the back of the piston, the piston-rod being forced forward the end of it comes into contact with the red-hot rivet, which has been inserted through a hole previously made in the plates; the rivet is kept in its place at the back; and the die fixed to the end of the piston-rod never stops till the plates are effectually riveted together. By common riveting three men and one boy can only rivet twenty three-quarter inch rivets per hour; with Garforth's machine, one man and three boys can rivet with perfect ease at the rate of six per minute, or 360 per hour.

NEW SOUNDING-MACHINE.

A new sounding-machine has recently been invented, by Mr. Faye, of France, which is represented to be of great value and importance. The apparatus consists of a cylinder of sheet-iron, or copper, with a conical top and bottom. This cylinder is filled with a liquid, specifically lighter than water — a small orifice near the bottom allowing the pressure of the water to be exerted on the inside as well as the outside of the machine. To sink the machine two cannon-balls are attached; and when it arrives at the bottom, a stop, projecting below the cannon-balls, is forced upwards and disconnects them. The machine then rises to the surface by virtue of the lightness of the liquid contained. This liquid would, of course, be contracted by the cold at the bottom, and the space left would be filled by the sea-water. And the orifice is so arranged, that, when the liquid expands, upon reaching the surface of the water, to its original bulk, the sea-water so entering shall remain and a corresponding portion of the liquid be forced out through the orifice, the volume of the sea-water contained denoting the temperature at the bottom. When this is not deemed sufficiently accurate, a tube of mercury, similarly arranged, within an orifice near the bottom may be used. A meter, fixed to the machine, denotes the distance through which it has passed, and, by connecting the apparatus for setting free the sinking weight with this meter, the machine may be made to descend to any given depth; its relative position, when it rises to the surface, determining the force and direction of the current at that depth. To collect a portion of water at the bottom, or any required depth, a small vessel is attached, upside down, and shuts when in that position by a valve, which, when the disconnecting apparatus sets free the weight and brings the vessel to its proper position, opens and allows the water to flow in. The thickness of the metal used is $\frac{1}{50}$th of an inch — the diameter of the cylinder is 16 inches, and the height three feet six inches. With the disconnecting apparatus it weighs 24 lbs., and costs about £12. It contains 25 lbs. of oil of potatoes, and when filled with that liquid, weighs upwards of 30 lbs. lighter than the quantity of water it displaces. To sink it, a couple of cannon-balls, each weighing a quarter of a hundred, would be sufficient. It is obvious that the only loss, each time, is that of the sinking weight, which would give an expense, taking cast-iron at £10, of 5s. The time employed in the operation would be less than in the case of the sounding-lead, namely, 4000 fathoms an hour.

NEW TYPE-COMPOSING AND DISTRIBUTING MACHINE.

In the Danish department of the Great Exhibition, was exhibited an ingenious machine for setting and distributing types at the same time — the composing part being supplied with types by the distribution of those previously used; and the distributing part of the machine being placed over the composing part. It rests with its hollow axis on the projected central axis of the latter, and distributes the types by revolving on that axis, and conducting each type to that place in the lower part of the machine to which it belongs. Here the types are piled on and between brass rods, of which there are as many as there are letters, characters, or signs wanted for printing. These rods are perpendicularly fixed between two plates of metal, in circular order, so that they form an open cylinder. The distributing part of the machine has a similar construction, consisting of vertical rods of the same size, of a similar number, between similar circular plates. The essential difference between them is, that the one is fixed, while the other is movable. All the rods have a longitudinal projection, by means of which the types, having a corresponding incision, can be fixed, and slide up and down; the triangular form of the projection and the incision keeping them in a horizontal position in which they are piled on the rods. In the composing cylinder, the triangular projection on each rod ceases at the lower extremity, so that the undermost type upon it can be pushed from its place by the action of a spring, which is moved by a string, in connection with a scale of keys corresponding to the letters or characters. By touching the key, a type is moved forward and falls, in the same position which it had on the rod, into a funnel; and on the inclined plane of this it slides down into a spiral tube, which brings, of necessity, all the types to a narrow opening connected with the receiver, in which the line, by type after type, is formed. By a common pedal, the composed line is continually moved forward, and afterwards divided to the width of the page. If the compositor finds in the MS. words requiring peculiar types, he indicates the place by a particular sign, and they are supplied afterwards. The types must be cast expressly for the machine, every letter or character having an incision of a different kind, corresponding with openings in the distributing plate. The expense of the machine is upwards of £100, and a skilful compositor, it is stated, can learn to use it in a few days.

IMPROVED PRINTING-PRESS.

A POWER-PRESS, involving some novel principles of construction, has recently been invented by Mr. Jason Burdick, of Utica, N. Y. Its principal advantages over any other press in use, are, that it prints both sides of the sheet at once, and secures a perfect *register*, and is, therefore, well adapted to either book or newspaper work. It will print, with the utmost ease, from five hundred to six hundred sheets per hour, which is equivalent to ten or twelve hundred impressions on the ordinary power-press. The press has two beds and two cylinders, one directly over the other. The sheet is fed in at one end of the machine, where it is secured by very ingeniously contrived steel clips; it then passes under one cylinder, receives an impression on one side, passes on and up under the upper cylinder, receives an impression on the other side, and is delivered a foot or so above the place where it was taken in.

Presses have before been invented to print both sides of a sheet at once; but the difficulty encountered was, that the side printed first, the ink having no time to set and dry, soon inked and smutted the tympan to such an extent, that it would off-set on the sheet and so blacken it in a short time as to obliterate the impression. This difficulty is obviated in Burdick's press by a movable absorbing blanket of cotton fabric between the upper cylinder and the printed side of the sheet, which, while the second impression is being taken, is pressed down upon the side already printed, and absorbs, like a blotter, any superfluous ink that may attach to that side of the paper. By two dogs and cog-wheels, with a sort of reel attached for the purpose, this blanket, before the next sheet comes through, is moved slightly forward, (about one-sixteenth of an inch,) by reeling it from one roller to another, sufficiently to bring the next impression from the printed side of the sheet upon a clean spot in the blanket. Two or three yards of cotton cloth will serve as a blotter in this manner to print an edition of two or three thousand, when it can be washed and used again ; or, a piece of some thirty yards can be put on at once, and will last a year or so. There are some other distinctive characteristics about the press which are difficult to describe, though they betoken much ingenuity on the part of the inventor. — *N. Y. Farmer and Mechanic.*

IMPERIAL PRINTING ESTABLISHMENT AT VIENNA.

The Imperial Printing Establishment at Vienna contributed an interesting collection of objects of graphic art to the Great Exhibition. The machinery department of the Imperial Printing-office is supplied with an engine of twenty horse-power, moving forty-eight printing, and twenty-four copper-plate presses, and ten glazing-machines. There are, moreover, thirty-six large and twelve small iron hand-presses, twelve numbering and embossing machines, and thirty lithographic presses. A fresh supply of types is constantly supplied by twelve casting-machines and nine ovens, and 3000 cwt. of type is kept on the premises. According to a moderate computation, each cwt. contains about 40,000 types, and the 3000 cwt. we mentioned make a total of 120,000,000 of types of various sizes and characters ; 500,000 sheets, or 1000 reams, of paper *per diem* are required for the consumption of the establishment. The report of the Austrian Commissioners states, that ten years ago but fifty persons were employed in the Imperial Printing-office. Among the objects sent to the Exhibition, was a collection of 11,000 Steel Punches, including 104 different alphabets, from the hieroglyphic, hieratic, and Demotic, down to the Kionsa, Laos, Shyan, Mandshah, and Formosan. There was a collection of gutta-percha and galvanized copper matrixes and patrixes of woodcuts, *fac-similes* of antique relievos ; and, as a specimen of the typographic strength of the Imperial Printing-office, there was a copy of *The Hall of Languages*, consisting of seventeen sheets in elephant folio, containing the Lord's Prayer in 608 languages, printed with Roman letters, and in 200 languages, in the characters peculiar to each language ; a work of vast design and exquisite execution. Next was a collection of MS. writing in the early ages — from the sixth century to the days of Guttenburg, and the invention of the art of printing. There were, besides, ornamental letters of the Middle ages, reproduced from the documents of the time, *fac-similes* of curious old woodcuts, chiefly taken from an old and very rare book, entitled, *Kaiser Maximilian's Ehrenpforte.* There was also a Japanese novel, the first work of this kind ever printed with movable type ; oil-color prints ; photography on paper, in its various applications to objects of nature and art ; and a selection of ornamental tools for book-binding.

HUTTON'S PATENT CLOCK.

This clock, invented by Mr. Hutton, of England, and contributed to the Great Exhibition, has a new compensation glass pendulum, and a barometric contrivance, to prevent the error arising from the changes in the density of the atmosphere. The metallic compensation is effected *without any friction*, by the ascent and descent of two spring levers with three adjustable weights, and which lengthen or shorten as they rise or fall. The mode of compensating is regulated by a screw in the top of the ball, which, in case of heat, is moved towards the centre of motion of the spring lever, or in the contrary direction in case of cold. The glass rod is attached to the pendulum-spring, by means of a screw cut on it, and below, a glass regulating-nut works into a glass screw, cut on the bottom of the pendulum-rod. The compensating wires being very small, a simultaneous action is ensured at each change of temperature. In the barometric contrivance, the ivory piston rests on the mercury, thus counterpoising the air-vanes, so that when the barometer is low, it causes them to approach the plane of the pendulum's motion, and raises them, on the contrary, when the barometer is high; thus the mechanical resistance to the pendulum is increased or decreased according to the density of the atmosphere.

SELF-ADJUSTING PENDULUM.

A new and economical self-adjusting pendulum was shown at the Great Exhibition. Instead of the ordinary rod, by which the ball is suspended, being attached to its centre, a bar is secured to the side of the ball, and a wooden rod fixed thereto; so that the elongation or shortening of the rod, by change of temperature, turns the ball on its axis, and thus preserves accurately the distance between the points of suspension and oscillation respectively.

CHEAPNESS OF AMERICAN CLOCKS.

To such perfection has the manufacture of clocks been carried in Connecticut, that time-pieces, warranted to keep good reckoning, are sold for sixty cents, at wholesale, and one dollar, retail. The works are all of brass, made by machinery. At the manufactory of Mr. Jerome, New Haven, 800 per day of these articles can be produced. Wooden clocks, but comparatively few years since, sold for from ten to twelve dollars.

ATMOSPHERIC CHURNS.

Dr. Page, of the Patent Office, in his report for 1849–50, states that during that year twenty-one applications were made for patents on churns. "Most of these were styled atmospheric churns, and I have never witnessed such a mania upon any one invention. The first impulse seems to have been given by the grant of a patent for a churn, in which there were boxes upon opposite sides of a common revolving dasher, so situated that as the dasher revolved, the box containing the cream, with its open mouth downwards, carried down a portion of the air to the bottom of the churn, and as the mouth of the box inclined upwards, the air escaped from it through the mass of the cream, while the box itself filled with the cream, and as it came out and revolved in the upper part of the churn above the cream, that contained in the box was thrown out and scattered into spray. Both the descent and size of the box occasioned a commingling of the air and cream, and answered the purpose of agitation as well perhaps as any form of dasher. In these atmospheric churns, the introduction of air plays no chemical part in the production of butter; its separation from cream being merely a mechanical process. And although the atmospheric churns operate to considerable advantage, yet it is by means of a more thorough agitation, which is increased greatly by the diffusion of air throughout the cream. As each portion of air rises through the cream, it forms a bubble upon the surface before it escapes, and in some atmospheric churns, where the dasher is constantly submerged, the whole mass of cream is converted into a complete mass of foam.

"From the success of such a churn as that above named in producing butter in a shorter time than other churns, a most enthusiastic speculation was at once commenced upon atmospheric churns, and inventive powers were racked to modify, mystify and contort a simple principle, with a view of producing novelties rather than improvements. From the immense number of churns used throughout the country, great gains could not fail to follow the monopoly of a new and superior churn. The golden prospects have tempted many into the field, and it is quite curious to observe in this instance the natural drift of intellect, bringing the workings of independent minds into one common channel. A patent was granted for one species of atmospheric churn, but before this could have been known far beyond the walls of the Patent Office, two other inventors, each and all from different parts of the country, had laid claim to the identical improvement. One was from Ohio, the second from Illinois, and the third from Vermont. An interference was accordingly declared, and no sooner had the decision been made in favor of the patentee, than three other inventors were found pressing their claims to the same invention. It presents an unprecedented case in the history of the Patent Office of seven persons, each a *bona fide* inventor, all claiming the same thing and about the same time, and all from distant portions of the country. This improvement consists simply in boring a hole through the entire length of a common upright churn dasher, and placing a valve either at the bottom or top of the dasher. This valve opens downwards, and when the dasher is raised with such rapidity that the cream cannot follow up, the air rushes down through the valve under the dasher, and upon the downward stroke the air is pressed out laterally and escapes by the side of the dasher and up through the mass of cream. It requires not a very quick motion, and but little force to effect this, and the agitation is most complete. A full-size model was exhibited in the office showing the operation with clear water only. Upon agitating the dasher, the water appeared as if in intense ebullition. Another peculiarity belongs to this churn worthy of note. In the common churn the dasher has to be raised out of the cream at each stroke, and plunged down with some force, and, as this scatters the cream, it is necessary to cover the churn tightly and allow the dasher to play through a small hole in the centre of the cover; but in this atmospheric churn the dasher is kept always under the surface of the liquid, and consequently there is no splashing of the cream, and the cover may be left off with safety, and enable you to watch the operation. A strong recommendation is its simplicity, and, as one of the inventors stated, he could alter any common churn dasher to this principle for twenty-five cents.

"Prior to this simple device for introducing air, several complicated inventions had been patented, and many more made and presented to the office to effect the same purpose. In truth, this invention at first was not considered patentable, but after the exhibition of its actual operation by one of the inventors, a different view was adopted and a patent ordered to issue. As atmospheric churns were not new, the ground was taken that the use of any known means of introducing air was not patentable. The ground of action is correct in itself, but did not appear applicable in the case after a personal explanation from the inventor, and an exhibition of the operation and result of his invention. The patentability of an invention frequently turns upon a nice point, and inventions the most novel are sometimes the most worthless, while again others least novel in appearance, bearing the similitude of common and unpatentable devices, are most valuable and important in practice. Simplicity is the essence of true invention, and it is often interesting to see, after a multitude of complicated inventions to attain a certain end, some discerning or perhaps fortunate inventor demolish a whole labyrinth of combinations, and arrive at the result by means so simple as almost to rob invention of its charms; such means as one would suppose should have been the first and not the last resort.

"A modification of the last-named churn has been patented, in which the hole in the dasher at the lower part was large enough to contain a solid plunger, fitting loosely within the dasher, which acts the part of a second valve. There have been also several patents granted for ingenious forms of rotary atmospheric churns. These inventors crowded upon the office so numerously, that they were examined with the most rigid scrutiny, and, on several occasions, actual demonstration, by experiment of making butter, was required of the applicants, to satisfy the office that the inventions claimed justified their pretensions to be real improvements. In most of these cases, the results were unfavorable to the inventor; but, in some, patents were ordered to issue. On one occasion an experiment was performed (humorously characterized by a bystander as a 'churn race,') between a patented and a new churn, in which they both came out alike, making butter from new milk in two minutes and a half. Such a rapid separation of the butter, however, is by no means desirable, although this is the general aim of these improvements. We have it upon the highest chemical authority, that butter made so rapidly is not likely to be so good as that which is made slowly."

IMPROVEMENTS IN FELTING.

The following is the specification of a patent granted to Joseph Wright, of Lawrence, Mass., Dec., 1851, for an improved method of felting wool and other fibrous materials: "I claim the felting of wool or other fibrous materials, upon a woven or netted fabric, substantially as set forth. I also claim the use of one or more moving platens, having a reciprocating rectilinear motion in the direction of the length of the cloth to be made, over one or more stationary platens, in combination with the endless cloth bands, operated substantially as described, for carrying forward and regulating the motion of the material, while under the action of the said platens, substantially as set forth."

In relation to this invention, the Boston Courier, Jan. 19th, states: We have been for more than a year aware that parties were trying to perfect a plan by which the cost of felting wool could be reduced to a point that would make it possible to produce the articles of floor-cloths, druggets, and the cheaper articles of woollens, at a lower price than the similar goods can be imported, but have never before seen anything that would justify the belief of success in the experiment. To many readers the devotion of a single paragraph to the records of this last triumph of American genius may seem unnecessary, but the initiated can well understand why and wherefore we are thus proud of this particular and specific invention; for to those it is known that by the cheap labor of Europe we were completely outdone in the production of the lower class of woollens, and that though the American woven goods possessed advantages in wear, the English articles, possessed of speciousness and cheapness, were invariably chosen in preference. The present invention does away with this, and obliges the European to make his articles still more durable and weighty, if he would insure the sale, for the American FELTS will be both solid and good.

This new process enables the manufacturer, by a machine no more cumbersome than a common loom, to take the lower qualities of brown cotton goods, and felt securely on this basis a firm coating of wool. This coating can be made pliable, to serve as flannel; or hard and firm, to serve as drugget, upon which can be printed any design to suit the fancy of the consumer. We understand the Bay State and Middlesex mills will be immediately put upon the production of these goods, and we hope, at no distant day, to be able to record the export of quite as many woollens as cottons.

FASHIONS FOR THE DEAD.

A RECENT English work, on the manufactures of Birmingham, contains the following suggestive remarks in relation to coffin ornaments:—

"The manufacture of ornaments for coffins is a very important part of the trade, and it is curious to find, that even in this last concession to human vanity, there is a constant demand for new designs. Who is it that examines and compares the ornaments of one coffin with those of another? We never heard of the survivors of a deceased person examining an undertaker's patterns. And yet, a house which consumes forty tons of cast iron per annum for coffin-handles, stated to the gentleman to whose letters we are indebted for this information, 'Our travellers find it useless to show themselves with their pattern-books at an undertaker's, unless they have something tasteful, new, and uncommon. The orders for Ireland are chiefly for gilt furniture for coffins. The Scotch, also, are fond of gilt, and so are the people in the west of England. But the taste of the English is decidedly for black. The Welsh like a mixture of black and white. Coffin lace is formed of very light stamped metal, and is made of almost as many patterns as the ribbons of Coventry. *All our designs are registered, as there is a constant piracy going on which it is necessary to check.*' "

WYLD'S MODEL OF THE EARTH.

A BOLD and curious attempt to impart geographical knowledge to the million was made, during the past year, in London, by Mr. James Wyld, geographer to the Queen, by the construction of an immense globe, or model of the earth, executed on the most gigantic scale, and with the most scrupulous regard to geographical accuracy. This colossal figure of the earth is modelled on a scale of ten geographical miles to one degree horizontal, or six inches to a degree, and it is one mile to an inch vertical, while the diameter is no less than sixty feet. The circumference of the model is one hundred and eighty-eight feet, and the extent of surface ten thousand feet. It is made up of some thousands of raised blocks or castings in plaster, from the original models, of mountain and valley, sea and river, in clay, the fitting of which has been one of the principal difficulties which the constructor has had to encounter. Recollecting that only a limited portion of a sphere can meet the eye at once, it occurred to Mr. Wyld that, by figuring the earth's surface on the interior instead of the exterior of his globe, the observer would be enabled to embrace the distribution of land and water, with the physical features of the globe,at one view; and in this he has succeeded; while, from the great size, the examiner of detail is hardly aware that he is gazing on a concavity. It was at first intended that the great globe should form part of the contents of the Exhibition building, but as the plan developed itself more completely, it was found impossible to place a model of the intended magnitude therein, and a site was sought for the erection of a building expressly fitted to receive it. An appropriate edifice was, therefore, erected on Leicester-square, in which the model is exhibited. The entrance is under a Grecian portico into a vestibule, whence the visitor is introduced to a circular corridor round the exterior of the globe. This corridor is very appropriately decorated, and is embellished with maps of different countries; but, to obtain a view of the earth, the visitor must pass through the crust of the globe. An entrance is effected through the Antarctic sea, which leads him to four tiers of galleries, rising one above the other, to the top of the building. The great panorama or map of the world is here spread out before him, and the effect is extremely striking and beautiful. The best idea that can be given of the design is, to conceive a gigantic hollow globe, with all the mountains, rivers, elevations, and depressions in relief, and then to suppose this globe turned inside out, and the spectator standing in the centre of the interior.

Upon first entering, this view is limited to the southernmost parts of Africa and America, magnified, in comparison with the delineations of ordinary globes, to proportions almost beyond recognition. A staircase conducts to a zone where the central parts of these vast continents are seen broadly expanded, and exhibiting the diversities of mountains and valleys in bold relief, and of deserts and verdant plains, oceans, lakes and rivers, represented as they might be supposed to appear when seen from a great elevation. At the next ascent the spectator is placed on the equinoctial line ; a gallery above corresponds in position with the tropic of Cancer, and a still higher zone places in sight the whole of Europe, and most of the civilized countries of the globe. The higher the ascent the more interesting and more extended the view ; and, by the time the spectator has arrived at the highest zone, he becomes accustomed to the concave form, which, at first, is rather perplexing, as the exterior surface of the globe is seen from the interior. There is no writing on the model ; the land is of as natural a tint as possible to represent the temperature of the various zones, and the sea is colored blue. The earth's form, as a whole, is shown ; its general aspect, the relative quantity and positions of its several parts, the bearing of its hills, the flow of its great waters, and the seats of its rich dales and barren wastes. The volcanoes are distinguished by their fiery red tint ; and those mountains within the range of perpetual snow are vividly represented in the frosty, glittering garments with which nature clothes herself in these ice-bound regions. The relative heights of the several mountains are given, and the course of the rivers may be distinctly traced. The top of the globe is made the north pole, and the bottom the south, without any regard being paid as to what is known as the inclination of the ecliptic. The circular corridor, which surrounds the lower part of the globe, is tastefully hung with maps and charts of a most valuable description, and the walls and pillars decorated in arabesque painting, being exact copies from some of the ornamental work in the Alhambra.

FACTS IN RELATION TO THE TURBINE WHEEL.

The following is an abstract of a paper presented to the American Association, Cincinnati, by Mr. J. Chase, of Mass., in relation to the Turbine wheel : —

In computing the experiments which were made at Lowell, it was found that when the gate was fully open, the quantity of water discharged through the guides was 70 per cent. of the theoretical discharge. The effect of the wheel during these experiments was 81½ per cent. of the power expended ; but, when the gate was half open, the effect was 67 per cent. of the power, while the discharge through the guides was 11 per cent. more than the theoretical discharge. But, when the opening of the gate was still further reduced to one fourth of the full opening, the effect was also reduced to 45 per cent. of the power ; while the discharging velocity was *raised* to 49 per cent. more than that given by theory. In the first of these experiments the fall was $12\frac{8}{10}$ feet, in the second $13\frac{28}{100}$ feet, and in the third $13\frac{43}{100}$ feet ; and the quantity of water used upon the wheel with the full gate was 135 cubic feet per second.

Prof. Peirce remarked, that if, in the last of these experiments, the wheels were removed and the water suffered to run through the guides without obstruction, the head, which would be required to give a velocity of discharge equal to that actually observed, would be about 37½ feet.

ON THE USE OF AIR FOR THE PURPOSE OF CONVEYING MECHANICAL POWER.

Lt. Hunt, U. S. Engineer, read a paper at the American Association, with the above title, of which the following is an abstract. He stated that he was about to bring forward a new system of economy in the use of a mechanical power which was now entirely lost. He exemplified his meaning by citing the immense power which was lost at Rochester, by the formation of the ground over which the Genesee river flowed, and which, by his project, might be economically applied to tubes to condense air, which might then be made to supersede steam, as it would do away with the use of fuel to keep up the power which was chiefly used in manufacturing. He stated that Pepin had proposed the same project, though not as fully or on as large a scale as he thought it might be applied. For all stationary power this was invaluable, especially to localities where it was deemed advisable to establish manufactures. This principle was illustrated by the experiments made by the atmospheric railways, in which it was shown that atmospheric pressure might be applied for great distances. The principle was established, as far as the railways were concerned, though it was true the stockholders had to suffer some. It would also enable large central establishments to be formed, to which, by means of exhaustion or compression pipes, the power necessary for manufactures and machinery might be conveyed in the same manner as gas or water itself. Thus the space, attendance, risk and disagreeableness of steam generating would be saved, while all required power would be purchased from the power manufacturers, and distributed through air-wains, just as in gas or water distribution.

GAS COOKING APPARATUS.

A cooking-range, designed to be used with gas, has been constructed by Mr. King, chief engineer of the gas works in Liverpool. It is divided into three compartments, of different sizes, for roasting and baking, being furnished with a damper to regulate the flow of air through them. The burners are arranged inside the oven, at the bottoms, around the sides, back and front, with a dripping-pan occupying the centre. The meat is hooked on to a sliding frame or carriage, which, when pushed in, allows it to be suspended, surrounded by the gas. On the top of the range are eight spiral burners, in eight well-holes, for boiling, stewing, frying, &c., any of which operations may be performed with the same facility as on a hot plate, or over a charcoal fire. The meat roasted by this range, owing to the regularity and certainty of the operation, is of a more nutritive character than that cooked by the ordinary process, as more of the juices are retained, as is ascertained by the comparative small loss of weight after cooking. By the operation of broiling, twelve chops can be cooked at once, at a cost, in Liverpool, of not more than two pence per hour for gas. Comfort and cleanliness to the cook, and economy to the consumer, are among the qualifications of this useful invention.

PIN MANUFACTURE IN THE UNITED STATES.

The "American Pin Company," and the "Howe Manufacturing Company," now manufacture nearly all the pins consumed in the United States. Since the depression of 1846 to 1848, the business at the two companies named has been reasonably profitable, having been rendered so rather by reducing the cost of production and the expense of selling, than by the small advance in price which has been realized. Both companies manufacture the wire for making their pins. During the last year the two companies have used principally Lake Superior copper for making their wire; their joint consumption of copper amounting to about 250 tons per annum. The present weekly production of pins by the two companies may be stated at about eight tons.

In connection with the improvement effected in the manufacture of pins, by the introduction of self-acting machinery, superseding a process which formerly required six or seven different manual operations, important improvements have been made in the method of sheeting the pins, or sticking them on paper. This, as previously performed by inserting a few pins at a time by hand, was a tedious process, at which five or six dozen papers were as many as a good hand could do in a day. By the improved machinery now in use, one hand will stick from 75 to 125 dozen a day, and do the work better than it was usually done in the old way. The present price of American solid-headed pins is believed not to exceed two thirds of the lowest price at which imported pins of equal weight were ever afforded before the manufacture was introduced, and, for service, they are undoubtedly better than the article of which they have taken the place. The American improvements in both the pin-making and pin-sticking machinery have been for several years in operation in England and probably in other parts of Europe. — *Hunt's Merchant's Magazine.*

MANUFACTURE OF ICE.

The London Mechanic's Magazine thus describes Dr. Gorrie's new process for making ice, and the results obtained from it: — "To understand this machine, conceive of two vertical pumps, made precisely like steam-engines — one of which is adapted to condense atmospheric air, so as to squeeze out of it a portion of its gaseous heat, and the other is constructed to admit of the expansion of the same air, connected with the extremities of a beam common to both, and you will form an idea of all that is indispensable to manufacture ice on this principle.

It will be obvious to the slightest reflection, that, as the air, in expanding, becomes a powerful absorber of heat, and will greedily take it from all surrounding bodies, ice might be made by simply immersing the cylinder in which the expansion takes place in water. This process, however, would be too tardy a one for business purposes; and the operation, therefore, is prodigiously accelerated by various adjuncts. In the first place, in order that the free heat of the condensed air may be extinguished, so as to fit it for its highest degree of refrigerative effect, without any loss of time, a pump, connected also with the beam, but bearing a very diminished proportion in size to the air-pump, is made to inject a jet of cold water at and during every stroke of the machine. And so, a similar pump projects its measure of an uncongealable liquid among the expanding air in the other air-pump, so as to furnish it instantly with the caloric of volume, while the liquid itself becomes cooled at the same time from the heat it parts with. This liquid (a strong solution of salts) is withdrawn from a tank or vessel designed for the accumulation of "cold," into which, after performing its duty in the expanding engine, it is again sent back through the eduction valves. In this tank the ice is manufactured by simply immersing water, placed in metallic vessels, in the liquid; or with the mechanical addition of occasionally breaking up the adhesions of the ice to the sides and bottom of the vessels, so as to present a new surface of water to the action of the external cold. The reservoir of cold, the expanding engine, the injection pump, and, indeed, every part of the apparatus employed in generating or preserving cold, are so thoroughly concealed from sight, and the radiating influence of the external air, by insulating chambers, that the processes going on within them are wholly unperceived.

It ought to be mentioned that the condensed air, instead of being transferred directly to the expanding pump, as the above description would imply, passes intermediately into a wrought-iron reservoir, large enough to store a considerable number of cylinder-fulls of air, and thus any disadvantage from leakage, or the unequal working of the pumps, is obviated.

With a machine, having pumps of about eight inches in diameter, and of 16 inches stroke, condensing and expanding air to and from a tension of three atmospheres, a block of ice, weighing nearly 60 pounds, was produced, by the labor of two men, in two hours.

NEW AGRICULTURAL MACHINES.

The Patent Office Report, for 1850–51, contains descriptions of various new agricultural machines for which patents have been recently granted. The following are especially worthy of notice: — A *corn-stalk harvester*, the frame of which resembles a low three-wheeled truck, and bearing upon its upper surface, near its middle part, two broad metallic disks, armed with teeth on their peripheries, which teeth slightly overlap each other, and are capable of seizing and holding within their grasp any herbaceous matter, and, as the machine moves forward, to tear it up by the roots. The meeting of these teeth is near the central part of the machine, anterior to which the space is perfectly clear, so that when the machine is driven over a row of the corn-stalks, the latter are successively brought against the teeth of the metallic disks, and drawn out of and deposited upon the ground.

An ingenious machine has also been invented for distributing the cut grain of a harvester into suitable parcels for bundles, by the weight of the grain. It is called a *grain-binder*. It consists of a self-regulating rotary cylinder, mounted on the rear end or extreme right side of the machine, and having its axle parallel with the rear end of the machine. This cylinder is supplied with catches and springs, and so arranged that, when a certain weight of grain is received into one of its three compartments, it performs a third part of a revolution, and deposits the amount received for a bundle, while the next compartment of the cylinder is being charged for a second bundle, and so on.

Two machines, adapted to harvest maize, have been patented. The first of these contains a thresher to husk and shell the grain. The harvester consists of a machine in its general arrangement not unlike a clover-head harvester. But it has a series of pairs of rollers, one pair between every pair of teeth, to seize the stalks and pull them downwards, until the ear is drawn against the tops of the fingers, by which the ear is severed from the stalk. The ear then rolls down an inclined plane to the thresher. The principle of the second machine consists in the construction of the grain reel, made with rows of fingers, projecting radially, and rotating over or through the standing grain. The stalks being received between the fingers, the ears are pulled off and deposited on an inclined endless apron.

A patent has been granted for *a machine to cut and assort broom corn.* The design is to cut the broom corn into lengths according to the size of the stalk, and to assort them into parcels, according to their lengths, by the machine, so that they may be properly distributed for making different-sized brooms. The machine consists of a long table, with an endless apron running lengthwise, and beside it, and on the same level, and a little obliquely to its direction, is arranged a pair of rollers running the whole length of the long table. These rollers lie one upon the other, and are farthest from the endless apron at the entering end. This endless apron is a belt of slat work, put in motion by machinery, and gradually moving forward from the entering or feeding end of the table, where the broom corn is fed to it by hand, and laid directly across the apron with the butts all in one direction. When the broom corn has traversed about one third the length of the table, it is brought under compressing rollers, while, at the same time that the body of the stalk is held firm in its place, the butt is brought between two rotary disks with cutting edges, arranged like two rotary or circular saws, having their cutting faces edge to edge, yet slightly lapping each other. The edges of these cutting disks are very thin, and the under one serrated. As the endless apron travels from the feeding to the discharging end, it brings successively the butts of all the corn-stalks between the cutters by which they are severed, and as they still move forward, those stalks which are the longest, and consequently project farthest, are caught first between the rollers, and, by this means, carried from the endless table, while those which are shorter are taken by that part of the rollers that is farther along. To avoid distributing the broom corn throughout the whole length of the assorting rollers, portions of the lower roller are turned out, leaving only enough to constitute the axle, and thus preventing any of the material from being drawn through in these sections, which divides the assorted material into several series or parcels, in number equal to that of the sections cut in the lower roller.

VENTILATION BY CHIMNEYS.

At the Royal Institution, in a series of lectures on chemistry applied to domestic purposes, Dr. Faraday introduced various illustrations to show the importance of the functions of the chimney. "A parlor fire," he observed, "will consume, in twelve hours, forty pounds of coal, the combustion rendering 42,000 gallons of air unfit to support life. Not only is that amount of deleterious product carried away and rendered innoxious by the chimney, but five times that quantity of air is also carried off by the draught, and ventilation thus effectually maintained." The force of a draught was illustrated by a descending flue. A colored flame was held near the end of a tube bent like an inverted syphon. As soon as the tube was heated, the ascent of air within the longer arm of the tube drew the flame downwards into the shorter arm with considerable force. Since the ascent of smoke up the chimney depends on the comparative lightness of the column of air within to an equal column without, the longer the chimney the stronger will be the draught, if the fire be sufficiently great to heat the air; but if the chimney be so long that the air is cooled as it approaches the top, the draught is diminished. A case of this kind occurred at a light-house on the Isle of Portland. The chimney which ventilated the building and lantern was carried on the outside, and in winter time the draught was so much impaired that the windows became dim and the light obscure. An attempt had previously been made to remedy the defect by lengthening the chimney; but that, of course, had made it smoke all the more. The application of a jet of steam to increase the blast of locomotive engine furnaces was illustrated. The lower end of a bent glass tube was placed in a dish which contained liquid, the upper end being inserted into a large and horizontal tube. A jet of high-pressure steam directed through the larger tube caused such a rush of air to supply the place of the air expelled by the steam, that the colored liquor rose to the top of the tube. The mechanical force of a jet of high-pressure steam was shown by causing it to sustain an egg, which was seen dancing about in the air without anything apparent to support it.

SUBMARINE EXPLORER.

A submarine vessel, of somewhat novel construction, has been recently built in New York, under the direction of a Mr. Alexander, a Frenchman. It consists of a large iron shell, somewhat resembling an egg, both ends, however, being of the same size and form. This shell is made of boiler iron plates, united together in the most perfect manner, and rendered perfectly air and water tight. The after part is occupied as the cabin, and is lighted by means of a number of "bulls' eyes." The cabin is capable of accommodating eight or ten persons with ease. The forward compartment is used as an air and water chamber. The length of the whole machine is 30 feet, diameter 10 feet. The principle upon which it operates is somewhat similar to the diving-bell, though the manner in which the occupants of the cabin are supplied with fresh air, and enabled to remain for a long time under water, is exceedingly ingenious, air-pipes extending to the surface not being employed. The interior is divided into compartments. The place which the submarine explorers occupy is about two fifths of the vessel; in the other part are two large reservoirs, all made of plate-iron, into which are fitted two pairs of pumps, having different functions, either for air or water. The object of the duplicating pumps is to guard against those accidents which might render one unserviceable. Each pump has four cocks to produce alternately the expansion and compression of the air, and the expulsion or supply of water, in such a manner that they may throw off or compress a supply of air or water, at pleasure, to the reservoir spoken of inside. The whole operation of this vessel depends upon the displacement of a certain quantity of condensed air, and in taking in or throwing off a body of water, more or less, by working the pumps. Thus, if it is desired to descend from the surface, the crew, before closing the top man-hole, (man-holes being placed both at the top and bottom of the machine,) will force into the air-reservoir the supply of air necessary to balance the weight of the column of water, proportioned to the depth it is desired to descend; the deeper the descent, the more air is condensed in the reservoir; this prevents the water from coming in below, according to the laws of equilibrium of fluids. Having obtained a sufficient supply of air, the man-hole above is closed, and the submersion of the vessel effected, by using pumps to pump water into the water-reservoir. When the vessel has arrived at the bottom, the lower man-holes are opened, and explorations made at convenience. A valve communicates with the air-reservoir and the apartment of the operators. When it is desired to ascend to the surface, the lower man-holes are closed, and the water, which was before pumped in, is expelled. The operations of ascending and descending are thus performed with great rapidity; but for the purpose of guarding against the possibility of accidents, another plan is arranged on the outside of the vessel. Upon each side is placed a strong metallic platform, or shelf, loaded with ballast. These shelves are connected with a lever in the cabin, and, in case of accident, can be made to fall, dislodging the ballast and instantly sending the vessel to the surface. The vessel can thus descend safely to any depth, from 10 to 100 feet, without direct or indirect communication with the exterior. This is altogether the reverse of the diving-bell, which receives its air always through a tube from the surface of the water. It is calculated that from three to seven men can remain in the vessel for seven hours. It is also proposed to purify the air of the cabin from the carbonic acid generated in respiration, by forcing it, by means of a pump, through caustic potassa. The vessel is propelled by means of a screw-propeller in the stern, turned by hand by a crank in the cabin. A rudder is also operated in the cabin, giving those within a perfect control of the boat. The propeller and rudder lever both pass through stuffing boxes, which prevent the egress of air from the cabin, or the ingress of water. The cost of this curious submarine vessel is about $9,000 dollars. — *Scientific American, and Farmer and Mechanic.*

REMOVAL OF OBSTRUCTIONS IN "HELL GATE," LONG ISLAND SOUND.

The great terror to navigators through Long Island Sound, known as "Hell Gate," or "Hurl Gate," as some choose to call it, is situated opposite Harlem, eight or nine miles from New York Battery. The East River, or Sound, from the Battery up to Harlem, runs a northerly course. Here it makes a sudden bend, almost at a right angle, and runs easterly for a mile or more, when it makes another bend to the northward. Between these two bends in the Sound lies this celebrated estuary, realizing to the mariner all the dangers and difficulties of Scylla and Charybdis, pictured by the ancient poets. The eastern end of Long Island Sound has a broad opening to the ocean, and as the tide presses in from the sea, it finds a broad channel most of the way through the Sound, eight, ten, or a dozen miles wide. When it reaches this neck, between the two bends mentioned above, it is compressed to about half a mile in breadth, producing a very rapid, wild current. And it is here, in the midst of this rushing flood, that several rocks and reefs rise up from the bed of the river, almost to the surface, and throw the whole current into the wildest commotion. The most formidable of these, and the most in the way, is Pot Rock, which lies nearly midway in the channel. To the westward of this, and a little nearer the northern shore, is the Frying Pan. Way's Reef lies to the southward of Pot Rock, towards the Long Island shore.

Ever since the settlement of the country the navigation of the Sound has been obstructed by these terrific barriers, and no hopes were entertained that they would ever be removed. To drill and blast them, especially Pot Rock, was seen to be utterly impossible ; for no vessel, or structure whatever, which man could raise, could be stationed upon it to effect the drilling. At length, however, a few months since, a French gentleman, by the name of Maillefert, advanced the bold assertion that he could blow Pot Rock to atoms, without drilling, and clear it out of the channel to a sufficient depth to render navigation over it safe at all times of tide. The idea was regarded as absurd, and but little attention was paid to it. The assertion was repeated, and evidence was produced that M. Maillefert had already performed a similar feat at Nassau, New Providence, where he had, without drilling, blasted and removed nearly a hundred tons of rock eighteen or twenty feet under water. M. Maillefert offered to undertake the job of removing Pot Rock, if the means were furnished to carry on the work, stipulating not to receive a dollar for his own services till the work was fully accomplished. Some interest began to be awakened upon the subject, and at length Henry Grinnell, Esq., whose liberality in aid of humane and public enterprise is so well and widely known, subscribed five thousand dollars for commencing operations. Assurances of aid were obtained from other quarters as fast as there should be any evidences of success, and the enthusiastic Frenchman went to work. His mode of operation is to sink a tin canister of powder down upon the top of the rock, and there ignite it through a wire by means of a galvanic battery. This is performed during the few minutes of slack tide at *high water*, for the deeper the water over the powder the better. By the expansive force of the explosion, the large mass of water above and around must be instantly removed, lifted. But the motion of all matter requires *time*. The expansive force is created instantly by the explosion, and exerts itself instantly in every direction. It will not willingly wait for the slow rising of the mass of waters high enough to afford it relief. It therefore makes its way at the same time downward upon the solid rock, crushing, crumbling, and grinding it to pieces. All matter, as far as we know, is porous and compressible, and rocks are more compressible than water. Philosophy should therefore teach us that a sudden expansive force between a body of water and a body of rock, while it requires *time* to remove the water, must necessarily to some extent crush the surface of the rock, if it is too large or too much confined to be removed in a body. And this has proved to be the fact by every blast which M. Maillefert has made. At high water, the top of Pot Rock is now eighteen feet below the surface. After a blast, it is found to be covered with broken fragments, some of which are grappled and taken up. One piece was taken up weighing two hundred pounds. The next rushing tide sweeps the top of the rock clean, and after the next blast it is again covered with fragments.

The effect of these blasts has been so successful, that little doubt remains that the obstructions will be removed, and that the navigation, hitherto dangerous, will be rendered safe and easy.

A correspondent of the National Intelligencer describes the method of blasting, as follows: "A large float is anchored in the channel about eighty feet from the rock. Precisely at high water, there being but three or four minutes' cessation of the current, the large tin canister is carried from the float and sunk upon the top of the rock. The boat returns to the float, bringing the end of the wire attached to the canister. Mons. Maillefert attaches the wire to his battery and completes the circuit. Instantly a report is heard, and the mass of waters over the rock rise into the air. There seems to be a solid body of water, perhaps twenty feet in diameter, rising to a height of fifteen or twenty feet, and then towering up in broken fragments and jets twenty or thirty feet higher."

SUPPLY OF WATER TO BLACKWELL'S ISLAND BY MEANS OF A GUTTA PERCHA PIPE.

Among the engineering achievements of the past year, the supplying of Blackwell's Island with water, by means of a gutta percha pipe, is worthy of notice. In December, 1850, the proper preliminary examination having been made, it was determined to supply Blackwell's

Island with Croton water to the amount necessary for 5000 inhabitants. The island is situated just below Hell Gate, the upper or northern end of it reaching the southern limit of that far-famed pass. The water thus divided by the island rushes past it in two deep channels, with a tide little inferior in power to that of the most dangerous parts of " the Gate " itself. For the entire length of the island, the centre-depth of the channel next to the New York shore is from 70 to 75 feet, with a rock bottom. The range of the ledges of rock is in a line with the flow of the tide, while, the rift being nearly perpendicular, the wearing away of the rock has caused the bed of the stream to be exceedingly irregular; the transverse soundings showing profiles singularly uneven and abrupt in their rise and fall. It was on such a bottom and in such a tide that the pipe was to be laid. At the point selected the channel is about 900 feet wide, and the depth of water in the line of crossing varies from 55 to 75 feet, the bed of the stream falling off boldly and attaining the former depth within a short distance from either shore. The difficulty and expense attending the laying a leaden pipe in such a location induced the trial of gutta percha pipe. By all that could be yet ascertained in reference to this comparatively new material, the experiment was warranted, and a contract was accordingly made for the manufacture of the pipe. A pipe was accordingly manufactured, of a strength sufficient to sustain a pressure of 180 lbs. to the square inch. Owing to the great strength of the tide, the operation of laying down the pipe was one of considerable difficulty. It could only be done during the few minutes of comparatively slack water, when a partial cessation of the current ceases from five to twenty minutes. During this time the pipe was to be run across the river from shore to shore; anchors for sinking and holding it in its bed put on at every joint, lowering lines attached from the several boats, and the pipe lowered to its place by movements so graduated that the whole line of it conforming to the profile of the bottom should reach its bed at the same moment. This was considered necessary in order to obviate all risk of the high projecting points of rock chafing the pipe by the vibrating action of the tide, in case it should hang suspended between two rocks. The arrangements and mode of operation were as follows: A line of 12 large boats was stretched across the river and held by stem and stern anchors. Thirteen other boats were stationed near the shore, the men ready to pull to their respective posts as soon as the order was given. Each of these 25 boats was provided with an anchor to attach to the pipe, with a strap to hold the pipe during the operation, and a lowering line. The pipe in one continuous length of 1100 feet was ready on the shore, and a coil of rope, one end of which was attached to it, placed in a well-manned and swift boat. As soon as the tide would permit the crossing, this boat started for the opposite shore, across the stems of the anchored boats. As the boat struck the opposite shore, the rope she carried was immediately manned by a sufficient number of men stationed there, and, aided by those who manned it on the island, the pipe was rapidly drawn across the river. At the moment the pipe was stretched on the surface, from shore to shore, straps were passed around it from the boats in line, the anchors attached, and the pipe lowered to its bed by two separate movements, —the first to bring it in a line of suspension conforming to the bottom of the river; the second, to lay it upon every point of its bed at the same time. From the moment when the first boat started from the island until the work was finished there elapsed 17 minutes. During this time, besides the other necessary work, about one hundred anchors were attached to the pipe. Apparently the work was thoroughly performed, and had it not been for an untoward accident it would have been. A large vessel, disregarding the signals and sentinels which had been placed to prevent all craft from taking this channel, bore directly across the line at the moment when the men were engaged in attaching the anchors—greatly endangering the lives of those in its course. The result was some confusion, and the consequent failure of one of the men to put on all the anchors at his station. This was not known at the time—the tide was now making rapidly, and the order was given to lower. This was at the end of December, 1850. The pipe performed its work very well until the beginning of June following, when, failing to supply the island with water, it was taken up to ascertain the cause of failure. It was found that at the point above mentioned several anchors had been omitted, leaving nearly fifty feet of the pipe subject to the vibratory action of the tide. The constant abrasion against the sharp rocks at the bottom, consequent upon this, had of course chafed the pipe through at one or two points in the space thus unprotected. Except in these points it was comparatively uninjured by abrasion. The rest of the pipe was now subjected to tests, and found to have undergone no perceptible chemical change whatever. Being again proved by the hydraulic press, it stood as much pressure as it did before it was put down. Being convinced, by the winter's experience, of the durability of the material and the advantages it presented in a location like this, and being satisfied that by another method of putting it down all chance of the recurrence of such an accident as the one above described could be obviated, it was determined to use this same kind of pipe again. The second line of pipe was furnished about the 20th of September, and put in its place on the 26th of the same month. To avoid accidents like the one which had rendered imperfect the work of last December, the mode of operation now adopted was different. The pipe being all put together in a continuous length, as before, was attached to a line of large boats, which was stretched down the stream, and along the shore of Blackwell's Island, in the eddy, but in water of sufficient depth to make the proper arrangements for subsequent operations. These boats were stationed at such intervals that the slack of the pipe between them, properly graduated, would conform to the inequalities of the bottom in the line of the destined position of the pipe, the boats themselves being kept in place by being made fast to a hawser 1150 feet long, drawn taught between heavy anchors at the ends of it. The anchors at the upper end were at the point at which the pipe was intended to connect with the Island. The anchors to hold the pipe down were now put on thoroughly, the workmen not being subject to the strength of the tide or danger from sailing craft. As a further precaution against abrasion, both the number and weight of the anchors was increased. Those now put on were but five feet apart instead of nine feet; and the weight of each one was 34 instead of 28 lbs. The line being thus prepared, a steam tow-boat, properly fitted with bitts in the stern, was made fast to the hawser, at a distance from its upper end equivalent to the width of the river. Just before the slack of the flood-tide, the lower end of the hawser was cut loose from the anchor which had kept it stretched, the end taken on board the steamboat and made fast to the bitts, and the movement across the river commenced. The hawser, notwithstanding the weight of anchors upon the pipe, was still kept extended by the power of the steamboat, and the whole line swung round on its centre, until it stretched across the river to the New York shore; when the steamboat was sufficiently near the proper point of that shore, the bite of the hawser was run ashore by a heaving-line, slipped into a large snatch-block, (which had been previously attached to the solid rock just above high-water mark,) the rest of the bite cast loose from the steamboat, and she getting again under headway, the hawser was drawn taught through the snatch-block, and every boat was brought up in a perfectly straight line. From the bows of this line of boats the pipe now hung immediately over its destined bed. The line which suspended it to each boat passed over a chopping-block—a man stood by with a hatchet, and when the word was given, a single blow from each man let the pipe drop to its place. There is but little doubt that it is properly placed, and but little fear that it will fail. It perhaps may be as well to mention here, that the first attempt to put down the pipe in this manner failed. The power of the steamboat was, of necessity, applied in a direction tangent to the arc which she would describe while performing her work. The difficulty of doing this, while so great a weight at her stern was counteracting the power of the rudder, was found to be much greater than was anticipated, and the ebb-tide making when the steamboat had reached about half way across the river, she, together with the entire line of boats, was swept back to the shore whence she had started. The operations at the slack of the flood-tide next day were successful, and the time occupied was twenty minutes.

From this experiment, partly induced by a desire to obtain professional knowledge of a new material, partly forced by the difficulties of the locality, such results as have been determined may be considered satisfactory. Its flexibility and lightness, and the consequent ease and economy in handling it, certainly proved great advantages in the work here detailed. Its specific gravity is about 98, and its flexibility sufficient for its close adaptation to a very uneven and irregular bed. Under the hydraulic press, also, the pipe was found to be slightly elastic, and to this may be attributed the success with which the line bore the pressure to which it was subjected during the winter. The pressure of the Croton at this point is (in a state of rest) about 45 lbs. to the square inch; but in view of the sudden strain often occasioned by the too rapid shutting down of a stop-cock, the iron pipes are always subjected to a test-pressure of 300 lbs. During the winter, a stop-cock, on the lower end of the island, was broken from this cause, although it had previously borne the test-pressure; while the gutta percha pipe, which under the test had not been able to sustain a *continued* strain of more than 180 lbs., bore without rupture the same shock. This is owing directly to its elasticity; the shock was but momentary, and the material yielded sufficiently for its protection. Its toughness and cohesiveness, when properly worked, proved, under various tests, to which it was subjected, to be wonderful. Of its great durability while used in this manner, chemists who have examined the pipe which has been taken up, speak most favorably and confidently.

The gutta percha pipe used was three inches in diameter — the material being ⅜ inch thick, and made in lengths of nine feet. The joints were made as follows: the end of one length was pointed off and partially roughened on its surface with a hot rasp; the end of another piece was made flexible by being heated in hot water, then opened by the hand sufficiently, and carefully dried. The pointed end being inserted, and the other closed around it by the pressure of the hand merely, and being suffered to get cool, the junction became perfect, and the whole pipe essentially one piece. —*Appleton's Mechanic's Mag.*

EXTINCTION OF FIRES IN COAL MINES.

In 1849, a successful attempt was made in England to extinguish a fire which had been raging for considerable time in the Astley coal mines,* by means of carbonic acid gas. During the past year another gigantic experiment has been made, by Mr. Gurney, (the gentleman who operated in the former case,) on a coal mine, long known as the "Burning waste of Clackmannan." This fire had raged for about 30 years, over an area of 26 acres, in a nine-foot seam of coal. It is supposed to have been set fire to by some persons who had been distilling illicit whiskey in it. Shortly after its discovery it rapidly extended itself, and threatened the destruction of the entire coal-field. A sum of £16,000 was laid out in surrounding the fire with a puddle-wall, to prevent its extending to other workings. The wall took five years in building, the workmen being frequently driven back, and obliged to recommence at a greater distance from the fire. It was, however, finally completed 19 years ago. In the building of this wall the lives of nine men and three women were unfortunately lost at various times by the roof falling down and cutting off their retreat, and the fire overwhelming them before they could be excavated. One unfortunate girl was enclosed in this manner, and not burnt, but roasted to death, so that, to use the expression of those who found her, when they took hold of her arm to lift her it came off like the wing of a roasted fowl. The fire having taken place near the crop of the coal, it was surrounded by running the wall from the crop in a form resembling nearly a semicircle towards the dip, and then round again towards the crop, so that the line of the crop formed the diameter of the circle. Still, however, the wall required constant attention; as, if the fire once passed it, it would be a matter of great difficulty and expense again to surround it. In consequence, it has cost the owner of the property (the Earl of Mans-

* See *Annual of Scientific Discovery* for 1850, pp. 194–5–6.

field) about £200 a year in keeping it up, and in the payment of overlookers, there being always a danger of the fire getting, by some accident, such as a fall of the roof, beyond the wall into the lower wastes, and burning the extensive coal-field below. Various reports have from time to time been made by men of great authority in the coal-trade, all of which have agreed in the utter impossibility of extinguishing this fire. It will, nevertheless, readily occur that if the fire was thus, as it were, corked and bottled up to itself, it ought to have gone out from want of air. This, however, was not the case, for no part of the fire-mine being deeper than 20 fathoms, and some of it running at no great distance below the surface, it obtained a sufficient supply of air thence, as well as through the leakages in the puddle-wall, to maintain a smouldering, sulky and volcano-like existence — sometimes more active, and sometimes less so, which could be traced by occasional falls of the surface, the last of which occurred about five months ago, laying bare the burning waste, and discharging smoke and steam. At the request of Lord Mansfield, an inspection of the fire was made by Mr. Gurney, and, notwithstanding the immense extent of the burning waste, he thought it possible to extinguish the fire; and, extraordinary as it may appear, this object has been effectually accomplished by a simple and inexpensive process.

We are accustomed to judge of great things by small, and, as a popular illustration, all the world knows practically that putting on an extinguisher puts out the candle; but perhaps few have taken the trouble to consider why it does so. It is simply that the extinguisher contains a very small quantity of air, of which about one fifth is oxygen, and the rest nitrogen. As soon as this oxygen is consumed, which, in so small a quantity of air as the extinguisher will hold, is almost at once, nothing remains to support combustion, and the candle goes out; for the extinguisher then contains only the nitrogen of the air and carbonic acid, the product of the combustion of the candle, which mixture of nitrogen and carbonic acid is chokedamp. It is, of course, obvious that if the fire-mine could have been similarly treated it would have extinguished itself by the product of its own combustion, as in the above case of the candle, and as is often the case in coal-pits. The difficulty was that another element would come into the problem, which was, that supposing the mine to be placed under an extinguisher, (almost an impossibility, considering its size,) and all combustion to have ceased, still the magazine of heat collected during so many years' burning would continue, and cause the mine to reïgnite on the reädmission of fresh air. Mr. Gurney's method of effecting this object was to force a stream of chokedamp through the mine, by means of the high-pressure steam-jet, at such a temperature as would, after putting out the fire, cool down the mine below any degree of heat that would permit it to reïgnite on the admission of atmospheric air, and at such a pressure as to make all the leakages of the waste outwards of chokedamp, so that every inlet might become an outcast by means of which the atmosphere was perfectly excluded from all contact with the fire. The machinery for conducting the experiment consisted of a high-pressure steam-boiler, about 60 feet of inch gas-pipe, and a small cone for the high-pressure steam-jet at the end of it, which jet was placed at the proper striking distance from a cylinder of sheet-iron one foot in diameter and about nine feet long. The cylinder was the passage between a coke furnace and the downcast shaft, through which the air was driven by the force of the steam-jet, and, by a simple contrivance, we were able to blow in either the air passed through the furnace, or fresh, at pleasure.

When the preparations were completed, a party descended into the mine, Mr. Gurney blowing them in fresh air from above, and there cleared away two old iron doors into the waste, and knocked a hole through an old puddle-wall, and then, hearing a good deal of rumbling and rushing, as if the roof were falling, they thought it more prudent to retreat, as they had effected their object of opening a passage for the gases into the burning waste. The heat at the bottom of this shaft was 100° F. at this time. These obstacles having been cleared away and a free passage obtained, the shaft was covered with iron plates and clayed over, so as to render it air-tight, and the chokedamp was turned on. The extinguishing gas was made by passing the atmospheric air through an intense coke fire in a brick furnace, which deprived it of all its oxygen, or rather the oxygen combined with the carbon of the coke, and formed carbonic acid, which gas, in mixture with the nitrogen left, was forced through the furnace, along the iron cylinder, down the shaft and into the burning waste; the quantity of coke consumed being a sufficiently accurate measure of the air passed.

The remainder of the process is thus described by one of the assistants of Mr. Gurney: After blowing in about 8,000,000 cubic feet of chokedamp, (at the rate of about 7,000 cubic feet per minute,) which we calculated to be about the contents of the waste, (allowance having been made for falls of the roof,) we found the upcast or high level shaft or drift was full of it to the mouth, flowed over, and ran along the ground, extinguishing lights if held near the surface of the earth at some distance from the spot. We found when we ceased blowing in gas that after a time the chokedamp receded in the upcast, and that whenever we blew it into the downcast, it poured out of the upcast in volumes, being thus a perfect measure of the quantity of chokedamp in the mine, and giving us a proof that it had passed completely through it. After keeping the mine full for upwards of three weeks, it was thought advisable to blow in chokedamp at a lower temperature than we had been previously doing, which we believed to have been about the temperature of 250°. In order to effect this, Mr. Gurney used a very beautiful contrivance, by which, by the power of the steam-jet, water was driven into the shaft along with the chokedamp in the form of the finest spray. This process Mr. Gurney thought very important, as he considered the difficulty of cooling the immense magazine of heat, after the fire was extinguished, to prevent reïgnition on the admission of fresh air, to be the most uncertain part of the whole experiment. That he could extinguish the fire he had no doubt whatever, but to cool down the waste against the existing conditions of non-conduction and non-radiation, he considered far more difficult. The water being so minutely divided by the immense force of the jet, was held in suspension in the air, and floated on with it through the mine. A large portion was in actual solution, but far the greater part was simply mechanically suspended like fine mist, and did not precipitate or condense. When the temperature was sufficiently reduced, as indicated by the thermometer, so as to leave no fear of reïgnition, fresh air was blown in by the spray-jet, so as to pass through the mine charged with vapor, in order to cool it enough to allow of its being entered. After a time the jet was reversed, and the air drawn through the mine in a contrary direction, so drawing out the air we had blown in charged with mist; and we continued drawing out mist or vapor for several days, which showed that it had filled every part of the waste and had remained suspended. The temperature of the air that was drawn out gradually decreased at the rate of about six degrees a day. After about one month's operations the downcast shaft was uncovered and descended, and found to be of a temperature of about 98°. A shaft was then sunk into the middle of the burning waste at a point where the fire was supposed to have been the most fierce at the commencement of our operations. The roof was here found to have fallen, so that it was impossible to enter. The fire, however, was extinct.

CAOUTCHOUC, ITS PROPERTIES AND APPLICATIONS.

The following is an abstract of a paper, read before the Royal Institution, London, by Mr. Brockedon, on Caoutchouc, its properties and applications: —

Caoutchouc is a vegetable constituent, the product of several trees. The most prolific in the substance are, *Siphonia Caoutchouc*, *Urseola elastica*, *Ficus elastica*, &c. Of these, the first-named extends over a vast district in Southern and Central America; and the caoutchouc obtained from these districts is best adapted to manufactures. The *Ficus elastica* is abundant over 10,000 square miles in Assam, Asia. The *Urseola elastica* abounds in the islands of the Indian Archipelago. It is described as a creeper, of a growth so rapid that, in five years, it extends 200 feet, and is from 20 to 30 inches in girth. This tree can, without being injured, yield, by tapping, from 50 to 60 pounds of caoutchouc in one season. A curious contrast is exhibited in the tardy growth of the tree from which the gutta percha is obtained. This tree does not come to its prime in less than from 80 to 120 years. The produce cannot be obtained but by sacrifice of the tree. It is found in a concrete state, between the bark and the wood, after the tree has been cut down; and it is in this condition that, having been scraped out, it is sent to our markets. When coagulated by evaporation or agitation, caoutchouc separates from the aqueous portion of the sap of the trees which yield it. This solid and fluid cannot afterwards be reünited, any more than butter is capable of mixing with the milk from which it is separated. Some specimens of caoutchouc are harder than gutta percha itself, while others never solidify, but remain in the condition of bird-lime or treacle. The process termed vulcanizing was discovered in 1843. A sheet of caoutchouc immersed in melted sulphur absorbs a portion of it, and, at the same time, it undergoes some important changes in many of its characteristic properties. It is no longer affected by climatic temperature ; it is neither hardened by cold nor softened by any heat which would not destroy it. It ceases to be soluble in the common solvents of caoutchouc, while its elasticity becomes greatly augmented and permanent. The same effect may be produced by kneading sulphur into caoutchouc, by means of powerful rollers ; or the common solvents, naphtha and spirits of turpentine, may be charged with a sufficient amount of sulphur in solution to become a compound solvent. A vulcanized solid sphere, of two and a half inches in diameter, when forced between two rollers a quarter of an inch apart, was found to maintain its form uninjured ; in fact, it is the exclusive property of vulcanized caoutchouc to be able to retain any form impressed upon it, and to return to that form on the removal of any disturbing force which has been brought to bear upon it. Caoutchouc slightly expands and contracts in different temperatures ; it is also capable of being condensed under pressure. A tube of two and a quarter inches, impactly secured, was subjected to a force of 200 tons ; the result was a compression amounting to one tenth. Great heat appeared to have been evolved ; and the excessive elasticity of the substance caused a fly-wheel, weighing five tons, to recoil with an alarming violence. The evolution of heat from caoutchouc, under condensation, is a property possessed by it in common with air and the metals ; it differs from the latter, however, in being able to exhibit cold by reäction. Mr. Brockedon stated, that he had raised the temperature of an ounce of water two degrees in about 15 minutes, by collecting the heat evolved by the extension of caoutchouc thread ; he refers the heat to the change in specific gravity. He contends that this heat thus produced is not due to friction, because the same amount of friction is occasioned in the contraction as in the extension of the substance, and the result of this contraction is to reduce the caoutchouc thus acted upon to its original temperature.

Among the recent applications of the elastic force of caoutchouc, attention was directed to the application of tubes of vulcanized caoutchouc as *torsion springs* to roller blinds, adjusted to the heaviest external blinds of houses, or the most delicate carriage-blinds ; and equally applicable to clocks and various machines as a motive power. To the *raising of weights*, (Hodges' patent application,) short lengths of rubber, termed *power-purchases*, are successively drawn down from, or lifted to, a fixed bearing, and attached to any weight which it is required to raise. When a sufficient number of these power-purchases are fixed to the weight, their combined elastic force lifts it from the ground. Thus, ten purchases of the elastic force, of 50 pounds each, raise 500 pounds. Each purchase is six inches long, and contains about one and a half ounces of vulcanized caoutchouc. These ten purchases, if stretched to the limit of their elasticity, not of their cohesive strength, will lift 650 pounds. This power — the accumulation of elastic force — though it obeys the common law of mechanical powers, differs enough to be distinguished as a new mechanical power.

GLASS SHADES.

The largest glass shade ever produced was lately blown at Birmingham by an English workman. It is 62 inches by 26½ inches in diameter, and contains nearly 40 pounds of glass. A secret in blowing great glass bubbles was lately described in the London Builder. It consists in simply moistening the mouth with a little water before blowing. The water is converted, in the interior of the drop, into steam, which greatly aids the breath in extending the dimensions of the "bell."

EXPANDING MODEL OF A MAN.

A mechanical curiosity, called the "Expanding Model of a Man," was contributed to the Great Exhibition, by Count Daru, an exiled Pole. The figure represents a man five feet high, in the proportions of the Apollo Belvedere. From that size the figure can be proportionally increased to six feet eight inches; and, as it is intended to measure the clothing of an army, it is so constructed as to be capable of adjustment in every part to the particular proportions of each individual. This is obtained by mechanism composed of 875 framing pieces, 48 grooved steel plates, 163 wheels, 202 slides, 476 metal washers, 482 spiral springs, 704 sliding plates, 497 nuts, 8500 fixing and adjusting screws, with numerous steadying pins; so that the number of pieces is upwards of 7000.

IMPROVED SAFETY LAMP.

The great objection against the use of Davy's safety lamp was the insufficient light it afforded to the miners. This has been remedied by M. Eloin, of Belgium, who has constructed a lamp perfectly safe, and giving a light equal to six Davy lamps. It consists of a lamp surrounded by a strong short glass cylinder, surmounted by an iron or brass one, capped with coarse wire gauze; the air for supporting combustion being admitted through fine wire gauze at the bottom, and made to impinge directly upon the flame. This air being only such as is necessary to support the flame, and the combustion being perfect, the portion of the cylinder above the flame must always be filled with the products of combustion, and never with an explosive atmosphere. The weight of the lamp is by no means objectionable; it is inexpensive, and the power of perceiving the presence of fire-damp is fully equal to the original Davy. — *London Mining Journal.*

NATURAL PHILOSOPHY.

STAITE'S ELECTRIC LIGHT.

The Manchester (Eng.) Courier gives an account of an exhibition of Staite's electric light, in that city, before a committee appointed to inquire into its adaptation for general illumination. The apparatus exhibited was constructed with a view of testing the self-sustaining power of the mechanical arrangement adopted for the continual development of the light, the sustaining power of the battery, and the cost of the whole. At four the light was set in action, it being understood that it was to burn for five hours and a quarter without interruption, that being the period at which the committee had expressed themselves satisfied that it could be continued for any definite length of time. From four o'clock to six the light continued to burn with increasing brilliancy, giving successively a light, adjudged equal, the first half hour, to 200 candles, at five to 300, at half-past five to 400, and so successively till the electric fluid came into its fullest action at half-past six, when the light, by the instrument used, developed the immense number of 700 candles, which intensity of light was steadily kept up till the experiment concluded at a quarter past nine o'clock. Colored prints were brought from the influence of the direct sunbeam to that of the ray from the electric light, in which not the slightest difference of shade of color could be observed. The light of each was then passed through the prism, which still further established their identity, as their point of junction could not be ascertained, thus proving its immense value to the manufacturer and exhibitor of goods.

PAGE'S ELECTRO-MAGNETIC LOCOMOTIVE.

An experiment of applying electro-magnetism as a locomotive power, was made by Prof. Page, during the past season, on the Baltimore and Washington Railroad. The apparatus used was that perfected by the gentleman making the experiment. The progress of the locomotive, when it started, was so slow that a boy was enabled to keep pace with it for several hundred feet. But the speed was soon increased, and Bladensburg, a distance of about five miles and a quarter, was reached in thirty-nine minutes. When within two miles of that place, the power of the battery being fully up, the locomotive began to run, on nearly a level plane, at the rate of nineteen miles an hour, or seven miles faster than the greatest speed heretofore attained. This velocity was continued for a mile, when one of the cells cracked entirely open, which caused the acids to intermix, and, as a consequence, the propelling power was partially weakened. Two of the other cells subsequently met with a similar disaster. The cells were made of light earthenware, for the purpose of the experiment merely, without reference to durability. This part of the apparatus can therefore easily be guarded against mishap. The great point established was, that a locomotive on the principle of Professor Page can be made to travel nineteen miles an hour.

The locomotive of the above experiment weighs ten and a half tons, and has five-feet drivers, with two-feet stroke. In appearance it does not differ much from a passenger car.

PAGE'S MAGNETIC ENGINE.

The following is a mechanical description of the magnetic engine, constructed and exhibited by Prof. Page, the principle of which was explained in the Annual of Scientific Discovery, 1851, pp. 104–8.

Prof. Page's engine differs from all others hitherto constructed, both in principle, in arrangement, and in action. He found, in the commencement of his experiments, that the magnet required time to receive the magnetism of the coil, and that it also required time, when the circuit was broken, for the magnet to part with its induced magnetism ; the induced magnetism, or secondary current of the magnet, acted also in the very opposite direction to the one required. To remedy this he came to the conclusion that it was necessary to make the current of the magnet (the secondary current) act always in the same direction with the object to be moved ; at the same time it was necessary that the magnet should always be magnetic. This was for the purpose of gaining in the element of time, as the magnet could not at once be deprived of its counter-force. He therefore adopted the principle of *hollow electro-magnetic coils.*

The principle, therefore, by which this engine is operated, is electro-magnetic attraction, by the intermittent charging of a series of hollow magnets acting continuously on a piston magnet moving inside of them, in the direct line of motion, whether that line of motion be horizontal, vertical or circular [rotary.] These hollow magnets are formed of coils of copper wire, covered with a non-conducting substance ; about 1500 yards of wire being comprised in each coil. The several coils, when arranged on a frame, form a cylinder made up of sections. The several sections are all connected by a metallic connection, but are so arranged and joined to the cut-off, or slide, that but three magnets (hollow coils) are charged at once, and one coil is being continually cut off behind, and the current continually thrown on to the coil before in the direction in which the piston is moving. The peculiar feature of the engine, then, is to be found in a continual electro-magnetic draught in the secondary current direction of the iron magnet, or piston. When the coils are charged, this piston moves in their centres, touching nothing. To the end of this piston is attached a double crank, which gives motion to a shaft, on which is a fly-wheel. Attached to one side of the piston is an arm, which works the cut-off. The battery wires are screwed to two rods of copper, one running along one side the whole length of the coils, the other close to the coils on a narrow platform on the engine frame. Small blocks of copper, connected with the hollow coils by wires, form the connecting points in the circuit, and perform a similar office to the ports of a steam-engine. Attached to a slide, moved by the arm connected with the piston, are two thin strips of copper, separated a short distance at the middle part. Each strip has two metal spring plates, always in contract with the copper blocks. Of these plates, two only are in connection with the battery at once. As the plates, by the motion of the arm, move backwards and forwards, the circuit is formed alternately, from coil to coil, cutting off the current behind and throwing it ahead. The stroke of the engine is reversed by throwing the current from one half the coils to the other half. This is done by two dogs, or projections, fixed on the side of the frame, which strike against a charger fixed on a centre-pin. When this charger strikes one projection, it brings one set of slides, or plates, to form the circuit; and when it strikes upon the other projection, it turns upon its pin and comes in contact with the strip of copper attached to the other slides; there is therefore three of the coils always charged at once. Whenever a full stroke has been made, the charger at once diverts the current from one half the coils to the other, acting upon the opposite end of the piston; the three coils near the middle, being first charged, and so on, one after another, as the piston moves along. A stroke of any length can thus be given to the engine, a matter never before accomplished. — *Scientific American.*

ELECTRO-MAGNETIC TRACTION ON RAILWAYS.

The idea of increasing the adhesiveness of the wheels of locomotives, without increasing their weight, has, for a number of years past, occupied the attention of mechanicians. To effect this, a plan has been presented to the French Academy, by Mr. Nickles, to convert the wheel of the locomotive into a magnet, and make it stick to the iron rail by a like adhesion. This he does by placing a galvanic battery under the body of the engine. A wire coming from the poles of this battery is then coiled horizontally round the lower part of the wheel, close to the rail, but in such a way that the wheel turns round freely within it, fresh portions of its circumference coming continually into relation with the coil. The part of the wheel in immediate contact with the rail is thus made magnetic, and therefore has a strong adhesion for the surface along which it moves, and the amount of the adhesion may be increased or diminished at any time, by merely augmenting or reducing the intensity of the galvanic current that circulates through the surrounding coil. By means of a handle the electricity may be turned on or off, and an effectual brake be thus brought into activity, that can make the iron rail smooth or adhesive according to the requirements of the instant, and this without in any way interfering with the free rotation of the wheels, as the friction brakes of necessity do. The lower portion of the wheel, for the time being, is in exactly the same condition as a bar of soft iron placed within a coil of wire circulating electricity. But as it rises up out of the coil during the rotation of the wheel, it grows less and less magnetic, the descending portions of the opposite side of the circumference acquiring increased magnetic power in like degree.

Experiments, made with a large locomotive, give the following results: — "The rapidity of rotation, however great it may be, does not at all effect the process of magnetizing the wheels. This is conceivable, when we reflect upon the rapidity of the propagation of electricity, and upon the instantaneousness of the magnetizing action.

"Upon a horizontal plane of iron, dry and perfectly polished, the force required to make an electro-magnet slide is, clearly, to the force required to remove it vertically from the plane, as the force required to make a mass of unmagnetized iron slide to the weight of that mass.

"But this is not the case upon inclined planes. While the coefficient of the force required to make the mass of iron slide, diminishes till it becomes nothing, the magnetic adhesiveness remains invariable. This is conceivable, since the resultant of the actions produced by a magnet upon a plane of iron is perpendicular to that plane, while the mass of iron, which only acts by its own weight, exercises its action in the direction of the weight.

"Thus, upon inclined railways, one portion of the surcharge intended to produce adhesion is not only inefficient for this purpose, but it even operates unfavorably, in that, by the influence of weight, it tends to cause the train to descend; while, on the contrary, magnetic adhesiveness is always the same, whatever be the degree of inclination. Atmospheric perturbations, fogs, &c., which so considerably impair adhesion produced by weight, do not sensibly affect magnetic adhesion, which remains the same whether the rails be wet or dry. Finally, a locomotive with magnetized wheels does not require a greater force of traction than one of which the wheels are in the normal state."

THOUGHTS ON TELEGRAPHIC COMMUNICATIONS TWENTY YEARS AGO.

In 1833, Hon. John Pickering, since deceased, by request of the Boston Marine Society, delivered a lecture on the subject of "Telegraphic Language," tracing the art from the first communications made by torches at the siege of Troy, until the date of the address. In conclusion, he makes the following curious reflections and suggestions, which all must acknowledge to border very closely upon the prophetic:—

"But the application of the art to other subjects will naturally follow the progress of those rapid improvements which are believed to be characteristics of the present age. If, for instance, we take the case of *commercial affairs* in general, we know what a change has taken place in the transmission of intelligence, relating to business, within a few years past; and it would seem, too, as if every new impulse in business rendered it necessary to add new energy to our means of communication. Is it too much to suppose that the demands of business may, before a long time, lead to the establishment of telegraphic communications* between our principal cities? Twelve years ago it was stated in the French papers that *three thousand* messages could be conveyed in one day from Paris to any extremity of France, and that answers could be received to them. Even since I have been preparing to meet you at this time, the question has been agitated as to the practicability of a telegraphic line for purposes of business between the great seat of our northern manufactures and this city. And why may we not look forward to the time when there shall be such a communication between this city and New York, Philadelphia, and Washington? I dare not presume to predict such an event for some time to come; and yet when we daily witness the extraordinary resources of this growing country — when we observe the wonderful results of an active and intelligent population incessantly occupied in developing their powers and resources — and stimulated, by the circumstances in which they are placed, to greater and more intense exertion than the same number of people have probably ever been — when we see, too, that all ordinary calculations, founded upon the precedents of other nations, fall short of what is here actually accomplished — when we witness all this, we cannot believe that it is being too sanguine to expect the application of the telegraph to a vastly greater extent than we have yet seen. Will it be said that the demands of business will never be such as to warrant the adoption of it, for instance, between this city and New York? For want of practical knowledge, I dare not affirm that this will very soon be the case; and yet if there are now essential advantages to business in obtaining intelligence from New York in two days, or less, or at the rate of eight or ten miles an hour, any man can perceive that there may be a proportionate benefit, when we can transmit the same information for that distance, by telegraph, at the rate of four miles in a minute, or in the space of a single hour from New York to Boston. Let us take as an example, by way of illustrating this view of the subject, the case of the great question now agitated at Washington, and in which the welfare of the country is so essentially involved. Might it not prove to be of vital importance to thousands of our men of business, in this quarter of the Union, whether friendly or adverse to the tariff, to be able to know the decision of the government at Washington, in two hours and a quarter after that decision was made? Why do we annually see such extraordinary efforts made to transmit the message of the chief magistrate, and other state papers and public acts of government, through all parts of the country? When, therefore, we find by actual experience that this rapid mode of communication is deemed necessary to the wants of an active community, who will venture to set bounds to its application? We can, in imagination, suppose it to be extended on our coast from one end of the continent to the other; and

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* Mr. Pickering here refers to the old form of telegraph by which intelligence is communicated from station to station by means of signals.

if any people shall ever carry it from our Atlantic shores across the continent to the coast of the Pacific Ocean, I feel the strongest conviction that it will be accomplished by our countrymen; when we may obtain intelligence from China in as short a time as it now reaches us from Europe."

ON THE CONDUCTION OF ELECTRICITY THROUGH WATER.

Mr. Bakewell, at the British Association, stated the results of some experiments on the conduction of electricity by water, made with a view to prove that an electric current may be transmitted for a considerable distance through unprotected wires immersed in water. A thin copper wire, (No. 20,) 320 feet long, was stretched across a pond, and two copper plates, ten inches square, to which wires were soldered, were immersed to serve as conducting plates for the return current. A Smee's battery of two pairs of plates was used; and when the connexion was made with a galvanometer on the opposite bank, a steady deflexion of 30° was maintained, and a strong blue mark was produced by a steel electrode on paper moistened with a solution of prussiate of potass in diluted muriatic acid. In this experiment the conducting plates were placed close to the wire and on opposite sides of it, so that the return current passed diagonally across the exposed wire. The water in this case appeared to act as a conductor and as a non-conductor at the same time, in proportion to the surfaces exposed to its influence. In the next experiment the wire was doubled, and a current of electricity from the same battery was transmitted through the wires, both being immersed in the water. In this case the deflexion of the needle was more powerful, and it continued steady at 45°.

SPEED OF THE MAGNETIC CURRENT.

A long experience of the Coast Survey, with some different lines of telegraph, establishes the fact, that the velocity of the galvanic current is about *fifteen thousand four hundred miles per second*. The time of transit between Boston and Bangor was recently measured, and the result was, that the time occupied in the transmission was *one hundred and sixtieth of a second*, and that the velocity of the galvanic current was at the rate of sixteen thousand miles per second, which is about six hundred miles per second more than the average of other experiments.

SUBMARINE TELEGRAPH BETWEEN ENGLAND AND FRANCE.

The project of constructing a submarine telegraph between England and France, across the Strait of Dover, unsuccessfully attempted in 1850, has been again undertaken during the past year; and, aided by experience, has been fully accomplished. The line or cable at present in use is much more substantial than that formerly employed; and was constructed in the following manner: — Four copper wires, known as the 16 wire gauge, each encased in a covering of gutta percha, of a quarter of an inch in diameter, constituted the first layer. These several lines are twisted and plaited about each other, in spiral convolutions, in the manner of an ordinary cable or rope. The next superincumbent coil to this consisted of hempen yarn, previously saturated in a reservoir of prepared pitch and tallow, and, in its turn, is tightly twisted and compressed, impermeably and by steam-power, over the gutta percha, with its enclosed copper wires. This is overlaid again with a series of hempen yarns, five or six in number, and about an inch in diameter, saturated in the pitch and tallow, with a view of what the workmen call "worming" the gutta percha. The gutta percha thus protects the wire, and the hempen yarn in addition acts as a cementitious material to the gutta percha, which, ultimately, has thrown over it a coat of galvanized wire. This completes the first process, and the manufacture of the rope in the spiral form is for the purpose of giving flexibility. The second process consists in hauling off the cable, so far completed, and passing it on to another wire-rope machine, where the cord is completely covered over with ten galvanized iron wires, each wire being about the thickness of a lead-pencil, and known as "No. 1 galvanized wire gauge." This galvanized iron sheathing is to protect and preserve the interior layers from the action of the sea, and the weight is considered to be sufficient to sink the cable *ex necessitate gravitatis.* The appearance of the cable, thus completely encased in a shining coat of galvanized iron, and divested of tar and dirt, is quite lustrous and silvery. The entire weight of the cable thus completed was about 200 tons. The actual submersion of the great cable took place on the 25th of October. The huge coils were arranged on board her majesty's ship *Blazer*, towed by the steamship *Fearless.* One end of the cable being secured to the beach, on the South Foreland coast, the *Fearless* then steamed ahead — having made fast her towing tackle to the hull of the *Blazer* — at the rate of two miles an hour out to sea, the men on board the latter vessel paying out continuously the cable over her stern, from whence, by the action of its own weight, it sank into the submarine sand and valley. The track between South Foreland and Sandgate — the corresponding point on the French coast, and which was selected as presenting, from soundings and surveys, the fewest obstacles and probable disturbances — was marked out by pilot buoys as the best site for the submerging of the wire that could be adopted by those having the best knowledge of naval and marine dynamics. The depth of the sea line at starting point was from 20 to 30 feet, and its maximum depth 180 feet, or 30 fathoms. At intervals during the progress, fusees were fired, and messages sent along the wires, in order to test the perfectness of the connection and insulation. The distance from coast to coast was 21 miles, and the length of wire provided for, 24 miles; yet, notwithstanding the surplus wire, the line was found, on nearing the French coast, to be wanting in length for a distance of more than a mile. This mishap of the cable running short arose from the fact that, while the *Blazer* was being towed by the *Fearless* at only two miles an hour, the cable, at certain intervals, was run out at the rate of four and five miles an hour, which necessarily caused it, from want of regularity in the delivery motion, to take the sea bottom in a series of loops or "kinks;" thus accounting for each mile of cable not covering its allotted mile of sea. The vessels were, therefore, compelled to remain anchored at the end of the submerged wire until the deficit could be manufactured and forwarded. This was, however, soon effected, and the connection between the two coasts rendered firm and complete. The connections with the inland telegraphs of England and France were soon afterwards made; and the line is now in practical working order, messages having been transmitted and returned from London to Paris in less than three minutes.

The whole cost of the cable was about £15,000, and it is confidently hoped that it will remain permanent and unaffected by the agitation of the sea. A patent to obviate that difficulty has been secured in England, by Mr. Dick, of Ayr. His process is to enclose the wire, previously encased in gutta percha, in a cast-iron envelope. This envelope is made of perforated balls and perforated cylinders, threaded on the cable in succession; first a ball, next a cylinder, another ball, another cylinder, and so on. Of course, the ends of these cylinders are so formed as to fit the balls exactly, and the structure is a succession of knee-joints, or rather a shark's back-bone. This arrangement claims to produce an effective protection of the rope, with flexibility and cheapness.

The success of the telegraph between England and France has, to some extent, revived the project of a trans-atlantic one between Europe and the United States. The London Morning Post, in discussing the subject, says that the only difficulty of the undertaking is to provide the requisite funds. Making an estimate for a wire rope, one inch in diameter, covered as usual, the cost would be £50 per mile, and the nearest points of Europe and America being 2,000 miles apart, the whole expense would not exceed $2,500,000. The importance of such a work is not to be estimated by thousands of millions.

APPLICATION OF THE ELECTRIC TELEGRAPH TO A NEW SYSTEM OF FIRE ALARMS.

The following is an account of the application of the electric telegraph to a new system of fire-alarms, first devised by Dr. William F. Channing, of Boston, and recently carried out by the municipal authorities of that city, under his direction. The application of the telegraph to fire-alarms was first published by Dr. Channing in the Boston Daily Advertiser, of June 3, 1845. In 1847–8, an attempt was made to realize it in Boston; but the experiments by the city were not carried to the extent of erecting wires. In the month of March, 1851, he presented a detailed plan to the city government of Boston, which was adopted in June; and an appropriation of $10,000 was made to carry it into effect. An essential feature of the system is the employment of electricity, first, to *signalize* the existence of a fire to the central office, and, second, by means of electro-magnetism, to produce *mechanical effects* at the churches or other buildings containing alarm-bells, so as to give a public alarm. Two separate circuits are employed for these two functions; one, the signal circuit, and the other the alarm circuit. Comparing the municipal telegraph to the nervous system of man, these circuits correspond respectively to the *sensitive* and *motor* nerves. A single agent at the centre controls the whole system, receiving the indication of a fire by *the signal circuit*, and throws the current of the battery on the alarm circuit at will. In the course of the signal circuit are forty signal stations, consisting of locked cast-iron boxes, placed on the outside of buildings, and in charge of suitable persons. In case of fire, one of these is opened, and a crank within it turned a few times. The axis of this crank carries a circuit wheel, which communicates to the central office the number of the district and station — striking them upon a bell, and also recording them permanently on a Morse register. The agent of the office immediately depresses the appropriate key of the district keyboard connected with the alarm circuit. The keyboard has a key for every district signal which is to be struck on the bells. When the key is held down, a circuit cylinder revolves beneath it, completing the circuit at the precise intervals requisite to strike the signal of the district with suitable intermissions. This action of the current liberates each time the detent of a powerful striking machine at each belfry or alarm station in the circuit, so that a single blow is struck synchronously upon each bell. The Boston *nineteen* alarm-bells are thus telegraphically connected. The machines are carried by weights, varying from 800 to 2000 pounds. The detents of these machines are liberated by a falling arm, which is set off by the attractive force of an electro-magnet. This beautiful device, by which an immense saving of electro-magnetic power is obtained, is due to Mr. M. T. Farmer, the constructor of the system, to whom, also, many of the adaptations and details of arrangement in the system are to be ascribed. In the central office is an alarm-bell register, which shows the number of blows struck upon the bells. There is also a testing-clock, which tests each circuit automatically once an hour; all the batteries employed in the system are also at the central office. In each signal box there is a little electro-magnet and armature, whose *click* enables police or other communications to be transmitted from the central office to the signal stations, while a signal key in the box allows return communications to be made. At each signal and alarm station, sixty in all, discharges of atmospheric electricity are provided with a ground connection. This affords incidental protection to the city from lightning. The circuits comprise *forty-nine miles* of No. 8 and 10 wire of Swedish iron. To prevent irregularities, the ground is not used as part of the circuit. Between each station there are always *two* wires following widely different routes. If one is accidentally broken it occasions no interruption of the circuit. The buildings, for the support of the wires, are carefully selected.

The signal and alarm circuits in Boston are, for various reasons of economy and security, increased in number to three of each class. These are the North, South and South Boston Circuits. By an arrangement of the District key-board, the current from the battery is thrown momentarily in rapid succession on each of the three alarm circuits for each stroke of the bell. A great economy of battery power is thus obtained. In the place of the bells and striking machines, the alarm circuit may be applied to setting off one or more air-whistles, at such intervals as to give and repeat the district signal. The wires may be insulated in a metallic tube and buried under the streets, instead of the mode of suspension above the buildings. The system proposed is a step in municipal organization, in advance of any heretofore attempted. It is an indication of a higher social development. The municipal telegraph, in this and other applications, is to constitute the nervous system of organized societies. A fire telegraph (probably only for *signalizing*, not for *mechanical agency*, in connection with the bells) is stated to be in operation in Berlin. A private signalizing telegraph also connects the alarm-bell towers in New York. But these are very distinct from the thorough organization which Dr. Channing has proposed, and from the development of the *motor functions of the telegraph*, described in the preceding pages. — *Editor.*

ELECTRO-MAGNETIC CLOCKS AT BERLIN.

As there exist already at Berlin electro-telegraphic wires for signalizing fires, the same apparatus will also be used for the clocks. There will be established several leading clocks in the different parts of the town, which, being connected with the wires, will indicate the time on *simple dials.* The cost of such a clock and wires will be twenty-eight thalers ; the subsequent yearly expense only four thalers. Such apparatus can be applied at any private house, and an additional advantage would be, that all these watches would keep an uniform and exact time.

EFFECT OF FUNNELS OF STEAMERS UPON THE COMPASS.

The following is a communication from Captain Johnson, R. N., to Col. Sabine, containing the results of experiments made for the purpose of determining the effect of the telescopic funnels of steamships upon the compass : —

" I wish you to bring under notice the following results which I obtained with reference to the effect of hollow iron cylinders upon the compass, when placed inside each other ; the object being to ascertain whether the whole difference of deviation, under the two conditions of these telescopic funnels, was due to the difference of their elevation and depression only, or whether a portion of the said differences was attributable to the induced magnetism of the separate parts of the funnel, when lowered, acting upon each other. As it would have required more time than could be afforded to hoist the parts of those huge funnels in and out of the ship, while the requisite succession of observations were made, I procured three hollow iron cylinders of smaller dimensions, their several diameters being such as to admit of one cylinder being placed inside of another, and leaving a space of about one eighth of an inch between their surfaces. Having placed a standard compass on one of the pedestals in the observatory, and ascertained the magnetic meridian for the moment by the collimator, the largest or external iron cylinder (No. 1) was brought in and placed to the eastward of the compass, the principal mass of the cylinder being below the level of the needle and card, and its upper end being 2½ inches above that level. By this means a deflection or deviation of 10° 10′ was produced, the north end of the needle being drawn that amount to the eastward of the correct magnetic north. Cylinder No. 2 was next placed inside of No. 1, when the deviation was increased to 12° 15′. Cylinder No. 3 was then placed inside of No. 2, and the deviation was again increased to 14° 15′, the north end of the needle being drawn to the eastward in each case. Hansteen's Magnetic Intensity instrument was then placed with the centre of its needle (as nearly as I could adjust it) in a similar position to that which the course of the compass had occupied, and the following results were obtained: —

Time of 100 vibrations, starting from an arc of 18° —

Previous to the cylinders being brought into the observatory,	6′ 57″
No. 1 cylinder in place, ...	6′ 51″
No. 2 cylinder in place inside of No. 1, . . .	6′ 47″
No. 3 cylinder in place inside of No. 2, ...	6′ 45″

"The intensity instrument being removed, a dipping needle was then employed, and the following are the results of observations:

	Dip.
Previous to the cylinders being brought into the observatory,	68° 37′
No. 1 cylinder placed to the south of the instrument, .	70° 10′
No. 2 cylinder in place inside of No. 1, . . .	70° 27′
No. 3 cylinder in place inside of No. 2, ...	70° 37′

"The conclusion to be deduced from all these observations appears to be, that to the deduced magnetism of the surfaces of the cylinders acting upon each other is due a portion of the deviation; and reasoning by analogy, a similar deduction is applicable to the telescopic funnels of steamships."

INSULATOR FOR WIRES OF THE ELECTRIC TELEGRAPH.

A PATENT has been obtained by Mr. John M. Batchelder, of Boston, for an improved insulator for wires of the electric telegraph. It consists of a cast-iron cap, which is lined throughout with glass by the operation of blowing. The shank, or holder, is then introduced with a hot mass of glass, by which it is firmly fixed in its place in the centre of the cap. The distance from the shank to the lower edge of the cap is about four inches, measured upon the surface of the glass. When the shank is inserted, the end is prevented from coming in contact with the metallic cap by the glass lining; thus insuring perfect insulation at this point. The wires are attached to the top of the insulator, or at the side, as may be preferred. The reëntering angle at the lower part of the cap protects the glass within from missiles, and is calculated, in a storm of wind and rain, to direct the rain downward, and thus preserve the insulation. The patent also includes a lining of porcelain, which is applied to the inner surface of the cap, in the same manner as in culinary utensils. This insulator is used for the wires of the Municipal Telegraph, recently introduced in Boston. — *Editor.*

GALVANIC SURGERY.

One of those extraordinary applications of science to the benefit of mankind, with which, in this age of progress, we are becoming so familiar, has recently been made in the substitution of the galvanic battery for the knife of the operating surgeon. It has been long known that if a galvanic current of great power is conducted through a very small wire, the latter becomes heated to whiteness, and if formed of any of the ordinary metals, is rapidly destroyed; but if made of platinum, remains unaltered; and that a galvanic battery may be so arranged, that the current can at any moment be transmitted along such a wire, or as suddenly arrested. It sometimes unfortunately happens that in various parts of the body deep-seated abscesses occur, having several openings, and these are unable to be healed until laid open, and it may so occur that a vast collection of veins in such a part renders the use of the knife excessively dangerous. In the olden time, a surgeon would have employed a red-hot knife; but such a practice has been in modern times entirely relinquished, as cruel and barbarous, the vast amount of heat given out destroying the adjacent parts; if, however, a very fine wire is first placed in the required position, and then connected with the galvanic battery, it instantly becomes heated to whiteness, and may be readily caused to cut in the proper direction, almost without causing any pain, as the parts in immediate contact with the heated wire are instantly deprived of life and sensation; and, from its small size, the heated body is unable to throw off enough heat to injure adjacent parts; and, furthermore, a cut by the heated wire possesses a great advantage over one made by a knife, inasmuch as it is not attended with any loss of blood. Of course this mode of operating is not calculated to supersede the use of the surgeon's knife, except in certain cases; but in all probability it may become a very valuable auxiliary in the practice of surgery. The mere idea of a red or white hot substance in immediate contact with the human body, is, at first, exceedingly painful; but when we recall to our readers' recollection the experiments of M. Boutigny and others, with red-hot bodies,* they will at once perceive that the contact of a body heated to whiteness is not necessarily, if applied under proper circumstances, attended with pain. Another new application of this novel remedial agent is to effect the destruction of the nerves in decayed teeth; and in some cases it is said to have been used with great success for this purpose.

ATMOSPHERIC MAGNETISM.

The following is an abstract of a lecture on atmospheric magnetism, read by Prof. Faraday, before the Royal Institute, April, 1851. It contains results supplemental to those announced in the Bakerian Lecture, of Nov. 28th, 1850, on the magnetism of oxygen and other gases.†

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* See *Annual of Scientific Discovery*, 1850, and 1851.
† See *Annual of Scientific Discovery*, 1851, pp. 133–4.

"On a former occasion it was shown that oxygen gas was magnetic, being attracted towards the poles of a magnet; and that, like other magnetic bodies, it lost and gained in power as its temperature was raised and lowered, and that the change occurred within the range of natural temperatures. These properties it carries into the atmosphere, and the object of this lecture was to show how far they might be applied to explain certain of the observed variations of the terrestrial magnetic force. The earth is a great magnet; its power, according to Gauss, being equal to that which would be conferred if every cubic yard of it contained six one-pound magnets; the sum of the force is therefore equal to 8,464,000,000,000,000,000,000 such magnets. The disposition of this magnetic force is not regular, nor are there any points on the surface which can properly be called poles; still the regions of polarity are in high north and south latitudes, and these are connected by lines of magnetic force (being the lines of direction) which, generally speaking, rise out of the earth in one (magnetic) hemisphere, and, passing in varied directions over the equatorial regions, into the other hemisphere, then enter into the earth to complete the known circuit of power. A free needle shows the presence and direction of these lines. In London they issue from the earth at an angle of about 69° with the horizon (being the dip or inclination); and the plane in which they rise forms an angle of 23° W., nearly with true north, giving what is called west declination. Where the dip is small, as at the magnetic equator, these lines scarcely rise out of the earth, and pass but a little way above the surface; but where it is large, as in northern or southern latitudes, they rise up at a greater angle, and pass into the distant realms of space, from whence they return again to the earth in the opposite magnetic hemisphere; thus investing the whole globe with a system of forces like that about an ordinary magnet, which wherever it passes through the atmosphere is subject to the changing action of its magnetic oxygen. There is every reason to believe that these lines are *held* in the earth, out of which they arise, and by which they are produced, just as the lines which originate in a magnet are held by it, though not in the same degree; and that any disturbance from above, affecting them, will cause a greater change in their place and direction in the atmosphere and space above, than in the earth beneath.

"The system of lines of magnetic force, around a magnet or the earth, is related by a lateral tension of lines of static electrical force; both the one and the other being easily made manifest by experiment. The disturbance of the tension in one part is accompanied instantly by disturbance of the tension in every other part; for as the sum of the external powers of a system, unaltered at its origin, is definite and cannot be changed, so any alteration, either of intensity or direction amongst the lines of force at one place, must be accompanied by a corresponding change at every other. So, if a mass of soft iron on the east side of a magnet causes a concentration of the lines of force from the magnet on that side, a corresponding expansion or opening out of the lines on the west side must be, and is, at the same time, produced; or if the sun, on rising in the east, renders all the oxygen of the air on that side of the globe less magnetic and less able therefore to favor the transition of the lines of terrestrial force there, a greater number of them will be determined through the western region; and even though the lines of force may be doubted by some as having a separate existence such as that above assumed, still no error as to the effects on magnetic needles would in that case be introduced, for they by experiment would be and are the same.

"The power of a magnetic body, as iron or oxygen, to favor the transmission of lines of force through it more than other bodies not magnetic, may be expressed by the term conduction. Different bodies, as iron, nickel, oxygen, conduct in various degrees; and not only that, but the same body, as iron or oxygen, conducts in different degrees at different temperatures. When space, traversed by uniform lines of magnetic force, is occupied by an uniform body, as air, the disposition of the lines is not altered; but if a better conducting substance than the air is introduced, so as to occupy part of the space, the lines are concentrated in it; or if a worse conducting substance is introduced, the lines are opened out. In both cases the lines of force are inflected, and a small magnetic needle, standing in them at the inflected part, would have its direction changed accordingly. Now this, by the hypothesis, is assumed to take place in the atmosphere. Supposing it all at mean temperature, the lines of force would have the direction determined by the arrangement of the power within the earth. Then the sun's presence in the east would make all the atmosphere in that region a worse conductor, and as the sun came up to and passed over the meridian and away to the west, the atmosphere under his influence would bring up changes in that direction; it would therefore manifestly set a needle in a given latitude in opposite directions as it passed by; and as evidently set two needles in north and south latitudes in opposite directions at the same moment of time. As the night came on, and a temperature lower than the mean came up from the east and passed over, the lines of force would be inflected, and a reverse variation of the needle to that which occurred before would now take place. That natural effects of variation must be produced, consequent upon the magnetic nature of oxygen and its daily variations of temperature, is manifest; but whether they cause the observed variations, or are competent to do so, is a question that can only be decided after a very careful inquiry. Observations are now made on the surface of the earth with extreme care in many places, and these are collated, and the average or mean result, as to direction and intensity of the earth's force, ascertained for every hour and season; and also many remarkable anomalous and extra results evolved. A theory of the causes of any or all of these variations may be examined, first by the *direction* which the varying needle does or ought to assume, and then by the *amount* of the variation. The hypothesis now brought forward has been compared with the mean daily variation for all the months in the year, at north and south stations, as Toronto and Hobarton, and at many others near to and far from the equator, and agrees in direction with the results observed far beyond what the author anticipated. Thus the paths described by the upper ends of free needles in the north and south hemispheres, should be closed curves, with the motion in opposite and certain directions, and so they are; the curves described by needles in north or south latitudes should be larger in summer and smaller in winter, and so they are; a night or cold action should grow up in the winter months, and such is the case; the northern hemisphere ought to have a certain predominance over the southern, because of its superior temperature, and that is so; the disposition of land and water ought to have an influence, and there is one in the right direction; so that in the first statement and examination of the hypothesis it appears to be remarkably supported by the facts. The next step will be to ascertain what is the amount of change in the conducting power of the air for giving changes of temperature, and then to apply that in the endeavor to ascertain whether the amount of change to be expected is (as well as the direction) accordant with that which really occurs." — *Jameson's Journal, July*, 1851.

MAGNETISM OF OXYGEN.

Plucker has given the result of a comparison of the magnetism of oxygen with that of iron. A glass globe was filled with oxygen of the same tension as the surrounding air. The amount of attraction exerted by an electro-magnet upon this globe was then determined by means of a very delicate balance. The globe was then emptied and filled with a solution of chloride of iron, and the magnetic attraction again determined in the same manner. The attraction upon the oxygen was found to be to that on the solution of 8.0678 : 1. To determine the attraction exerted, under the same circumstances, upon soft iron, a glass vessel was filled with a paste, made by grinding pure metallic iron in powder, (reduced from the oxide by hydrogen,) with a mixture of fresh lard and wax. The amount of attraction upon this glass vessel when empty was first measured, then the attraction upon the same vessel when filled with the solution of chloride of iron, and, finally, the attraction upon the glass when filled with the paste of iron. The amount of attraction upon the glass vessel when empty was subtracted from the amount upon the vessel when filled with the solution and with the paste. In this manner, the magnetism of the solution was found to be to that of the iron as 1 : 230.49; the diamagnetic action upon the lard and wax was found to be so slight that it could be entirely neglected. By combining the two numerical results obtained above, Plucker found the specific magnetism of oxygen to be to that of iron as 1 : 285.7. If we refer the specific magnetism of the two substances to equivalents instead of to equal weights, we find for the equivalent of iron a degree of magnetism 81.8 as great as that for an equivalent of oxygen. By the same method, Plucker found for the magnetism of sesquioxide of iron the number 891, that of iron being taken as 1.000.000.—*Pogg. Ann.* 83, 105.

ON THE MAGNETIC RELATION OF GASES.

Plucker has studied the magnetic and diamagnetic relations of various gaseous bodies, in different states of pressure. The apparatus employed consisted of a delicate balance, the beam of which was of glass, and which gave a perceptible deflection of 0.0001 milligramme. The gases examined were enclosed in spheres furnished with stop-cocks and attached to one of the arms of the balance; these were capable of resisting an internal pressure of about two atmospheres. The sphere of glass, containing the gas, was placed over the two half armatures of a powerful electro-magnet, and then the attraction or repulsion measured by means of weights placed in the opposite scale-pan. The trifling amount of magnetism in the glass was exactly compensated by the magnetism of the surrounding air. The following were the principal results obtained: —

1. The specific magnetism of oxygen, compared with that of iron, as unity, was found to be 0.003500. 2. Oxygen loses its sensible magnetism in almost all gases where it enters into chemical combination. Deutoxyd of nitrogen, NO^2, is an exception to this rule, its magnetism being two fifths of that of oxygen. 3. If we introduce oxygen, little by little, into a sphere containing NO^2, the magnetism diminishes, till the proportion of the two gases is sufficient to form hyponitric acid NO^4, when the magnetic action becomes insensible. On adding more oxygen, the magnetism reäppears. 4. Hypo-nitric acid NO^4, when condensed into a liquid, is diamagnetic. 5. The magnetism of oxygen, deutoxyd of nitrogen, and magnetic mixtures is proportioned to the density of the gas. 6. A magnetic gas, mechanically mixed with any other indifferent gas, preserves its magnetism, whatever be the density of the mixture, only in the neighborhood of the poles there appears to be, to a certain extent, a separation of the gases, which must slightly augment the attraction of the entire mass. 7. A magnetic gas, which has been for some moments attracted by an electro-magnet, is very readily repelled, if the polarity of the magnet be changed. Hence, it appears that gases possess a very distinct coercive force. — *Comptes Rendus*, 33, 301.

ON THE PROBABLE RELATION BETWEEN MAGNETISM AND THE CIRCULATION OF THE ATMOSPHERE.

Lieut. Maury, in a recent supplement to the Washington Astronomical Observations, brings forward some arguments to show a probable connection between the magnetism of atmospheric oxygen, and the circulation of the atmosphere. Before the discovery of Faraday, that the oxygen which composes one fifth of the atmosphere was magnetic, Lieut. Maury, in the construction of his "Wind and Current Charts," had conceived the existence of some agent, whose office, in the grand system of atmospherical circulation, was neither understood nor recognized. He found that the agencies of heat and the rotation of the earth would not furnish a complete and satisfactory explanation of the distribution of moisture and the circulation of the atmosphere over the earth's surface. A new agent was required, and this, there is reason to suppose, exists in the magnetic properties of oxygen. The facts adduced by Lieut. Maury in support of this new view are as follows: — From the zone of calms, near the tropic of Cancer, which extends entirely across the seas, there is an efflux of air both to the north and the south. From the south side of this zone the air flows in a never-ceasing breeze, called the north-east trade winds, towards the equator. On the north side the prevailing winds come from it also; but they go towards the north-east. They are the well known south-westerly winds which prevail along the route from this to England. Both these winds are surface breezes. From the equatorial calms there is a perpetual upper current to the tropical calms, equal in volume to the trade winds. One peculiarity of the trade winds is, that the south-west breezes give out a great deal of moisture, proceeding from a calm belt to cooler regions, in a course where precipitation is the natural result. The north-east trade winds, on the other hand, proceeding from the same belt of calms, are dry at the very outset. It might be supposed that the upper current, which flowed from the calms at the equator, descended at the calm belt at the tropics, and then returned on the surface as a trade wind, then ascended at the equator, returning as an upper current, thus keeping up a continual ring of breezes. Lieut. Maury says, he knew of no agent in nature that would prevent the winds taking this circuit; but, on the other hand, he knew of circumstances which rendered it probable that such in general is not the course of atmospheric circulation. But there are also south-east trade winds; and Lieut. Maury has come to the conclusion, that the current which flows to the equator as a surface north-east trade wind, ascends at the equatorial calms, and passes to the south as an upper current, while the current which comes as the south-east trade winds ascended and passed to the calm zone of Cancer. The reasons for this conclusion are, that the evaporating surface of the south is the greatest, but all the great rivers are in the northern hemisphere, and at those seasons of the year, when the sun is evaporating most at the south, the greatest quantity of rain is falling in the northern hemisphere. Without taking this view of the subject, Lieut. Maury "could find no part of the ocean of the northern hemisphere from which the sources of the great rivers, Mississippi, St. Lawrence, and others, could be supplied. It appeared to me," he says, "that the extra tropical regions of the northern hemisphere stood in the relation of a condenser to a grand steam-machine, the boiler of which was in the region of the south-east trade winds," and the north-west trade winds to the tropic of Capricorn on the other side of the equator, perform the same office to the regions beyond that tropic, which the south-east winds perform for our northern regions. Meteorological observations, made in various parts of the south-western states, show, in confirmation of these views, that the south-west winds are generally the rain-bearing winds; but a further, and almost conclusive proof is found in the fact that Ehrenburg has detected in the blood rains of the South of Europe, infusoria from South America. It is, therefore, probable that the trade-winds of the southern hemisphere, after arriving at the belt of equatorial calms, ascend and continue in their course towards the calms of Cancer as an upper current from the south-west, and after passing this zone of calms, they are felt on the surface as the prevailing south-west winds of the extra-tropical parts of our hemisphere; and that for the most part they bring their moisture with them from the trade wind regions of the opposite hemisphere. Continuing on towards the north pole from the south-west, they enter the arctic regions, on a spiral curve, continually lessening the gyrations, until, whirling about in a contrary direction to the hands of a watch, this air ascends and commences its return as an upper current, to the belt of calms at the tropic of Cancer.

Lieut. Maury attributes to magnetism that influence or power "which guides the air from the south through the calms of Capricorn, of the Equator, and of Cancer, and conducts it into the north," and back again. This he compares to a spiral coil, and the continuous circuit of a magnetic current passing around both poles and winding across our globe. The attractive and repulsive influence is attributed to the nature of oxygen, which, as its temperature is increased, diminishes in para-magnetic force, and which increases as its temperature falls. The whole subject, which is of great interest, is to such an extent complex, that a partial abstract like the foregoing does not afford a full illustration of Lieut. Maury's views or arguments.

ON THE CONNECTION BETWEEN THE COLOR OF SUBSTANCES AND THEIR MAGNETIC PROPERTIES.

Mr. Richard Adie, of Liverpool, communicates to the Edinburgh Philosophical Journal, April, the results of an investigation, undertaken with a view of ascertaining whether there was any connection between the color of a body and its magnetic properties. The experimental tests for magnetism, in the various bodies examined, were made partially by means of the torsion balance, which takes cognizance of degrees of magnetism long before a magnet will show any attraction when applied in the usual way; and partially by spreading the pulverized substance over a smooth sheet of paper, when, if the substance was strongly magnetic on the torsion balance, an ordinary steel magnet, moved to and fro close beneath the paper, without touching, will set some of the particles in motion. The result of Mr. Adie's experiments seems to show that when the forces of aggregation which bind the particles of a substance together produce transparency, or whiteness, such a combination has feeble magnetic properties; and that when the same forces produce a dark, or dull-colored substance, then the magnetic power is more developed. This relation between color and magnetic attractions of bodies must be held to rest only among those of similar constitution.

Among the numerous illustrations, confirmatory of the theory, brought forward by Mr. Adie, we select the following:—The ferrocyanide of potassium is a translucent lemon-colored salt, possessed of no attraction for the magnet; when heated moderately, it loses water and assumes an opaque white hue, but is still unattracted by the magnet; when the heating is continued until the color darkens, then the degree of darkness becomes an index of the magnetic force, until the color reaches black, when the altered salt has all the characters of an iron body. If this was a solitary case the change would at once be set down to the decomposition of cyanogen, and the formation of a carburet of iron.

There are, however, other striking instances. Silver is a metal possessed of only feeble torsion balance magnetism; in its dark-colored sulphuret and oxide, the attraction is more decided; the white chloride is like the pure metal, very feeble in its attraction. Through the influence of light it passes to the dark oxide, gaining magnetic force with the change. Should these experiments be confirmed, this well-known action of light on the chloride of silver will serve as a very beautiful illustration, for in it the whole question is resolved; the light effects a change in the color; the alteration of color is accompanied with an increase of magnetic attraction.

Copper possesses a degree of magnetism so minute, that it is recognized with the utmost difficulty on the torsion balance, yet it gives the dark-colored oxide and sulphuret, both of which are strongly magnetic; for if well dried particles are spread upon a sheet of paper, some of their particles are moved in the manner described. Palladium and manganese exhibit somewhat similar properties. Arsenic, in its pure state, is magnetic on the torsion balance, but when pulverized is not disturbed by a magnet. In union with its equivalent of sulphur, the ruby-red real gas is produced. Sulphur has been shown by Faraday to be diamagnetic, yet in this union with arsenic a compound is given that is far more magnetic than the metal, or any other of its products; for realgar when bruised and spread out upon paper can be moved and can be streaked by the magnet. In most of the foregoing cases, the dark magnetic substance is an oxide formed or set free by heating; but with this metal oxygen forms the well known white oxide, diamagnetic according to Faraday, but which, with the feebler magnetic force from a small steel magnet, proves slightly magnetic; however this may be, the contrast is striking between the feeble magnetism of the white oxide and the decided magnetism of realgar. Carbon, in the form of a pure diamond, is feebly attracted; in the finely divided black state the attraction increases, and in the coal left after the decomposition of colorless starch, or sugar, there is a very great increase in the magnetic attraction. In conclusion, Mr. Adie states, that all the heavy metals, in every-day use in the arts, have furnished either oxides, carburets, sulphurets, or fluorides, which contain particles sufficiently magnetic to move on paper to an ordinary steel magnet passed to and fro underneath.

In the examination of the corollæ of different flowers, it was found that the white colors were, when fresh, diamagnetic, while the colored corollæ differed much, the diamagnetism of many being apparently due to their moisture, which, at the same time, tends to make them transparent. In dyed everlasting flowers, the various colors show very well the change of magnetic properties, and, being in a dried state, the results are not subject to that disturbance which the moisture of fresh flowers occasions; the pale-yellow is diamagnetic, the dyed chrome-yellow nearly inert, the verdigris-green feebly magnetic, and the log-wood-purple strongly magnetic. Solar rays bleach dead vegetable matter with rapidity, while in living parts of plants their action is frequently to strengthen the color; two opposite effects, which, according to my experiments, should be accompanied by different magnetic properties. The bleaching power of the sun's rays is familiar to every one; their power in developing fine colors is perhaps best seen on the sides of peaches, apples, &c., which, exposed to a mid-summer sun, become highly colored. During the last open winter, a wall-flower plant afforded me the proof of a like effect; in the dark months there was a slow succession of one or two flowers. These were of a uniform pale-yellow hue; in March, streaks of a darker color appeared on the flowers, and continued slowly to increase, till, in April, they were variegated brown and yellow, of rich strong colors. On the supposition that these changes are accompanied by alterations in magnetic properties, we may hereafter be able to explain Mrs. Somerville's experiments on steel needles exposed to the sun's rays under envelopes of silk of various colors. The results obtained by this distinguished lady have been the source of much discussion among men of science; and there can be no doubt that the most rigid experiments have failed to magnetize steel needles in the colored rays of the spectrum. But to magnetize them under envelopes of dyed silk is quite a different experiment, and, if I do not much mistake, the effect in this case will hinge *on the chemical change wrought in the silk and its dye by the solar rays.* Consequently, to repeat the experiments hereafter, it will be necessary to attend to the materials used in dyeing. In concluding this inquiry, I may say, that I view the nature of the connection between color and magnetism to be, that there are forces which act in common on the magnetism, and the power of the body in transmitting or reflecting light. Faraday and Plucker have previously shown the intimate connection between the crystalline and magnetic force; while the tendency of my experiments has been to show that the color, a property much more strongly attached to a body than its crystalline force, is likewise connected with the magnetism. When a number of bodies are grouped together, the connection is seen clearly enough; but when single cases only are examined, apparent contradictions are not unfrequent. This appears to indicate that color and magnetism are mixed up with other qualities derived from the forces of aggregation, together giving the various properties possessed by the bodies by which we are on every side surrounded, while the further knowledge for the unfolding of these may demand the labor of ages to come.

OF THE NATURE AND SOURCE OF THE SUN'S LIGHT AND HEAT.

That so brilliant a display is kept up by the combustion or destruction of something, appears to be generally, if not universally, maintained; but what that matter is, and how supplied, no probable guess has yet been made. The intensity of the solar light and heat is easily proved, and that it resides chiefly, if not entirely, at the surface; and that surface, on being closely watched, is found to be in a state of excessive agitation, and experiences periodical disturbances and alterations of a very singular character. When periodical changes are seen, we may expect secular ones also; and if the former were of a regular character, the latter might be necessarily inferred; but although no regular law has yet been made out for the sun, the probability of their slow variations through long periods of time is great, and is increased when we turn our attention to those other suns, the stars, and find some of them increasing and others decreasing or going through regular periods of varied lengths, and many degrees of gradation in brightness. The same may also be inferred from the geological discoveries, of there having been formerly glacial ages in the world, and again torrid ones, for there is no other cause that we know of equal to produce the effects observed; while, if our sun were to have increased or decreased in the amount of light and heat thrown out, as much as some stars have done during the last four years, all organic bodies might have perished on the surface of the earth, before now, from excess or from lack of heat.

In this connection some theoretical views have recently been presented to the Royal Astronomical Society, by Mr. James Nasmyth, from which we make the following extracts: —

"A course of observations on the solar spots, and on the remarkable features which from time to time appear on the sun's surface, which I have examined with considerable assiduity for several years, had in the first place led me to entertain the following conclusions, namely, that whatever be the nature of solar light, its main source appears to result from an action induced on the exterior surface of the solar sphere, — a conclusion in which, I doubt not, all who have attentively pursued observations on the structure of the sun's surface will agree. Impressed with the correctness of this conclusion, I was led to consider whether we might not reasonably consider the true source of the latent light to reside, *not in the solar orb*, but in space itself; and that the grand function and duty of the sun was to act as an agent for the bringing forth into vivid existence its due portion of the illuminating or luciferous element, which element I suppose to be diffused throughout the boundless regions of space, and which in that case must be perfectly exhaustless. Assuming, therefore, that the sun's light is the result of some peculiar action, by which it brings forth into *visible* existence the element of light, which I conceive to be latent in and diffused throughout space, we have but to imagine the existence of a very probable condition, namely, the unequal diffusion of this light-yielding element, to catch a glimpse of a reason why our sun may, in common with his solar brotherhood, in some portions of his vast stellar orbit, have passed, and may yet have to pass, through regions of space, in which this element may either abound or be deficient, and so cause him to beam forth with increased splendor, or fade in brilliancy, just in proportion as the richness or poverty of this supposed element may occur in those regions of space through which our sun, in common with every stellar orb, has passed, or is destined to pass, in following up their mighty orbits. Once admit that this light-yielding element resides in *space*, and that it is *not* equally diffused, we may then catch a glimpse of the cause of the variable and transitory brightness of stars, and more especially of those which have been known to beam forth with such extraordinary splendor, and have again so mysteriously faded away.

"Finally, in reference to such a state of change having come over our sun, as indicated by the existence of a glacial period, which is now placed beyond doubt by geological research, it appears to me no very wild stretch of analogy to suppose that in such former periods of the earth's history our sun may have passed through portions of his stellar orbit in which the light-yielding element was deficient, and in which case his brilliancy would have suffered the while, and an arctic climate in consequence spread from the poles towards the equator, and leave the record of such a condition in glacial handwriting on the walls of our mountain ravines, of which there is such abundant and unquestionable evidence, as before said; it is the existence of such facts as we have in stars of transitory brightness, and the above-named evidence of an arctic climate existing in what are now genial climates, that require some adequate cause to be looked for.

"This view of the source of light, as respects the existence of the luciferous element throughout space, accords with the Mosaic account of creation, in so far as that light is described as having been created in the first instance *before the sun* was called forth."

ON THE CLASSIFICATION OF COLORS.

M. Chevreuil, the *directeur des Gobelins*, has presented to the French Academy a plan for a universal chromatic scale, and a methodical classification of all imaginable colors. Mayer, a professor at Gottingen, calculated that the different combinations of primitive colors produced 819 different tints; but M. Chevreuil goes much further, and establishes not less than 14,424, all very distinct and easily recognized — all, of course, proceeding from the three primitive simple colors of the solar spectrum, red, yellow and blue. His nomenclature is somewhat different from that generally received; viz., he calls full colors (*couleurs franches*) the simple or binary colors of the solar spectrum; *abated, or less colors*, (*rabatues*,) these same colors tinged with black; *relieved colors*, (relevées,) the same colors mixed or tinged with white; tones, (tons,) the different gradations of a color modified by different proportions of black or white; gamut, the *ensemble* of the tones of the same color; *nuances*, the mixture of a full color with another. He constructs his chromatic scale in this manner: he places in a circle, at 60° distance each from the other, the six colors, red, orange, yellow, green, blue and violet; then between each of them, and at equal distances, the intermediate *nuances*, red-orange, orange-yellow, yellow-green, green-blue, blue-violet, violet-red; then he fills the intervals between each fundamental color and its *nuance* by five progressive *nuances*, which suffices to give to the eye an *ensemble* of perfectly continued tints. There would then be a series of seventy-two primitive colors, which serve as a base for the classification of all others; this is the chromatic circle of the author, presenting an *ensemble* of comparable types of simple and *nuancée* colors — samples which M. Lebois, of the Gobelins, has succeeded in fixing completely upon wool, and M. Salvetal, of the manufactory at Sevres, upon porcelain. These types or samples being unalterable and methodically distributed, they can always be clearly designated and found when wanted. M. Chevreuil has completed this classification, by adding to his horizontal chromatic circle a series of vertical circles, containing all the intermediate *nuances*. By this, every color, simple or binary, gives twenty *tones*; the seventy-two colors of the chromatic table above indicated, give,

multiplied by twenty, ...	1440	tones.
Each simple, or binary color, giving, besides, nine *gamuts*, each of which has twenty *tones*, we have . .	12,960	"
Add the differences [*degradations*] from black to white, which give twenty-one tones, ...	21	"
We have a total of *tones*, ...	14,421	

By the aid of this table any one can designate in future any and all colors imaginable, whether applicable to printing, painting, or any other object; in chemistry, the colors of all substances, precipitates, &c., can be defined with a precision which until now has been impossible; and in natural history the colors of living animals, their changes at different periods of their life, and the colors of their different varieties, can be ascertained with the last precision. For example, M. Chevreuil states that in the violet there are twenty-eight colors, and in the dahlia forty-two.

POLARIZATION OF THE CHEMICAL RAYS EXISTING IN SOLAR LIGHT.

It is well known that physicists have found in the solar spectrum, produced by means of a good prism, three orders of relations, which are in part superposed, the calorific, the colorific or luminous, and the chemical. The rays of the two first orders are susceptible of polarization, and consequently of extinction. The chemical rays, however, have not until quite recently been examined in this respect. Professor E. Wartman, of Geneva, Switzerland, has, during the past year, shown that, like the rays of heat and light, the chemical ray is susceptible of polarization and of complete extinguishment. The conditions under which the experiment was effected were similar to those ordinarily made use of in polarization, an exquisitely sensitive daguerreotype being the test.

ARAGO ON POLARIZED LIGHT.

A paper was recently read before the French Academy, by M. Arago, relative to his further researches on light.* The following is an abstract: "Up to the present time no means have been furnished of measuring the quantities of polarized light contained in a ray reflected by a surface which does not completely polarize the light. M. Arago, by employing a pile of glass plates, placed so as to incline suitably on the track of a reflected ray, so as to obtain neutral light, has found that at an equal number of degrees above and below the angle of maximum polarization, the proportion of polarized light contained in a ray was the same; a fact which has enabled him to determine the angle of the maximum polarization of certain metals, such, for instance, as steel and

* See *Annual of Scientific Discovery*, 1851, pp. 137, 139, 140.

mercury, and thence to deduce, by the well known law of Brewster, the index of the refraction of these substances, which he found to be two for steel and four for mercury. This method does not give the quantity of polarized light, but the relative proportion between that quantity and the total light. To modify the process so as to render it suitable for that purpose, it is essential to commence by the graduation of the pile of glass plates, in order to ascertain for a given incidence what was the quantity of polarized light which the glass plates neutralized. By causing a completely polarized ray to fall on a plate of rock-crystal, perpendicular to its axis, in such a manner that the principal section of the crystal coincides with the primitive plane of polarization, we have, on turning the plate, two images, varying in intensity according to the law of the square of the cosine, but which, from the thinness of the plate, entirely superpose on each other. These two images are polarized in two perpendicular planes, and form neutral light, by their superposition, as long as the quantity of light is equal in the two; but if this quantity happens to vary in either one of the images, the other, having all its light neutralized, will leave a certain residue of polarized light, which the pile of glass plates will entirely obliterate. The green color observed in light, when it is obliged to traverse a greater thickness of glass than ten plates, has prevented M. Arago, up to the present time, from extending the limits of the table for representing the quantities of polarized light; but they hope, that by using very transparent glass, having oxide of zinc for its basis, which they are at present occupied in preparing, that they shall be able to extend the table considerably. This process of polarimetry will allow of our measuring the quantity of light reflected and refracted at great angles, which the usual phometetric method was always found, by M. Arago, incapable of effecting.

ON THE HYPOTHESES RELATING TO THE LUMINOUS ÆTHER, AND AN EXPERIMENT DEMONSTRATING THAT THE MOTION OF BODIES ALTERS THE VELOCITY WITH WHICH LIGHT PROPAGATES ITSELF IN THEIR INTERIOR.

THE following important communication was read to the French Academy, by M. Fizeau:

Many hypotheses have been proposed to account for the phenomena of aberration in accordance with the undulatory theory; but from the want of any definite ideas as to the properties of the luminous æther, and its relations to ponderable matter, none of them can be considered as strictly proved. These various hypotheses may be reduced to three principal ones. They refer to the state in which the æther existing in transparent bodies may be considered to be.

1st. This æther is either adherent, and as it were attached to the molecules of bodies, and, consequently, participates in the motions to which the bodies may be subjected; 2d. The æther is free and independent, and is not influenced by the motions of bodies; 3d. Only a portion of the æther is free, the other portion being attached to the molecules of bodies, and participating in their motion. This latter hypothesis was proposed by Fresnel, and constructed for the purpose of equally satisfying the phenomena of aberration, and an experiment of Arago, by which it has been proved that the motion of the earth has no influence upon the refraction which the light of the stars suffers in a prism.

We may determine the value which in each of these hypotheses it is necessary to attribute to the velocity of light in bodies, when the bodies are supposed to be in motion. If the æther is supposed to be wholly carried with the body in motion, the velocity of light ought to be increased by the whole velocity of the body, the ray being supposed to have the same direction as the motion. If the æther is not supposed to be free and independent, the velocity of light ought not to be changed at all. Lastly, if only one part of the æther is carried along, the velocity of light would be increased, but only by a fraction of the velocity of the body, and not, as in the first hypothesis, by the whole velocity. Although the velocity of light is enormous comparatively to such as we are able to impart to bodies, we are at the present time in possession of means of observation, of such extreme delicacy, that it seems possible to determine, by direct experiment, what is the real influence of the motion of bodies upon the velocity of light. We are indebted to M. Arago for a method, based upon the phenomena of interference, which is capable of indicating the most minute variations in the index of refraction of bodies. It is by adopting the same principle, and joining the double tube of M. Arago to the conjugate telescopes, which were employed for determining the absolute velocity of light, that I have been able to study directly, in two mediums, the effects of the motion of a body upon the light which traverses it.*

I will now endeavor to describe what was the course of the light in the experiment. From the focus of a cylindrical lens, the solar rays penetrated almost immediately into the first telescope by a lateral opening very near to its focus. A transparent mirror, the plane of which made an angle of 45° with the axis of the telescope, reflected the rays in the direction of the object-glass. On leaving the object-glass, the rays, having become parallel among themselves, encountered a double chink, each opening of which corresponded to the mouth of one of the tubes. A very narrow bundle of rays thus penetrated into each tube, and traversed its entire length. The two bundles, always parallel to each other, reached the object-glass of the second telescope, were then refracted, and by the effect of the refraction reünited again at its focus. They there encountered the reflecting plane of a mirror, perpendicular to the axis of the telescope, and underwent a reflection back again towards the object-glass; but, by the effects of this reflection, the rays had changed their route in such a way, that that which was to the right before was to the left after reflection, and *vice versa*. After having again passed the object-glass, and been thus rendered parallel to each other, they penetrated a second time into the tubes; but as they were inverted, those which had passed though one tube in going, passed through the other on returning. After their second transit through

* See *Annual of Scientific Discovery*, 1850, pp. 145–6; 1851, 137–8.

the tubes, the two bundles again passed the double chinks, reëntered the first telescope, and lastly intersected at its focus in passing across the transparent mirror. There they formed the fringes of interference, which were observed by a glass carrying a graduated scale at its focus. It was necessary that the fringes should be very large, in order to be able to measure the small fractions of the width of a fringe. I have found that that result is obtained, and a great intensity of light maintained, by placing before one of the chinks a thick mirror, which is inclined in such a way as to see the two chinks, by the effect of refraction, as if they were nearer to each other than they really are. It is in this way possible to give various dimensions to the width of the fringes, and to choose that which is most convenient for observation. The double transit of the light was for the purpose of augmenting the distance traversed in the medium in motion, and further to compensate entirely any accidental difference of temperature or pressure between the two tubes, which would be mingled with the displacement which the motion alone would have produced, and thus have rendered the observation of it uncertain.

It is, in fact, easy to see that, in this arrangement, all the points situated in the path of one ray are equally in the path of the other; so that any alteration of the density, in any point whatever, of the transit, acts in the same manner upon the two rays, and cannot consequently have any influence upon the position of the fringes. The compensation may be satisfactorily shown to be complete, by placing a thick mirror before one of the two chinks, or as well by filling only one of the tubes with water, the other being full of air. Neither of these two experiments gives rise to the least alteration in the position of the fringes. With regard to the motion, it is seen, on the contrary, that the two rays are subject to opposite influences. If it is supposed that in the tube situated to the right the water runs towards the observer, that of the two rays which comes from the right will have traversed the tube in the direction of the motion, while the ray coming from the left will have passed in a direction contrary to that of the motion. By making the water move in the two tubes at the same time, and in contrary directions in each, it will be seen that the effect should be doubled. This double current having been produced, the direction may be again reversed simultaneously in the two tubes, and the effect would again be double.

All the movements of the water were produced in a very simple manner, each tube being connected by two conduits, situated near their extremities, with two reservoirs of glass, in which a pressure is alternately exercised by means of compressed air. By means of this pressure the water passes from one reservoir to the other by traversing the tube, the two extremities of which are closed by the mirrors. The interior diameter of the tubes was five millimetres, their length one metre and four tenths. The tubes were of glass. The pressure under which the flowing of the water took place might have exceeded two atmospheres. The velocity was calculated by dividing the volume of water running in *one second* by the area of the section of the tube. Great care was taken to obviate the effects of the accidental motions which the pressure or shock of the water might produce. Therefore, the two tubes, and the reservoirs in which the motion of the water was made, were sustained by supports independent of the apparatus, and especially of the two lunettes; it was, therefore, only the two tubes which could suffer any accidental movement; but both theory and practice have proved that the motion or flexions of the tubes alone were without influence upon the position of the fringes. The following are the results obtained.

When the water is set in motion the fringes are displaced, and, according as the water moves in one direction or the other, the displacement takes place towards the right or the left. The fringes are displaced towards the right when the water is running from the observer, in the tube situated to his right, and towards the observer in the tube situated to his left. The fringes are displaced towards the left when the direction of the current in each tube takes place in a direction opposed to that which has just been described. With a velocity of water equal to two metres per second, the displacement is already very sensible; with a velocity of four to seven metres it is perfectly measurable.

After having demonstrated the existence of the phenomenon, I endeavored to determine its numerical value with all the exactitude which it was possible to obtain. By calling that the simple displacement which was produced when the water, at rest in the commencement, was set in motion, and that the double displacement which was produced when the motion was changed to a contrary direction, it was found that the average deduced from nineteen observations sufficiently concurring, was 0.23 for the simple displacement, which gives 0.46 for the double displacement, the width of a fringe to be taken as unity. The velocity of the water was 7.09 metres per second.

The results were afterwards compared with those which have been deduced by calculation from the different hypotheses relative to the æther. According to the supposition that the æther is entirely free and independent of the motion of bodies, the displacement ought to be null.

According to the hypothesis which considers the æther united to the molecules of matter in such a way as to participate in its motions, calculation gives for the double displacement the value 0.92. Experiment gave a number only half as great, or 0.46.

According to the hypothesis by which the æther is partially carried along, the hypothesis of Fresnel, calculation gives 0.40, that is to say, a number very near to that which was found by experiment; and the difference between the two values would very probably be still less, if it had been possible to introduce into the calculation of the velocity of the water, a correction which had to be neglected from the want of sufficiently precise data, and which refers to the unequal velocity of the different threads of fluid. By estimating the value of that correction in the most probable manner, it is seen that it tends to augment a little the theoretical value, and approach the value of the observed result.

An experiment similar to that which I have just described, had been made previously with air in motion, and I have demonstrated that the motion of the air does not produce any sensible displacement in the motion of the fringes. In the circumstances in which that experiment was made, and with a velocity of 25 metres a second, which was that of the motion of the air, it is found that according to the hypothesis by which the æther is considered to be carried along with the bodies, the double displacement ought to be 0.82. According to the hypothesis of Fresnal, the same displacement ought to be only 0.000465, that is to say, entirely imperceptible. Thus the apparent immobility of the fringe in the experiment made with air in motion is completely in accordance with the theory of Fresnel. It was after having demonstrated this negative fact, and while seeking for an explanation by the different hypotheses relating to the æther in such a way as to satisfy at the same time the phenomena of aberration and the experiment of M. Arago, that it appeared to me to be necessary to admit with Fresnel that the motion of a body occasions an alteration in the velocity of light, and that this alteration of velocity is greater or less for different mediums, according to the energy with which those mediums refract light, so that it is considerable in bodies which are strongly refractive, and very feeble in those which refract but little, as the air. It follows from this, that if the fringes are not displaced when light traverses air in motion, there should, on the contrary, be a sensible displacement if made with water, the index of refraction of which is very much greater than that of air. The success of the experiment seems to me to render the adoption of Fresnel's hypothesis necessary, or at least the law which he found for the expression of the alteration of the velocity of light by the effect of motion of a body; for, although that law being found true may be a very strong proof in favor of the hypothesis of which it is only a consequence, perhaps the conception of Fresnel may appear so extraordinary, and in some respects so difficult to admit, that other proofs and a profound examination on the part of geometricians will still be necessary before adopting it as an expression of the real facts of the case.—*Comptes Rendus*, *Sept.* 1851.

HELIOCHROMY, OR DAGUERREOTYPES IN COLORS.

From the time of the discovery of the Daguerreotype, unceasing efforts have been made by scientific men to produce photographic pictures in which the various natural colors of objects might be faithfully represented. M. Becquerel, in experiments made in 1849–50,* succeeded so far, as to be able to transfer to a metallic plate the colors of the prismatic spectrum in great brilliancy. These colors, however, could not be rendered permanent, and soon disappeared. During the past year, however, the problem has been solved by M. Niépce, a distinguished French photographer, and nephew of the celebrated Niépce, who, in connection with Daguerre, discovered the Daguerreotype. The process by which this has been effected, has received the name of Heliochromy, or sun-painting, and although still imperfect, is of the highest

* See *Annual of Scientific Discovery*, for 1851, p. 150.

scientific interest. In order to a more full understanding of the subject, we copy, from the London Art Journal, the memoir presented to the French Academy, by M. Niépce, prefaced by some introductory remarks by Robert Hunt, well known for his photographic researches.

For the perfect understanding of the results obtained, it is necessary that the chromatic conditions of a decomposed sunbeam should be clearly appreciated and the relation of the colored image to the chemical effects obtained distinctly understood. A pencil of light is passed through a prism, and we obtain an elongated image consisting of a beautifully colored set of bands. There are three primaries, red, yellow and blue, which by intercombination give rise to other tints, so that altogether we are acquainted with nine colored rays — crimson, red, orange, yellow, green, blue, indigo, violet and lavender. The colors of natural objects are produced by the decomposition of the rays of light, this being effected by some peculiar *surface* action. Now, if we expose a piece of photographic paper, or a daguerreotype plate, to the action of this spectrum, or to the radiations from colored surfaces, we shall find that the chemical effect has no relation to the intensity of light belonging to the colored ray. For example, supposing the colored image of the nine rays to fall upon a sensitive tablet, the result is of the following curious character :— One of the red rays protects the paper from all change, the other usually makes a *red* impression ; the orange and yellow rays have no chemical action, though these have the most illuminating power. The chemical action commences in the green ray, rapidly increases in energy in the blue, and exerts its maximum power over the space covered by the indigo, violet, and lavender, still continuing with much energy over a space beyond the lavender in which no light can be detected. It was upon the consideration of these peculiarities, clearly proving that ordinarily there was a remarkable want of agreement between the actinic power of the sunbeam and the chromatic phenomena depending upon it, that M. Biot wrote the following passage :

"Substances of the same tint may present, in the quantity or the nature of the radiations which they reflect, as many diversities, or diversities of the same order, as substances of a different tint ; inversely, they may be similar in their property of reflecting chemical radiations when they are dissimilar to the eye ; so that the difference of tint which they present to the eye may entirely disappear in the chemical picture. These are difficulties inherent in the formation of photographic pictures, and they show, I think, evidently, the illusion of the experimenters who hope to reconcile, not only the intensity but the tints of the chemical impressions, produced by radiation, with the colors of the objects from which these rays emanate."

These are the natural suggestions of the mind when merely considering the ordinary phenomena of the chemical action of the solar spectrum. But color is the result of a peculiar condition of the *surface*, and if the different rays produce a dissimilar molecular or chemical change, there is no reason why the result should not be the production of chromatic impressions. The yellow rays produce a small amount of chemical action, but that may result in such a molecular arrangement as will determine the reflection of yellow light, and so of the other rays. In fact, in 1840, Sir John Herschel published an account of some experiments in which the production of color was very evident; and on paper prepared with a brown vegetable juice, he obtained an impression of the spectrum, colored from end to end, the color of each ray being impressed in the natural order. To Becquerel, is, however, certainly due the discovery of the mode of preparing a metallic plate in such a manner as to produce a tablet susceptible of chromatic impressions. This was effected about two years since; his process consisting essentially in the formation of chloride of silver, or probably of a sub-chloride, upon a metal plate. In the camera-obscura, highly colored images were copied, and the copies gave colors of a natural character. In this way, however, only large masses of color, as the colors of a geographical map, were copied, and impressions of the spectrum obtained.

The memoir of M. Niépce, before the French Academy, is entitled, "The relation existing between the colors of certain colored flames, with the Heliographic images colored by light."

When a plate of silver is plunged into a solution of sulphate of copper and chloride of sodium at the same time that it is rendered *electro-positive* by means of the voltaic battery, the chloride formed becomes susceptible of coloration, when, having been withdrawn from the bath, it receives the influence of light. This was the discovery of Becquerel. M. Niépce had been led to think that a relation existed between the color communicated by a body to a flame, and the color developed upon a plate of silver, which should have been chloridated with the body which colors this flame. The bath in which the plate of silver was plunged, was formed of water saturated with chlorine, to which was added a chloride possessing the property of coloring flame.

It is well known that strontian gives a *purple* color to flames in general, and to that of alcohol in particular. If we prepare a plate of silver and pass it into water saturated with chlorine, to which is added some chloride of strontian, and when thus prepared we place *upon it* a colored design, of red and other colors, and then expose it to the sunshine, after six or seven minutes we shall perceive that the colors of the image are reproduced upon the plate, but the reds much more decidedly than the others. When we would produce successfully the other rays of the solar spectrum, we operate in the same manner we have indicated for the red ray, employing for the orange the chloride of calcium, or that of uranium for the yellow, or hypochlorite of soda, or the chloride of sodium and potassium. If we plunge a plate of silver in the chlorine liquid, or if we expose the plate to the vapor, we obtain all the colors by the light, but the yellow only with any degree of veracity. Very fine yellows have been obtained with a bath composed of water slightly acidulated with hydrochloric acid with a salt of copper. The green rays are obtained with boracic acid, or the chloride of nickel; also with all the salts of copper. The blue rays are obtained with the double chloride of copper and ammonia. Indigo rays are obtained with the same. The violet rays are obtained with the chloride of strontia and the sulpnate of copper.

All the substances which give colored flames, give also colored images by the light. If we take any of the substances which do not give color to the flame, we do not obtain colored images by the light; we produce upon the plate a negative image, composed merely of black and white, as in the ordinary photographs. Those substances which give white flames, as the chlorides of antimony, lead and zinc, yield no color by luminous action. All the colors of the picture have been produced by preparing a bath composed of the deuto-chloride of copper; this salt thrown into burning alcohol produces a variegated flame, according to the intensity of the fire; and it is nearly the same with all the salts of copper mixed with chlorine. If we put a salt of copper in chlorine liquid, we obtain a very sensitive surface by a single immersion; but the result of this mixture is seldom good. I prefer taking the deuto-chloride of copper, to which I add three or four pounds of water; this bath gives good results. A mixture of equal parts of chloride of copper and chloride of iron, with three or four parts of water, is, however, the best. The chloride of iron has, like that of copper, the property of being impressed on the plate of silver, and of producing many colors; but they are infinitely more feeble, and the yellow always predominates; this agrees with the yellow color produced in flame by chloride of iron. If we form a bath, composed of all the substances which separately give a dominant color, we obtain very lively colors; but the great difficulty is the mixing in proper proportions, for it happens, nearly always, that some colors are found excluded by others. By care, however, we ought to arrive at the reproduction of all the colors. There exist many difficulties, more indeed than in any of the ordinary processes of photography. We cannot always depend upon obtaining the same results with the same materials, owing principally to the difficulty of preserving the solution at a uniform strength. Liquid chlorine is necessary; the application of dry chlorine will not produce the same result. The action of heat upon these prepared plates is, in some respects, analogous to the effects of light. By warming a plate over a spirit-lamp, we produce successfully the following tints: brown red, a cerise red, scarlet, and red having a whitish tint. Numerous experiments have been made by M. Niépce to produce the colors upon the salts of silver and copper spread on paper, but hitherto without success; a metallic plate of silver — the plated copper answers — must be employed. Iodine and bromine, and their salts, have been tried, but they will not produce a surface capable of developing colors. Chlorine, in the state of chlorates or chlorides, is the only substance which possesses the property of being colored by light, when chemically combined with metallic silver.

The mode of operating recommended is, to form a bath with one fourth by weight of the chloride, and three fourths of water. When the muriatic acid is used with a salt of copper, we must add one tenth of water. When the bath is composed of several substances, it is essential to filter the solution carefully, so as to obtain very transparent solutions, and it must be preserved in a well-stoppered bottle. The quantity necessary to prepare two or more plates should always be taken, because the bath is weakened considerably at each operation;

it can, however, be rendered active by the addition of a few drops of muriatic acid. The purer the silver employed, the more perfect is the impression, and the more intense the colors.

The plate being very highly polished, which is best effected by Tripoli powder and ammonia, is connected with the battery, and then plunged into the bath, and kept there for some minutes; it is then taken from the bath, washed in a large quantity of water, and dried over a spirit-lamp. The surface thus produced is a dull neutral tint, often almost black, and, upon exposing it to the light, the colors are produced by removing the blackness; the surface is, in fact, *eaten out in colors.* The sensibility of the plate appears to be increased by the action of heat, and when brought by the spirit-lamp to the cerise red color, it is in its most sensitive state. At present, however, the plate cannot be rendered very sensitive, two or three hours being required to produce a decided effect in the camera-obscura. It is, however, already found that the fluoride of sodium will very much accelerate the operation.

The fixation of the colored image is, however, still a point of considerable difficulty, and, although a certain degree of permanence has been recovered, the colors fade out by exposure and eventually pass away. A kind of lacquer appears to have been applied to the plates we have seen, and ordinary diffused light does not seem to produce much change upon them.

Such is an outline of the researches of M. Niépce, as communicated by him to the Academy of Sciences. He is still zealously occupied in the inquiry, and will soon, we trust, be enabled to communicate some yet more important results. The problem is, however, solved; we can produce pictures by the agency of the solar beam in natural colors; that principle which gives to the exterior creation the charm of color, will so regulate the chemical agency of the actinic power with which it is associated, that, on properly prepared surfaces, the images are painted in their native hues.

The following description of the pictures executed by M. Niépce, and exhibited in England, is from the London Athenæum: — "The three heliochromes now in London are copies of colored engravings, representing, the one a female dancer, the others male figures in fancy costumes; every color of the original being most faithfully impressed on the prepared silver tablet. The female figure has a red silk dress, with purple trimming and white lace. The flesh tints, the red, the purple, and the white, are well preserved in the copy. One of the male figures is remarkable for the delicacy of its delineation: — here blue, red, white and pink are perfectly impressed. The third picture is injured in some parts, but is, from the number of colors which it contains, the most remarkable of all. Red, blue, yellow, green, and white are distinctly marked; and the intensity of the yellow is very striking."

The Hillotype. — Much has been said, during the past year, respecting a discovery claimed by Rev. Mr. Hill, of Greene county, N. Y., of producing daguerreotypes with the natural colors of the object represented. The statements made by Mr. Hill and friends, not being confirmed by anything tangible, the New York Daguerrian Association appointed a committee to visit him and investigate the alleged discovery. They report, "that not only has Mr. Hill deluded many professors in the daguerrian art, but that he has deluded himself thoroughly and completely — that the origin of the discovery was a delusion — that the assumed progress and improvement of it was a delusion — and that the only thought respecting it, in which there is no delusion, is for every one to abandon any possible faith in Mr. Hill's abilities to produce natural colors in daguerreotypes — of which the whole history has been an unmitigated delusion."

IMPROVEMENTS IN PHOTOGRAPHY.

Enamel for Daguerreotypes. — A plan has been invented and perfected by Mr. Beard, of London, for coating the surface of the daguerreotype with a kind of transparent enamel, which effectually excludes the air, renders a glass unnecessary, and permits, moreover, the application of color more effectually than by any mode previously attempted.

Photography on Glass. — A new process has been discovered by M. Martens, of Paris, by which photographic negatives may be taken on glass, and afterwards transferred to paper on an increased scale, by means of a lens. The value of this process is enhanced by the capacity to enlarge, by the application of a magnifying power, the dimensions of the image produced on the negative plate. In this way, without creating to the traveller the embarrassment of extra luggage, he may make his negatives on as small a scale as may be convenient, — reserving to himself the choice of producing, at a future time, positives of such dimensions as he may desire. For topography and for the transcription of the peculiarities and minute details of architecture and costume, this discovery will prove of great value.

A writer in the London Athenæum, speaking of the pictures produced by this process, says, "There are in the impressions resulting from this process a clearness and a sharpness of definition in the architectural subjects such as we have never before seen. In a view of the portico of the Madaleine, as seen from the Rue Royale, the details of the tympanum, the frieze, the capitals, the bases, the shafts, the inscriptions, and the bas-reliefs, seen through a magnifying glass at our side, are extraordinary. The rendering of the bas-relief in the pediment is most perfect. Two views of the Salle de la Convention are marvellous to the naked eye: through the lens they reveal details which will provoke the admiration of the architect. The artist may throw down his brush in despair. No human eye or hand could trace from the objects themselves, within any moderate degree of accuracy, such details."

Instantaneous Photographic Images. — Mr. Fox Talbot, well known for his discoveries in photography, writes to the Royal Society, June, as follows: — "Having recently met with a photographic process of great sensibility, I was desirous of trying whether it were possible to obtain a truly instantaneous representation of an object in motion. The experiment was conducted in the following manner: — A printed paper was fixed upon a circular disc, which was then made to revolve on its axis as rapidly as possible. When it had attained its greatest velocity, an electric battery was discharged in front of the disc, lighting it up with a momentary flash. A camera, containing a very sensitive plate of glass, had been placed in a suitable position, and on opening this after the discharge, an image was found of a portion of the words printed on the paper. They were perfectly well-defined and wholly unaffected by the motion of the disc.

"The mode of preparing the plates was as follows:—1. Take the most liquid portion of the white of an egg, rejecting the rest. Mix it with an equal quantity of water. Spread it very evenly upon a plate of glass, and dry it at the fire. A strong heat may be used without injuring the plate. The film of dried albumen ought to be uniform and nearly invisible. 2. To an aqueous solution of nitrate of silver add a considerable quantity of alcohol, so that an ounce of the mixture may contain three grains of the nitrate. I have tried various proportions, from one to six grains, but perhaps three grains answer best. More experiments are here required, since the results are much influenced by this part of the process. 3. Dip the plate into this solution, and then let it dry spontaneously. Faint prismatic colors will then be seen upon the plate. It is important to remark, that the nitrate of silver appears to form a true chemical combination with the albumen, rendering it much harder, and insoluble in liquids which dissolved it previously. 4. Wash with distilled water to remove any superfluous portions of the nitrate of silver. Then give the plate a second coating of albumen similar to the first; but, in drying it, avoid heating it too much, which would cause a commencement of decomposition of the silver. 5. To an aqueous solution of prot-iodide of iron add *first* an equal volume of acetic acid, and then ten volumes of alcohol. Allow the mixture to repose two or three days. At the end of that time it will have changed color, and the odor of acetic acid, as well as that of alcohol, will have disappeared, and the liquid will have acquired a peculiar but agreeable vinous odor. It is in this state that I prefer to employ it. 6. Into the iodide thus prepared and modified the plate is dipped for a few seconds. All these operations may be performed by moderate daylight, avoiding, however, the direct solar rays. 7. A solution is made of nitrate of silver, containing about 70 grains to one ounce of water. To three parts of this add two of acetic acid. Then, if the prepared plate is rapidly dipped once or twice into this solution, it acquires a very great degree of sensibility, and it ought then to be placed in the camera without much delay. 8. The plate is withdrawn from the camera, and, in order to bring out the image, it is dipped into a solution of protosulphate of iron, containing one part of the saturated solution diluted with two or three parts of water. The image appears very rapidly. 9. Having washed the plate with water, it is now placed in a solution of hyposulphite of soda; which, in about a minute, causes the image to brighten up exceedingly, by removing a kind of veil which previously covered it. 10. The plate is then washed with distilled water, and the process is terminated. In order, however, to guard against future accidents, it is well to give the picture another coating of albumen or of varnish.

"These operations may appear long in the description, but they are rapidly enough executed after a little practice."

To the images obtained by this new process, Mr. Talbot has applied the term *amphitypes*, because they appear either positive or negative, according to the circumstances of light under which they are viewed. Thus, if held against a bright light, or against a sheet of white paper, they appear negative, and the reverse when held against a black surface and seen in oblique reflected light.

New Process for copying from Engravings. — A new process for copying engravings has been discovered by M. Niépce, of France. It consists in submitting the engraving to the vapor of iodine (at a temperature of 15° or 20° C.) for about two minutes; a longer time is necessary, if the temperature be less elevated; ten grammes of iodine to be used per square of four inches. The paper intended to receive the impression is to be covered with a coat of paste, taking care previously to have it moistened with water containing one part of pure sulphuric acid. The proofs, after being pressed with a linen cloth, present a design of admirable purity. Those impressions taken on paste will, however, in drying, become vaporous; but, if taken on paper, prepared with one or two layers of starch, the design will not only be clear, but will preserve much better. What is most extraordinary is that many impressions may be taken from the same print without submitting it to a new preparation, the last proofs being always the clearest. Designs of various colors may thus be obtained, according as the paste is more or less boiled, or according to the quantity of acid used. Proofs may also be taken on different metals, by observing the following precautions. In submitting the engraving to the vapor of iodine, care should be taken to have it perfectly dry, in order that the white portions of it may become impregnated. In this case it should be exposed but a few minutes to the vapor. Let it be afterwards applied, without wetting it, to a plate of silver, and then placed under a press; at the end of five or six minutes there will be a most faithful reproduction of the original. By afterwards exposing the plate to the vapor of mercury, a proof similar to that of a daguerreotype is obtained.

MM. Clenisson and Terreil have presented to the French Academy *a method of obtaining daguerreotype impressions on metallic surfaces, free from the usual mirror-like appearances*, which destroy, to a considerable extent, the artistical effect. The process consists in submitting the impression, after washing in the hypo-sulphate of soda solution, to the action of very weak aqua regia, which transforms the amalgam, producing the white parts of the impression, into chlorides of silver and mercury unalterable to the action of the light, and which produces on the dark parts a chloride of silver, susceptible of alteration under the influence of light. After this operation the harmony of tints is preserved, and the image fixed, as if by chloride of gold.

Gutta Percha in Photography. — Mr. Fry, of England, has greatly improved the process of obtaining pictures on glass, by the addition of gutta percha to collodion — gun-cotton dissolved in ether. This is employed with the ordinary materials for the processes on glass, the picture being developed by pyro-gallic acid. The extraordinary sensibility of this preparation may be inferred from the fact, that a positive copy, from a glass negative, has been obtained in five seconds by gas-light. The film formed on glass is far more adherent than the ordinary collodion or albumen.

Hyalotype. — A new process of taking photographs upon glass has been invented by Messrs. Langenheim, of Philadelphia. The most interesting application of this discovery is stated to be the formation of pictures upon magic-lantern slides, taken from nature by the camera obscura, without the aid of pencil or brush. These pictures are prepared by the action of light alone ; and the smallest details are delineated on the glass with astonishing fidelity. When these slides are magnified in the magic lantern, they give a perfect representation of nature, and are perfectly free from all those defects and inaccuracies existing in the old slides, which can never be avoided in painting upon so small a scale.

IMPROVEMENTS IN CAMERAS FOR DAGUERREOTYPES.

M. Evrard, of Paris, in experimenting on the proper form of the camera, as used for taking daguerreotypes, has ascertained, contrary to what has been the opinion heretofore on the subject, that the black coating inside of all the cameras now used, to prevent the reflection of light, lessens the photogenic action on the prepared plate or paper. He has, therefore, lined the sides of his camera with white paper, and given the interior of his tube a white coat, at the extremities of which are the two object-glasses. With the above alterations in his instrument, he has experimented on the silver plate, albumenized glass, and on paper, and he states that the image forms in one half the time required in the blackened camera ; that it is formed by light insufficient to give an image in the usual camera ; that the action is more uniform — the light parts not disappearing before the shaded parts are fully impressed — and there is far less resistance to photogenic action in red, yellow, and green colors.

Sir David Brewster, in noticing in a late publication this discovery of Evrard, remarks : — " It is not easy to explain the results obtained by M. Evrard ; the effect of internal light on the negative must be to darken the whole of the negative paper, and, consequently, to accelerate the production of all the lines which constitute the picture ; but if the light acts *equally* upon the dark lines when they are darkening, as it does upon the light parts, the depth of color of the black lines cannot be increased, because the depth of the ground on which they are drawn is equally increased. The internal light must, therefore, darken the dark parts of the negative more than the light parts. It is obvious that the internal light scattered over the negative cannot be uniform. It would, therefore, be better to keep the camera black, as hitherto, and to admit light through one or more apertures, so as to illuminate equally the surface of the negative. This might be done either through ground glass or paper, or by reflection from any white surface. It would be curious to try lights of different colors, and to see if the process could not be accelerated by exposing the negative paper to a certain quantity of light, either after it has received a faint picture, or before it is placed in the camera. If M. Evrard's results are correct, there must be some new principle called into play by the supplementary light assisting the natural light from the object." — *Daguerrean Journal.*

DAGUERREOTYPES OF THE SUN AND MOON.

During the past season, Mr. J. A. Whipple, of Boston, aided by Mr. Bond, of the Cambridge Observatory, has succeeded in taking several large and beautiful daguerreotype likenesses of the moon, as seen by a high power, under the great equatorial of the Observatory. We have rarely seen anything in the range of the daguerreotype art of so great beauty, delicacy, and perfectness, as the pictures referred to. The inequalities and striking peculiarities of the moon's surface are brought out with such distinctness, that the various mountain ranges, highlands, and isolated peaks are at once recognized. Crater-formed depressions in some of the mountains may be also seen. The views represent the moon at quarter and half-quarter, and are from three to four inches in length. Mr. Whipple, with the aid of Mr. Bond, succeeded in daguerreotyping the solar eclipse of July, in its various stages; and also the sun's disk, with the various spots which appeared upon its surface in the spring of 1851. Several of these daguerreotypes were exhibited at the American and British Associations, and also at the Great Industrial Exhibition, where a medal was awarded to Mr. Whipple. — *Editor.*

NEW ELLIPTIC ANALYZER.

A new instrument, constructed for the purpose of investigating experimentally the nature of elliptically polarized light, that is to say, the elements of the ellipse described, has been invented by Professor Stokes, of England. In its exhibition before the British Association, Prof. Stokes said, that, in its construction, he had aimed at being, in all important points, independent of the instrument-maker, assuming nothing but the accuracy of the graduation. The construction was as follows: — A brass rim, or thick annulus, is fixed on a stand, so as to have its plane vertical. A brass circle, graduated to degrees, turns round within the annulus, and the angle through which it is turned is read by verniers engraved on the face of the annulus. The brass circle is pierced at its centre, and carries on the side turned towards the incident light a plate of selenite, of such a thickness as to produce a difference of retardation in the oppositely polarized pencils, amounting to about a quarter of an undulation for rays of mean refrangibility. The brass circle carries a projecting collar on the side next the eye, and, round this collar there turns a movable collar carrying verniers, and destined to receive a Nicol's prism. The observation consists in extinguishing the light by a combination of the two movements. The retarding plate converts the elliptically polarized light, which has to be examined, into plane polarized; and this plane polarized light is extinguished by the Nicol's prism. There are two distinct positions of the retarding plate and the Nicol's prism in which this takes place. In each of these principal positions the retarding plate and the Nicol's prism may be reversed (*i. e.*, turned through 180°), and the means of the readings in these four subsidiary positions may be taken for greater accuracy. The readings of the fixed and movable verniers in each of the two principal positions are four quantities given by observation, which determine four unknown quantities; namely, 1. The index error of the fixed verniers, or which comes to the same, the azimuth of the major axis of the ellipse described by the particles of æther, measured from a plane fixed in the graduated circle. 2. The ratio of the axis of the ellipse. 3. The index error of the movable verniers. 4. The retardation due to the retarding plate. The unknown are determined from the known quantities, by certain simple formulæ given by the author. The author stated that he had made a good many observations with this instrument for the sake of testing its performance, and that he had found it very satisfactory. Inasmuch as light is not homogeneous, the illumination never vanishes, but only passes through a minimum, and in passing through the minimum the tint changes rapidly. This change of tint is at first somewhat perplexing; but, after a little practice, the observer is able to know it mainly by intensity, taking notice of the tint as an additional check against errors of observation. The accuracy of the observations is a little increased by the use of rather pale-colored glasses. To give an idea of the degree of accuracy of which the instrument is susceptible, suppose the ratio of the axes of the ellipse described to be about three to one. In this case the author found that the mean error of single observations amounted to about a quarter or the fifth part of a degree in the determination of the azimuth, three or four thousandths in the determination of the ratio of the minor to the major axis, and about the thousandth part of an undulation in the determination of the retardation. On account of the accuracy with which the retardation is determined, and the largeness of the chromatic variations to which it is subject, the instrument may be considered as determining not only the elements of the ellipse described, but also the refrangibility of the light employed, or its length of wave, which corresponds to the refrangibility. The author stated, that the error of the thousandth part of an undulation, to which the determination of the retardation was subject, corresponded to an error of only the twentieth or thirtieth part of the interval between the fixed lines D and E of Fraünhofer.

ON THE APPARENT MOTION OF CERTAIN COLORED FIGURES.

Prof. Loomis, at the American Association, Albany, presented a communication, relating to the apparent motions of certain colored figures, a phenomenon generally known under the name of the "dancing mice." The phenomenon to be explained is this: — When a green figure or stripe is worked on a red ground, and the card gently agitated, a shade of lighter green appears to spread over the whole figure, and overlap the surrounding red ground. A red stripe upon a green ground, when agitated, appears of a lighter red on each margin, alternately with a deep-red wave, oscillating back and forth at each motion of the card. It has been suggested that the *pile* of the worsted, in which these figures are generally wrought, was essentially connected with the phenomena. This Prof. Loomis had found not to be the case. He had experimented with cotton, silk, leather, and paper; and in all had succeeded in producing an effect similar to that with the worsted. With the colors of natural objects, he had found that the red of certain flowers, combined with certain green leaves, exhibited the effect in question very handsomely. The scarlet flower of the verbena, or geranium, combined with green leaves of lettuce, succeeds beautifully. These experiments appeared to him sufficiently varied to prove that the effect in question is entirely independent of the material employed. Color alone appears to be the essential circumstance. A particular shade of color is required, and also a certain intensity. A brilliant red, combined with a complementary color, will always produce the required effect. A lustre or gloss upon the surface interferes somewhat with the effect, but does not entirely destroy it. Such a result might have been anticipated, because the existence of gloss implies that foreign light, (which, of course, is not homogeneous,) is reflected from the surface in question, and mingles with the light emitted from the body under experiment. Of course the color of the body is changed, or rendered less brilliant by this mixture. The conclusion arrived at was, that the wave-like motion which passes over a small red figure, upon a green ground, when gently agitated, is an effect of brilliant complementary colors, and has no connection with the nature of the material with which the color is associated.

These phenomena are believed to involve the following principles: — 1. The *continuance* of impressions on the retina. An impression made on the retina lasts for an appreciable interval. When a bright colored figure is agitated before the eye, it makes an impression upon a portion of the retina larger than that covered by the figure at rest. Thus a green figure upon a red ground, being agitated, appears to overlap the surrounding red ground. 2. There is a partial and transient *combination* of the complementary colors. While the impression of the central color remains upon the retina, the same portion of the retina, in consequence of the motion of the card, receives a new impression of the surrounding complementary color; in other words, two colors, which are complementary to each other, are impressed successively upon the same part of the retina; the new impression being made while the effect of the old one remains. These two colors partially combine to produce — not white light — but a much brighter shade of the primitive color. This explains the experiment with the green figure on a red ground; and it explains the brighter shade on the margin of the red figure upon a green ground. But the red stripe upon the green ground exhibits the remarkable peculiarity of a deep red wave oscillating from one side to the other of the strip at each motion of the card. In order to analyze this phenomenon, I tried the following experiment: —

When I used a broad red stripe between two green ones, the change of color was confined to the borders of the red, extending to a breadth of about a quarter of an inch, a bright stripe appearing on the upper side of the red when the figure was depressed, and on the lower side when the figure was elevated. No change of appearance could be observed in the intermediate red. Hence, when the red stripe is only a half inch in breadth, there is the appearance of a red wave transferred from one edge to the opposite, at each motion of the card. If the red stripe does not exceed a quarter of an inch in breadth, the effect is much impaired, and if the stripe be reduced to less than one tenth of an inch, the wave-like appearance ceases entirely, and the red stripe appears constantly of a very pale red.

The following, then, is my opinion of the origin of this deep red wave : — The red color appears to excite the retina more powerfully than the green, and its impression is more durable. When, therefore, I place a red stripe upon a green ground, and agitate it, the effect of the green ground is confined to a narrow margin of the red stripe, not generally exceeding a quarter of an inch in breadth. Consequently, if the red stripe is broad, say two or three inches, no peculiar effect is produced upon the central part; but a band of pale red, about a quarter of an inch in extent, is seen on the two opposite margins alternately. If the breadth of the red stripe does not exceed the tenth of an inch, its light is constantly blended with that of the surrounding green ; that is, it appears constantly of a light shade, and there is no appearance of a dark wave passing over it. When the breadth of the stripe is about half an inch, the red and green colors are made to combine on the opposite margins alternately ; the dark and the light bands succeed each other on the same part of the stripe, and the appearance is that of a wave-like motion. Thus, the two well known principles, first, of the continuance of impressions on the retina, and, second, that complementary colors combine to produce white light, appear to explain the essential circumstances of the phenomena in question.

VELOCITY OF LIGHT.

On the subject of the velocity of light, and the probability that it requires a certain time for its propagation, we find the earliest view expressed by Francis Bacon, in the second book of the Novum Organum. He speaks of the time required by a ray of light to traverse the immensity of space, and throws out the question whether the stars still exist which we now see sparkle. One is astonished at finding so happy a conjecture in a work whose celebrated author was so far below some of his contemporaries in mathematical, astronomical and physical knowledge. The velocity of the reflected solar light was measured by Römer, November, 1675, by comparison of the times of occultation of Jupiter's satellites, and the velocity of the direct light of the fixed stars by Bradley's great discovery of the aberration of light, made in the autumn of 1727. In very recent times a third method of measurement has been proposed by Arago, by the phenomenon of the light of a variable star ; for example, Algol in Perseus. We have to add to these astronomical methods a terrestrial measurement, which has recently been executed with great ingenuity and success by M. Fizeau, in the neighborhood of Paris.* It recalls to recollection an attempt of Galileo's with two lanterns, which did not lead to any result. From Römer's first observations of Jupiter's satellites, Horrebow and Du Hamel estimated the time occupied in the passage of light from the sun to the earth, at their mean distance apart, at 14′ 7″; Cassini at 14′ 10″; Newton, which is very striking, much nearer to the truth, at 7′ 30″. Delambre, by taking into account, among the observations of his time, only those of the first satellite, found 8′ 13″.2. Encke has very justly remarked how important it would be, with the certainty of obtaining the more accordant results which the present perfection of telescopes would afford, to undertake a series of occultations of Jupiter's satellites, for the express purpose of deducing the velocity of light. From Bradley's observations of aberration, recently discovered by Rigaud, of Oxford, there follows, according to the investigation of Dr. Busch, of Konigsberg, for the passage of light from the sun to the earth 8′ 12″.64; for the velocity of the light of the stars 167,976 geographical miles in a second; but from the more recent aberration observations of Struve, made for eighteen months with the large transit instrument at Pulkowa, it appears that the first of these numbers must be considerably increased. The result of Struve's great investigation is 8′ 17″, which gives for the velocity of light 166,196 geographical miles in a second; the probable error of this velocity scarcely amounts to eight geographical miles.

M. Fizeau has succeeded in executing a terrestrial measurement of the velocity of light, by means of an ingeniously devised apparatus, in which the artificial star, like the light of oxygen and hydrogen, is returned to the point from whence it came by a mirror placed at the distance of 8633 metres (28,324 English feet); a disc furnished with 720 teeth, which made 12.6 revolutions in a second, alternately stopped the ray of light and allowed it to pass freely between the teeth of the limb. From the indications of a counter, it was inferred that the artificial light traversed 17,266 metres (56,648 English feet), or twice the distance between the stations, in one eighteen thousandth of a second of time; whence there results a velocity of 167,528 geographical miles in a second. This result comes nearest to that of Delambre, derived from Jupiter's satellites, which is 167,976 geographical miles. Direct observations, and ingenious considerations on the absence of any alteration of color during the change of light of variable stars, have led Arago to the conclusion that rays of light which have different colors, and therefore very different lengths and rapidities of transverse vibration, move through space with equal velocities; but that in the interior of the different bodies through which the colored rays pass, their rates of propagation and their refractions are different. Arago's observations have shown, that in the prism the refraction is not altered by the relation which the velocity of light bears to that of the earth's motion. All the measurements accord in the result, that the light of

* *Annual Scientific Discovery*, 1850, Vol. I., pp. 145—147.

the stars towards which the earth is advancing has the same index of refraction as the light of the stars from which the earth is receding. The celebrated observer we have just named said, that bodies send forth rays of all velocities, but that among these different velocities there is only one which can awaken the sensation of light. If we compare the velocities of solar, sidereal and terrestrial light, which all comport themselves exactly in the same manner in the prism, with the velocity of the current of friction-electricity, we are inclined to assign to the latter, according to the experiments devised with admirable ingenuity by Wheatstone, a velocity superior to the former in the ratio of at least three to two. According to the lowest results of Wheatstone's optical rotating apparatus, the electric current traverses 288,000 English statute miles, or 250,000 geographical miles, in a second. If, then, we reckon with Struve for sidereal light in the aberration observations 166,196 geographical miles in a second, we get a difference of 83,804 geographical miles in a second for the greater velocity of the electric current. This result appears to contradict the previously mentioned view of William Herschel, which regarded the light of the sun and of the fixed stars as perhaps the effect of an electro-magnetic process, — a perpetual aurora. I say appears to contradict; for it cannot be deemed impossible that, in the different luminous bodies of space, there may be several magneto-electric processes very different in kind, and in which the light produced by the process may have a different rate of propagation. To this possible conjecture must be added the uncertainty of the numerical result obtained with Wheatstone's apparatus, which result he himself regards as "not sufficiently established, and as requiring fresh confirmation," in order to be compared satisfactorily with the deductions from aberrations and satellite observations. Later experiments, made by Walker, in the United States, on the velocity of the propagation of electricity, on the occasion of his telegraphic determination of the longitudes of Washington, Philadelphia, New York and Cambridge, have excited a lively interest in the minds of physical inquirers.*

Measurements made with conductors 1050 English statute miles, or 968 geographical miles, in length, gave, from 18 equations of condition, the rate of propagation of the hydro-galvanic current at only 18,700 statute, or 16,240 geographical miles in a second, that is, fifteen times slower than the electric current in Wheatstone's rotating disc apparatus. As in Walker's remarkable experiments two wires were not used, and but half the conduction, according to the common expression, took place through the moist body of the earth, it might seem a justifiable supposition that the velocity of the propagation of electricity is dependent on the nature as well as on the dimensions of the medium. In the voltaic current bad conductors become more heated than good conductors, and electric discharges are very variously complicated phenomena, as appears by the latest experiments of Reiss. The now prevailing views of what is commonly called "connection through the earth" are opposed to the view of linear conduction between the

* *Annual Scientific Discovery*, 1850, Vol. I., pp. 124—127.

two ends of the wire, and to the conjectures of impediments to conduction, and of accumulation and discharges in a current; as that which was once regarded as intermediate conduction in the earth is now supposed to belong only to an equalization or to a restoration of electric tension. Although, according to the present limits of exactness in this kind of observation, it is probable the aberration is constant, and, therefore, the velocity of light, of all the fixed stars, is the same, yet the possibility has more than once been spoken of that there may be luminous bodies in space whose light does not reach us because, from their enormous mass, gravitation constrains the luminous particles to return. — *Humboldt's Cosmos.*

CONSTRUCTION OF MIRRORS FOR REFLECTING TELESCOPES.

Lord Rosse, at the British Association, after adverting to the difficulties in the way of perfecting the reflecting telescope, stated that he had come to the conclusion that the only recourse in guarding against them consisted in improving the metallic plane reflectors as much as possible. As a material for reflectors he had tried silver; but, unfortunately, this metal was so soft that great difficulties presented themselves in giving it the requisite degree of high polish. He had tried, by the electrotype process, to procure a surface with a high polish, by depositing silver on a surface of speculum metal; but, unfortunately, after every precaution, the silver adhered to the metal. He tried copper similarly, which did not adhere, but produced a high degree of polish; its color, however, and other properties, rendered it inadmissible as a reflector. He then determined to endeavor to grind and polish a plane surface of silver, the softness of that metal having, however, heretofore caused the attempt to fail in the hands of the most experienced who had tried it. The processes of grinding and polishing are essentially different. In grinding, the substance, whether emery or other powder, must run loose between the substance which is used to rub it against the other and that which is to be ground; and he soon found that he could not use emery or any other grinding powder for bringing a surface of silver to a correct form; for, from the softness of the metal and the unequal hardness of its parts, the emery was found to confine its action to the softer parts, leaving the harder portions in elevated ridges and prominences, something in the way that the iron handle of a pump which has been long and much used may be observed to be worn away. Hard steel he found he could bring to a very true surface, and even impart to it a high degree of polish; but the quantity of light it was capable of reflecting was by no means sufficient; nor could he succeed in imparting to the surface of silver by compression with highly polished steel surfaces the evenly and highly polished surface requisite for his purpose. At length, he found that he could, by the use of good German hones, grind surfaces of silver perfectly true; and he had now no doubt that he could with safety recommend for that purpose, as the best material, the blue variety of German hone. The next point was, to polish the surface to a true optical plane reflecting surface. This was by no means so easy a task as may be supposed; for, although our eminent silversmiths do produce surfaces of silver of an extremely brilliant polish, as in the magnificent plateaux and other articles which they turn out, yet, if any one will take the trouble to examine these surfaces, they will be found to be so irregular, though highly polished, as to be entirely unfit for producing correct images by reflection. And it is a singular fact that, although in the first part of the process of polishing chamois leather of the finest kind was used to rub the rouge on the silver surface, yet the finer finishing polish had always to be communicated by the human hand. Nor would the hand of every individual answer; the manufacturer had to select those with the very softest and finest grain; nor would the hand of perhaps one in every twenty of the persons employed answer for thus giving the final finish. But it was obvious that the irregular action of the human hand would by no means answer the end he had in view. Suffice it to say, that, at length, after many fruitless trials, he had succeeded in producing a polishing surface, which seemed fully to answer the purpose, by exposing spirits of turpentine to the continued action of air, or by dissolving a proper quantity of resin in the spirits of turpentine, and, by means of this varnish, applying the rouge to the same description of polishing substance which he used in polishing the speculum metal, and which he had heretofore so frequently described. By the use of this polishing substance he had produced a plane surface of silver which, as far as the photometric means he had within his reach would enable him to measure the light before and after reflection, did not lose in that action seven parts of the hundred, and which, tested in the manner which he usually adopted, defined admirably.

The Astronomer Royal begged to know how Lord Rosse secured the plane form of the surface in grinding and polishing. — The Earl of Rosse replied that, as to the mode of grinding, it was that commonly adopted for producing accurately flat surfaces. But the mode in which he tested it was peculiar. It was this: — a watch-dial was placed before a good telescope; and, as soon as the eye-piece was accurately adjusted to the position of most distinct vision, the plane mirror was placed in front of it, at an angle of 45°, and the watch dial was moved round by a simple contrivance to such a position as that its image should very nearly occupy the place it had been just removed from. If now the adjustment of the telescope for distinct vision remained unchanged, the proper form had been attained; but if by drawing out the eye-piece more distinct vision was obtained, it was concluded it had received a convex form; if on pushing it further in it gave the image more distinct, then it was concluded the mirror had received a concave form. — *London Athenæum.*

ACTION OF SUNLIGHT UPON THE CONSTITUTION OF GLASS.

Prof. Faraday, at the British Association, exhibited a specimen of dark glass, which had been sent to him, which had been acted on in a curious manner by the solar beams concentrated at the eye-piece of a telescope which magnified 100 times. It was the fourth or fifth dark glass eye-protector which had been used with similar results. A small portion of the surface of the glass, and to a slight depth below it, of a conical shape, had been so altered by some peculiar action, as to be quite destructive to the correct transmission of the rays of light. A dark red glass in the same place had not been affected, but the heat passed through in such quantity as to be almost painful to the eye.

THE ZENITH TELESCOPE.

Observations for latitude in the coast survey, have, for some time past, been made with an instrument called the Zenith Telescope. The mode of observation is that first suggested by Capt. Andrew Talcott, formerly of the U. S. Corps of Engineers, and since practised with success by many American observers. It consists in observing with a micrometer, the difference of zenith distance of two stars, one north and the other south of the zenith, and making nearly the same angle with it. With the aid of the new Catalogue of Stars, by the British Association for the Advancement of Science, containing the places of over 8000 stars, many such pairs may be selected for any latitude. It is, however, a significant fact in the history of modern progress in astronomy, that it is found necessary to increase the number of stars observed, rather than to multiply observations upon the same pair. Experience has proved, that, upon the average, the probable error of an observation for latitude, with an instrument like that above described, is about one fifth as great as the probable error of the places of the same stars in the British Association's catalogue. The latter are the mean result of observations made at different observatories in Europe, at various periods in the last and present centuries. But the advance in astronomical science, and in means of accurate observation, during the last fifteen years, has been so rapid, that new determinations of the places of the fixed stars are necessary to keep pace with this advance, and are now being made at the National Observatory, in Washington, and other observatories in this country and Europe.

The discrepancies between the astronomical geodetic differences of latitude and longitude, afford data going to show that differences of density in the strata of the crust of the earth exercise a serious influence upon such observations; and that the nicer and more elaborate astronomical determinations of geographical position may yet become means, in the hands of the geologist, to enable him to discover the interior character and structure of the earth.

IMPROVEMENTS IN TELESCOPES.

At the Albany meeting of the American Association, Prof. Twining presented a communication on some experimental researches undertaken by him, tending toward improvements in telescopes. He had occasion to make some investigations to determine whether our best glasses did not fall short in the performance of what was expected of them; and taking the eye as a standard, their recorded penetrative power was found to fall short some two or three orders of magnitude, when pointed toward the stellar regions. He started from the point, *that only one eighth or tenth of the light is available to the vision in the best achromatics.* The observations and trials confirmatory of this were made by means of a Dolland telescope, of thirty-four inch aperture. The importance of the conclusion, if correct, at which he has arrived, lies in this: that a prospect thus opens of effecting a great penetrative or visual power in the telescope, by the employment of eye-pieces truly achromatic, *as by enlarging the object-glass with the ordinary eye-pieces.* The chromatic aberrations of converging or diverging refractions, it may be easily made to appear, can be completely eliminated by two lenses of the same kind of glass; or, probably, by the two surfaces of a single lense of considerable thickness. The other, or field aberration, it is true, will remain for objects upon which the telescope is not truly centred; but, since the employment of regular equatorial motions, this last has ceased to possess its former importance in a scrutiny of minute points of sight.

NEW REFLECTING TELESCOPE.

A NEW reflecting telescope has recently been constructed by Mr. J. Lyman, of Lenox, Mass., and by him exhibited at the American Association, Albany. The focal length of the instrument is sixteen feet; aperture, nine and a half inches at the clear. The tube is composed of thick Russia iron, the parts being fastened together by brass bands with screws. The arrangement of observation is that of Herschel and Lord Rosse; the finder being placed on the left of the front end of the instrument, (left to the person facing the object viewed,) and the eye-piece on the right. The lower end of the instrument has attached to it a frame-work, terminating in *Ys*, and resting upon two pivots at the ends of a horizontal axis. In the centre of this axis is a socket, working upon a vertical axis, rising from the centre of a tetrapod, which rests upon the ground or floor of the observatory, as the case may be. The front end of the telescope is supported by two legs, lengthened or shortened at pleasure, by a combination of cranks, cords and pulleys; the whole so contrived as to allow of every necessary motion with smoothness and uniformity, without any cramping of the parts. With this mounting, the instrument may be either portable or stationary. In the latter case, declination and azimuth, and even hour circles, may be used in connection with the foot-piece, if desired. One of the peculiarities of this instrument is, that the large speculum is held in its position by a system of triangles, so arranged as to produce perfectly uniform pressure upon the lower surface; and even the slight pressure requisite is mainly counteracted by an antagonist pressure upon the face. The great excellence of this telescope, however, lies in the remarkably accurate figure of the speculum. The singularly sharp outline of the stellar discs, the great clearness of the components of almost the closest double stars, seem to evince entire absence of spherical aberration. Indeed, the figure must be a very close approximation to the parabolic curve, if it is not the very curve itself.

Prof. Caswell, of Brown University, writes to Silliman's Journal respecting the power of this instrument as follows :—" Mr. Lyman deserves great credit for bringing so arduous an experiment to a successful issue. His telescope, in point of optical power, is, so far as I know, much in advance of anything heretofore achieved in this country. Under favorable circumstances, it will separate double stars, distant from each other by no more than *half a second of arc.* To construct an instrument that will accomplish this is no small matter. This fact is worthy of being known, and I hope Mr. Lyman, by the success of the present effort, will find encouragement to aim at still greater success."

ON A NEW MODE OF ILLUMINATING OPAQUE OBJECTS UNDER THE HIGHEST POWERS OF THE MICROSCOPE.

Mr. C. Brooke, at the British Association, described an arrangement for best effecting the illumination of opaque objects under the highest powers of the microscope. A parallel pencil of rays is obtained by placing a camphene lamp (which, of all kinds of lamps, gives the most intense illumination) in the principal focus of a combination of two plano-convex lenses. This pencil is secured on the surface of a small parabolic mirror, the vertex of which is truncated, so that the focus of the mirror may be about 0.1 inch beyond the truncated edge. The rays, which are converging to the focus, are received on the surface of a small plane mirror which is attached to the bottom of the object-glass, so that the surface of this mirror may be nearly level with the lowest surface of the object-glass. All the rays of light which subtend any angle from that of the object-glass up to about 170° are thus rendered available for the illumination of the object; which, as it is illuminated by very oblique rays, must not be placed in a depression or cavity of any kind.

Mr. Brooke also described *a new arrangement for facilitating the dissection of objects placed under the microscope.* Two short pieces of tube, one of them the size of the eye-piece, the other the same size as the body of the microscope, are attached at an angle of about 4° to the sides of a brass box containing a rectangular prism. The smaller tube enters the body of the microscope, and the larger screws the eye-piece. The image that enters the eye is now inverted in a plane passing through the axis of the body and of the eye-piece; and, in order to erect the image, a cap is placed over the eye-piece, to which is attached a small rectangular prism, having its axis in the plane in which the image is already inverted. This arrangement provides a very convenient position of the eye when the hands are engaged in manipulating an object placed under the microscope. A rectangular prism has already been introduced into the body of the microscope by Nachez; but as this was placed near the object-glass, it must, to a certain extent, interfere with the definition of the objects. For the purpose of drawing, a small piece of parallel glass is substituted for the rectangular prism, placed in front of the eye-piece, through which the drawing-paper is seen directly through two opposite surfaces, and the object is seen by reflection from an outer surface placed at an angle of about 45° with the axis of the eye-piece. The image inverted by the first reflection is again inverted in the same plane by the second; and is, therefore, correctly represented in the drawing.

Sir David Brewster, after expressing his approval of these simple contrivances, said, that there were physiological reasons which rendered these contrivances for enabling a person to use the microscope with erect head important. When the eye was turned downward, in the first place, the fluid which works the cornea, and which during ordinary vision is spread in a uniform film over the cornea by the action of the cornea, and is constantly draining downwards over the cornea in the intervals, collects, when the eye is placed downwards, in a lenticular shaped mass, on the very centre of the cornea, so as greatly to impede vision; and, moreover, those little fragmentary portions of the crystalline lens which, when it is breaking up, particularly in old age, become the elements of the *muscæ volitantes*, — those which, in the erect position of the head, by sinking down to the lower part of the lens, remain without interfering with vision,— these, when the eye is turned down, collect in what is then the lowest and central part of the lens in the direct line of sight, and greatly impede the rays of light. — *London Athenæum.*

COMPARATIVE VALUE OF DIFFERENT MICROSCOPES.

Dr. J. Lawrence Smith communicates to Silliman's Journal the result of a careful examination of three microscopes, the production of three of the most eminent manufacturers of the present day, viz.: Spencer, of the United States, Ross, of England, and Nachez, of France. The examinations were made at Paris, by a number of distinguished microscopists, with a view of testing the value of the respective instruments. Their magnifying powers varied from thirteen hundred to fifteen hundred diameters, with an ocular magnifying ten times; Ross' was the feeblest, that of Spencer the strongest. The angular opening was first measured with great accuracy, and found as follows: — Ross, 145°; Spencer, 135°; Nachez, 120°. The objects examined were the most difficult test objects among the silicious infusoria, as the *Navicula angulata*, one of the species *Gramatophora*, and a Navicula called the Amici test. The lenses were first adjusted to one of Nachez's mounting, and the best adjustment of oblique light used that this instrument affords. The difference in the effect of the three lenses was very slight, all failing to show the lines on the Gramatophora, or on the Amici test. With a better obliquity of light, in a different mounting, the lines on the Gramatophora were distinctly and beautifully seen by all, with slight advantages in favor of Spencer and Ross, the former of which magnified them most. The Amici test was next tried, which resulted in Ross showing the lines with perfect satisfaction; Spencer showing them, but not quite so well; Nachez still less distinctly. The difference between the lenses appeared to be owing entirely to difference in the angle of opening; for where a very oblique light is necessary to show lines, the lenses must be so constructed as to admit this light. For the examination of globules, no appreciable difference between the different lenses could be noticed. M. Nachez deserves much praise for the manner in which he has improved the microscope in France with out augmenting the cost of the instrument; out of England, he is undoubtedly the best maker in Europe. To furnish an idea of what he has done to diminish the cost of a good instrument, the following is a comparison of the price of the objectives which were the subject of the experiments: Ross, 306 francs; Spencer, 230 do.; Nachez, 60; and, what is still more, he is constantly improving his lenses without adding to their expense. The lower powers of the several makers were examined without finding any sensible difference in the defining effects of them; what little there was, was in favor of Spencer. The field of the three differed; Nachez's being the least, and Spencer's the greatest.

SPENCER'S AMERICAN MICROSCOPES.

At the meeting of the American Association, Albany, a committee, consisting of Professors Bailey, of West Point, Torrey, of New York, Smith, of Louisiana, Dr. Burnett, of Boston, and Clarke, of Albany, were appointed to examine and report on the microscopes manufactured by Mr. Spencer, of New York, a specimen of which was exhibited to the Association. The committee subsequently presented the following report:—

"The committee on microscopes have the honor to report that they have carefully examined several sets of microscopic objectives, recently manufactured by Mr. Charles A. Spencer, of Canastota, N. Y., and that, after numerous trials with the most difficult test objects known, they are unanimously of opinion that these lenses are of unrivalled excellence. The perfection of these glasses was shown by their admirable defining power, their unprecedented largeness of operation, but preserving good working distance, and by freedom from defects of lenses. The committee believe it unnecessary to report in detail the different experiments made, but confine themselves to the statement that, after numerous trials by all the modes and tests which have been repeatedly employed by members of the committee in examining many of the best foreign lenses, they arrived at results with Mr. Spencer's objectives, which, they believe, have never hitherto been obtained by any microscope in existence. The low powers, as well as the high ones, excited their admiration, readily and beautifully resolving test objects hitherto considered entirely beyond the reach of glasses of corresponding focal distance. As every improvement in the microscope has a direct and most important influence on the progress of scientific research, the committee believe they cannot express in too strong terms their admiration of the results obtained by the unaided efforts of Mr. Spencer, and, however reluctant to appear in a boastful attitude, they believe it would be an act of injustice not to state their sincere conviction, that Spencer's objectives are now the best in the world."

NEW FORM OF MICROSCOPE, WITH IMPROVED METHODS OF MEASURING THE DIMENSIONS OF OBJECTS AND THE ANGLES OF CRYSTALS.

The following is an abstract of a paper presented to the American Association, Albany, by Dr. J. Lawrence Smith, on a new form of microscope, and explained in connection with the instrument:—

"The construction of this microscope is based upon the principle of placing the objective glasses beneath instead of above the objects to be examined. The tube in which the eye-glass is, is thereby five degrees from the perpendicular, and the ray of light undergoes a deflection of one hundred and forty degrees before entering the eye. The deflection is produced by a four-sided prism with the angles 55°, 107½°, 52½°, 145°, the ray of light passing through the objective glass down; into the upper side of the prism it penetrates and is subjected to two total reflections, and passes out of the fourth surface upwards, making an angle of thirty-five degrees with the perpendicular. The eye regards, almost at the same moment, the object itself, on the stage of the microscope, and the image of the same in the instrument; and here the advantage of the instrument is seen for chemical purposes, for which it was originally intended. It is, however, not confined to this, for, owing to the convenience it affords for arranging the illumination, it is well adapted to much general use. The new plan of measurement is to introduce a micrometer into the tube of the microscope at any stage of the observations, by means of an arrangement placed so that the micrometer comes within the plane of the foci of all the eye-pieces used in the instrument. The method of measuring the angles of crystals is by having a graduated circle in the outer part of the tube of the microscope, and passing from the tube carrying the eye-pieces, which has a circular movement independent of that of the graduated circle. The manner of measuring the angles is as follows: — Introduce the micrometer, turn the eye-piece until the lines on the micrometer are parallel to one side of the angle to be measured; then, leaving the eye-piece, turn the graduated circle until the index on the eye-piece is at zero; this done, turn the eye-piece until the lines on the micrometer are parallel with the other side of the angle to be measured, and, in regarding the circle, the degrees of the angle passed through will be seen. The method is convenient, and more precise than any known."

EFFECT OF THE HEAT OF THE SUN UPON THE PERPENDICULARITY OF BUNKER HILL MONUMENT.

In the experiment of swinging a pendulum in the shaft of Bunker Hill Monument, for the purpose of illustrating the experiment of Foucault, it was observed that the ball of the pendulum, when at rest, was not always over the same point in the floor. The careful consideration of all the conditions of this fact resulted in ascribing it to the unequal expansion of the sides of the monument, in consequence of unequal exposure to the sun. Upon observing carefully, it was found during clear days that the motion of the ball in the morning was to the westward, at noon to the north-west, and at evening to the east. It was further observed that on days when the sun was obscured by clouds, no motion of the ball on its index-point occurred. It was still further observed on one occasion, during a sudden shower, accompanied with strong wind from the south-east, to move in the space of a very few minutes a quarter of an inch to the eastward. Observations were recorded through several weeks, and no doubt remains that a cause coincident with the sun in its progress produced the variations of the perpendicular in the Monument. The extreme departure of the ball from the centre was to the west of north-west; not to the north, as might at first glance be supposed. The explanation is found in the position of the Monument. Its sides do not face the cardinal points, but are inclined about 20°. The expansion of a single side would produce inclination in a direction perpendicular to the side. The expansion of two adjacent sides would produce inclination in the direction of the diagonal. In the morning the shaft is inclined to the westward. At noon it is inclined but little to the north of west. In the progress of the afternoon, it sweeps over twice the amount of movement in the morning; describing, in the twelve hours of observation, an arc of an ellipse. During the night it sets back to the centre, and before seven o'clock in the morning has already moved westward. The greatest diameter of the irregular ellipse, described by the index in twenty-four hours, is ordinarily less than half an inch, while the least was less than a quarter of an inch. The heat of the sun penetrates to but a moderate depth. This is evident from the prompt movement of the column when a shower falls only upon the more highly heated sides, and also from the ready change in inclination as the day advances.

The mode of observation at the Monument is this: — On either side, about three quarters of an inch from the centre, under the index of the ball, two slender needles have been driven into the floor, leaving not more than the sixteenth of an inch above. These are made by pressure to pierce a card of thin drawing-paper, which is kept from warping by slender bars of lead. When fixed, north and south and east and west lines are transferred in pencil mark from the floor to the paper. After bringing the ball to rest, in which the observer is aided by a contrivance enabling him to steady his hands, a dot is made with a pencil immediately under the index-point, which is about the sixteenth of an inch above the paper. At the close of the day, the card previously dated is removed, and another takes its place for the observations of the next day.—*Prof. Horsford, American Association, Albany Meeting.*

LATENT HEAT IN ICE.

Perdon has determined the latent heat of fusion of ice, at 0° C., and at lower temperatures, and has ascertained that in order to obtain the *total* quantity of heat which is absorbed when ice becomes liquid, it is necessary to set out from a temperature somewhat below 0°. The experiments were made by means of a calorimeter, founded on the method of mixtures. The loss of heat by radiation was compensated by placing the calorimeter in a space, the temperature of which could be made to follow that of the calorimeter itself, and the method was verified by determinations of the specific heat of water at different temperatures, which agree well with those of Regnault. The author first determined the specific heat of ice between 21° C. and 2° C., employing in the calorimeter a solution of salt, the specific heat of which had been previously determined. The specific heat of ice, between the limits above mentioned, was found to be 0.48. In determining the latent heat, the ice was formed into cylinders, in the axis of which were placed thermometers showing $\frac{1}{100}$th degree; the time of fusion in the calorimeter was on the average about 12 minutes. It was found that the latent heat of fusion of ice was very nearly constant, setting out from a temperature of 2°, and was then represented by 79.97. From this it may be inferred that ice approaches very near its point of fusion without sensibly changing its consistence, the slight softening which precedes the fusion being comprised within an interval of two degrees; the passage of ice from a solid to a liquid state, though sufficiently well defined, is still effected by degrees, and not abruptly. De la Provostaye and Dessains on the one hand, and Regnault on the other, had found, for the latent heat of ice, the number 79; the experiments of Regnault had, however, clearly shown that this number was not constant, but increased as the initial temperature of the ice diminished at least as far as —0.61, for which the corresponding latent heat was 79.71.—*Ann. de Chimie et de Physique, Sept.* 1850.

EFFECTS OF PRESSURE ON THE FREEZING OF WATER.

At a meeting of the American Philosophical Society, Prof. Crenon made some remarks on the experiments of Prof. Thomson, and which Prof. Thomson believes to show that the temperature of congelation of water and other bodies that expand, at the moment of solidification, is raised proportionably to the increase of pressure to which they are subjected — the ratio of temperature to pressure being in water 1.10 of a degree of Fahrenheit's scale, in ten additional atmospheric pressures. Mr. Crenon presented to the notice of the society a speculation into which he had been led on the subject, showing the effect that such a law might produce in causing water to retain the state of a solid, at a very high temperature. For example, if a continuous channel, admitting atmospheric communication, should exist in the crust of the earth to the depth of seventy miles, the pressure of the atmospheric column would exceed fifteen million pounds on the square inch; and, according to Professor Thomson, water would remain solid at a temperature above 10.000° Fahrenheit — a heat far above that of molten iron.

ON THE INTENSITY OF SOUND IN THE RAREFIED AIR OF HIGH MOUNTAINS.

In the Edinburgh Philosophical Magazine, for Jan., 1851, M. Martins communicates the results of various experiments, made with a view of determining the intensity of sound in rarefied air.

The intensity of sound depends on the density of the air at the place of the primitive disturbance, and not on that of the strata traversed by it, nor on that of the air surrounding the hearer. This was proved in the course of experiments made with two mortars, upon the velocity of sound ascending and descending, the mortars being of the same fount, the one placed upon the summit of a mountain, and the other below. It was found that, with the same charge, the sound created in the air, at an altitude of 2682 metres, was much weaker than that produced 2117 metres lower. To equalize the two sounds, it was necessary to charge the lower mortar with 75 grammes of powder, and the upper one with 90 grammes. The accounts of the ascents of the highest mountains contain some observations upon the weakening of the sound, but they often contradict each other. According to Saussure and others, the sounds on the top of Mt. Blanc were remarkably weak. A pistol shot made no more noise than an ordinary Chinese cracker, and the popping of a bottle of champagne was scarcely audible. M. Martins, in the same situation, was not able to verify these conclusions. He states that he was able to distinguish the voices of the guides in conversation at a distance of 400 metres, and to hear the tapping of a lead pencil upon a metallic surface at a distance of from 15 to 20 paces.

Desirous to acquire some ideas more positive upon this subject, the means of obtaining a continuous sound, of a constant intensity, producible at will, was sought for. This M. Martins effected by means of a diapason, properly mounted and constructed, and so arranged as to give 512 vibrations of sound in a second. With a sound having always the same intensity in an air of equal density, it is evident that the variable distance at which it ceases to be perceptible, in mediums of different densities, should give us the measure of the variations of this intensity. The agitation of the air complicates these experiments. It was ascertained by M. Holdat and De la Roche, in 1814, that the limit of distance for hearing is increased or diminished for a person having the wind from or to the origin of the sound. Both these observers agree in affirming that the sound is heard at the greatest possible distance in air at rest, the noise from the wind, come from what part it may, interfering with the perception of the sound.

In experiments made with the diapason, on a desert plain in a calm day, barometer 744 ^{mm} 3, thermometer 24° C., the limit of sound was found to be 254 metres. The same experiment, repeated at 11 o'clock in the evening, in the same place, and under nearly the same circumstances, gave 379 metres as the limit of sound; thus showing a difference of 125 metres in the distance at which sound ceased to be perceptible in the day and in the night. This result confirms the observations of other experimenters, as well as a fact noticed by Humboldt upon the banks of the Orinoco, where the cataracts were heard much better during the night than during the day, although the buzzing of insects was more intense, and the cries of wild animals were louder than during the day.

Experiments made 2620 metres above the level of the sea, barometer 558 ^{mm} 4, gave 550 metres as the limit of sound; at 3910 metres above the sea level, or 900 metres below the summit of Mt. Blanc, barometer 477 ^{mm} 8, the limit obtained was 337 metres. These experiments, in which sounds were heard during the day at greater distances upon the mountains than in the plain, do not contradict the observations of travellers who have been struck with the weakening of sound at great altitudes. In fact, these travellers having ascended suddenly from the plain upon the mountain, their organs, and particularly those of hearing, have not had time to put themselves in equilibrium with the ambient air. The experiments of M. Martins were made after several days' sojourn at the elevations cited, and when the senses, so to speak, were habituated to the aerial medium. So the inhabitants of Paz and Quito, in America, do not suffer from the effects of the rarefaction of the air, because they live habitually at a very great elevation above the level of the sea. There are causes, however, observes M. Martins, which favor the hearing of sound on high mountains, that more than compensate the rarefaction of the air. In the experiments made, a sound was heard at a greater distance, when the density was not more than 0′ 72, on a mountain, than at the level of the sea; and even when the density was only 0′ 64, as on Mt. Blanc, a sound was heard at greater distance than on a plain. Among these causes, *silence* should hold the first rank. On the grand *plateau* of Mt. Blanc there is a repose only broken by the noise of the wind or of thunder. In calm weather the silence is so profound that sounds are heard at a great distance, although their intensity be much less than in the low country. The fall of avalanches, so common in these high regions, is accompanied with a noise which has no relation to the masses of snow or ice precipitated from the neighboring rocks; nevertheless it is always heard, because the least sound is perceived by the ear. There are various other causes, which in the mountains favor the hearing at great distances; such as the configuration and nature of the soil, the hygrometric state of the air, the absence or presence of aerial currents. But all these causes, the influences of which have never been studied, appear secondary to that already noticed. Unfortunately, the silence, more or less perfect, which reigns in a place, cannot be expressed numerically. If that were possible, the intensity of the sound would probably be in the direct ratio of the density of the air, multiplied by a quantity which we may call the *coefficient of silence.*

VELOCITY OF SOUND.

MM. Wertheine and Breguet have presented to the French Academy a paper touching the velocity with which sound is communicated by means of iron wire. The experiments were made upon the wires of the electric telegraph established along the Versailles railroad on the right bank of the Seine. The length of wires between the operators was $4{,}067\frac{2}{10}$ metres, (13,344 feet.) The distance taken would have been greater, but the intervention of a tunnel through which the road passes was found to present insuperable obstacles. The wire was isolated and prevented from touching the wall of the tunnel at any point, but all to no purpose; the sound could not be made to traverse the tunnel. From the distinctness with which the sound, produced by a blow upon the posts supporting the wire, was heard, the operators judged that, but for the tunnel, the sound would have propagated to a much greater distance. The most perfect chronometers were employed, and a variety of ingenious expedients to ensure accuracy in the experiments; and the result reported to the Academy is, that sound is propagated over wire at the rate of 3,485 metres (11,434 feet) per second.

DETERMINATION OF THE VELOCITY OF SOUND BY THE METHOD OF COINCIDENCES.

This method, said Professor Bache, occurred to me about the year 1832, when observing the marching of the corps of cadets on the plain at West Point, to martial music and at a quick step. At first the left foot was brought to the ground in the cadences of the music, and, as the music and marching body receded, the right foot appeared to strike the ground in the cadences. There was a succession of such alternations. This suggested the idea that, by providing a regular series of alternating motions, any remarkable phase of which was simultaneous with a sound, and observing at a suitable distance corresponding to the loudness of the sound, and with proper appliances to assist our sight, a very simple and exact mode of determining the velocity of sound would be had. This method is of such easy application that it might be used to investigate many points yet requiring full experimental determination in regard to the effect of temperature, moisture, the force and direction of the wind, &c.

Professor Coffin remarked that by connecting the pendulum, proposed to be used by Professor Bache, with a galvanic circuit-breaker, the signals could be conveyed to any desired point and registered there, to which Professor Bache assented as an interesting development of his proposition. — *American Association, Cincinnati.*

LIMIT OF PERCEPTIBILITY OF DIRECT AND REFLECTED SOUND.

Professor Henry stated, that at the meeting of the Association at Cambridge, he had made a communication relative to the application of the principles of acoustics to the construction of rooms intended for public speaking. In that communication he had stated, as an important proposition, that when two portions of the same sonorous wave reach the ear of an auditor, one directly from the origin of the sound, and the other indirectly, after one or more reflections, if the two do not differ in the paths they travel by a difference greater than a given quantity, the two sounds will enforce each other, and one louder sound will be perceived; if, however, the interval is greater than a certain limit, the two sounds will appear distinct, or an echo will be perceived. As an illustration, suppose a speaker to stand before a wall at the distance of, say, ten feet; in this case the audience in front would hear but one sound. The direct and the reflected impulse meet the ear within the limit which I have called the limit of perceptibility. This limit, a knowledge of which is of considerable practical importance, may rather be expressed in time or in space. The simplest method of obtaining its amount is that of clapping the hands while standing before a perpendicular wall; if the distance of the observer be sufficient, an echo will be heard. If, in this case, the observer gradually approach the wall, and continue to make the sound at a definite point, the echo will cease to be perceived, and the two sounds will appear as one. If the distance from the wall be now measured, twice the distance found will give the limit of perceptibility in space. If the same quantity be divided into the space through which the wave of sound is known to travel in a second, we shall have the limit of perceptibility in time. The foregoing plan is the most simple, but not the most accurate, method of arriving at the quantity sought. The better plan is to employ another person to produce the sound while the observer is stationary at the distance of at least a hundred and fifty feet from the wall. The person who produces the sound being placed between the observer and the wall, at such a distance from the latter as to give a distinct echo; he is then directed gradually to approach the wall until the echo and the direct sound become one. The distance measured as before mentioned, will give the limit required. From a series of experiments on this plan, Professor H. found the limit ot perceptibility to vary from about 60 to 80 feet; or, in other words, the distance from the wall at which the echo ceased was from 30 to 40 feet. This will give from the one twentieth to the one fifteenth part of a second in time for the ear to distinguish the difference of two sounds which follow each other at an interval of one fifteenth of a second.

The experiments, when made under the same circumstances, gave the same result, almost within a single foot; but when a different source of sound was employed, and different observers, there was observed the difference of results, giving the limits between one twentieth and one fifteenth of a second. The limit was less with a sound produced by an instrument which gave a sudden crack without perceivable prolongation, such as is produced by an ordinary watchman's rattle when made to emit a single crack. This difference may be explained by taking into consideration the actual length of the sonorous wave. If a sound occupies one quarter of a second, which is about the time required for the utterance of a short single syllable, the length of the sonorous wave will be about 300 feet, and hence, when the distance travelled by the two sounds is not more than 80 feet to and from the wall, the two waves must overlap through a considerable portion of their whole length, and will be only separated at the two extremities. The portion of overlapping may therefore determine the limit of perceptibility, and this again is combined with the fact of the continuance of a sonorous impression on the nerve of the ear.—*Professor Henry, American Association, Cincinnati.*

ON AIR-BUBBLES FORMED IN WATER.

Dr. Tyndall, at the British Association, showed, by a few simple experiments, that water falling in a continuous column, which it always does for a certain distance, into another vessel of water, produces neither air-bubbles nor sound; but that, as soon as the distance is so increased as that the end of the column becomes broken into drops, both air-bubbles and sounds, varying from the hum of the cascade and of the ripple to the roar of the cataract and of the breaker, were produced. That the end of the column of issuing water, although it only seems to waver, in consequence of a delusion arising from the effect of the rapid succession on the retina, was really composed of separate drops, the author said was proved by a very pretty experiment, — viz., by placing behind it a platina wire kept glowing by a galvanic battery. The continuous part of the wire was hidden; but the portion behind the wavering end, he said, became separated into dots of light and spaces hidden by the drops. He also showed that lateral motions of bodies in water, when rapid enough, caused both bubbles and sounds; and he accounted for their production in both cases by the surface closing over the pit formed by the descending drops or laterally moving body; the inclosed air is then carried forward, and at length, ascending to the surface, bursts with the explosion which causes the sounds.

A writer in the Philosophical Magazine, in this connection, makes the following remarks on the origin of the sound of agitated water. "When the smoke is projected from the lips of a tobacco-smoker, a little explosion usually accompanies the puff; but the nature of this is in a great measure dependent on the state of the lips at the time, whether they be dry or moist. The sound appears to be chiefly due to the sudden bursting of the film which connects both lips. If an inflated bladder be jumped upon, it will emit an explosion as loud as a pistol-shot. Sound, to some extent, always accompanies the sudden liberation of compressed air. If the surface of the fluid on which a jet falls intersects its limpid portion, the jet enters *silently*, and no bubbles, as before remarked, are produced. The moment, however, after the bubbles make their appearance, an audible rattle also commences, which becomes louder and louder as the mass of the jet is increased. The very nature of the sound pronounces its origin to be the bursting of the bubbles; and to the same cause the rippling of streams and the sound of breakers appear to be almost exclusively due. I have examined a stream or two, and, in all cases where a ripple made itself heard, I have discovered bubbles. The impact of water against water is a comparatively subordinate cause, and could never of itself occasion the murmur of a brook or the musical roar of the ocean. It is the same as regards water-falls. Were Niagara continuous, and without lateral vibration, it would be as silent as a cataract of ice. It is possible, I believe, to get behind the descending water at one place, and if the attention of travellers were directed to the subject, the mass might perhaps be seen through; for, in all probability, it also has its 'contracted sections,' after passing which it is broken into detached masses, which, plunging successively upon the air-bladders formed by their precursors, suddenly liberate their contents, and thus create the thunder of the water-fall.

FOUCAULT'S EXPERIMENT — OR, THE ROTATION OF THE EARTH DEMONSTRATED BY THE PENDULUM.

Few incidents in the scientific history of the year 1851 have excited a more general interest than the experiment, devised by M. Leon Foucault, of Paris, for demonstrating the rotation of the earth by means of the pendulum. Although the rotation of the earth has, by demonstration, been rendered self-evident to all who are in the least degree conversant with the principles of natural philosophy; yet, by the experiment of Foucault, the same fact is made visible to the eye, and in a manner purely mechanical. The method by which this is effected may perhaps be best explained by the description of Foucault's arrangement, as first publicly exhibited in the Pantheon at Paris. To the centre of the dome of the Pantheon a fine wire is attached, from which a sphere of metal, four or five inches in diameter, is suspended so as to hang near the floor of the building. This apparatus is put in vibration, after the manner of a pendulum. Under, and concentrical with it, is placed a circular table, some twenty feet in diameter, the circumference of which is divided into degrees, minutes, &c., and the divisions numbered. Now, it can be shown, by the principles of mechanics, that, supposing the earth to have the diurnal motion upon its axis which is imputed to it, and which explains the phenomena of day and night, &c., the plane in which this pendulum vibrates will not be affected by this diurnal motion, but will maintain strictly the same direction during twenty-four hours. In this interval, however, the table over which the pendulum is suspended will continually change its position in virtue of the diurnal motion, so as to make a complete revolution round its centre. Since, then, the table thus revolves, and the pendulum, which vibrates over it, does not revolve, the consequence is, that a line traced upon the table, by a point projecting from the bottom of the ball, will change its direction relatively to the table from minute to minute, and from hour to hour; so that, if such point were a pencil, and paper were spread upon the table, the course formed by this pencil, during 24 hours, would form a system of lines radiating from the centre of the table; and the two lines formed after the interval of one hour would always form an angle with each other of 15°, being the 24th part of the circumference. The practised eye of a correct observer, especially if aided by a proper optical instrument, may actually see the motion which the table has in common with the earth under the pendulum between two successive vibrations. It is, in fact, apparent that the ball, or, rather, the point attached to the bottom of the ball, does not return precisely to the same point of the circumference of the table after two successive vibrations. Thus is rendered visible the motion which the table has, in common with the earth. It is true that, correctly speaking, the table does not turn round its own centre, but turns round the axis of the earth; nevertheless, the effect of the motion, relatively to the pendulum suspended over the centre of the table, is precisely the same as it would be if the table moved once in 24 hours round its own centre; for, although the table be turned, in common with the surface of the earth, round the earth's axis, the point of suspension of the pendulum is turned also in the same time round the same axis, being continually maintained vertical above the centre of the table. The plane in which the pendulum vibrates does not, however partake of this motion, and, consequently, has the appearance of revolving once in 24 hours over the table, while, in reality, it is the table which revolves once in 24 hours under it.

The occurrence from which M. Foucault was led to his discovery is thus related by him:—"Having fixed on the arbor of a lathe, and in the direction of the axis, a round and flexible steel rod, it was put in vibration by deflecting it from its position of equilibrium and leaving it to itself. A plane of oscillation is thus determined, which, from the persistence of the visual impressions, is clearly delineated in space. Now it was remarked that, on turning around with the hand the arbor which formed the support of this vibrating rod, the plane of oscillation was not carried with it, but always retained the same direction in space." From this came the conclusion that a pendulum set in motion will continue in the same plane of vibration, however the point of suspension be rotated; a fact easily proved by a simple trial with a weight at the end of a cord. The rotation of the point of suspension may make the pendulum revolve on its axis; but the plane of vibration will remain the same. The reason for this is obvious: the swinging pendulum, when about to return (after an outward swing) from its point of rest, is made to move from that point by gravity alone, and can therefore fall *in one direction;* and the momentum acquired by falling carries it beyond this centre in the *same* direction to the point of rest on the other side; here again it is in a like condition, and must return under the force of gravity in one and the same line, gravity acting in the same direction whether the point of suspension be rotated or not. Thus the plane of vibration is fixed from the very nature of the forces at work.

It is evident, therefore, that if a pendulum were swinging at the pole of the earth, the plane of vibration, as it would not change with the revolution of the earth, should mark this revolution by seeming to revolve in the contrary direction, and in 24 hours it would make *apparently* the whole circuit of 360 degrees. But, at the equator, the plane of vibration is carried forward by the revolution of the earth, and so undergoes no change with reference to the meridians. Between the equator and poles, the time required for the pendulum to make 360 degrees varies according to the latitude, being greater the farther from the pole.

The motion of the pendulum at the poles and the motion at the equator is not hard to comprehend; a clear explanation, however, of the motion of the pendulum at stations between the pole and the equator is a matter of no little difficulty. As the pendulum is here influenced by so many varying conditions, a strictly true mechanical conception of its motions may be impossible.

The peculiar interest of Foucault's experiment has caused it to be repeated in all parts of the world. Every experiment, says the London Philosophical Magazine, which has been properly conducted, under favorable circumstances, has furnished results most striking. Experiments made at Colombo, Ceylon, in latitude 6° 56′ N., with a pendulum 66 feet six inches long, give a mean hourly variation of 1.87, which is a very close approximation on the calculated variation, which is 1.8111. The law, therefore, seems to hold good even at points very near to the equator. A Mr. Bunt, of Bristol, England, in a set of long experiments, obtained a mean motion of 11°.750 per hour instead of 11°.7631, as per theory, the latitude being 51° 27′. In another set of experiments, undertaken at a different latitude, he obtained corresponding results, which, he thinks, not only confirm the truth of Foucault's hypothesis, but seem to show that the latitude of a place may be found by this means with a considerable degree of accuracy.

A new contrivance for exhibiting the rotation of the earth is reported to have been devised by Prof. Strong, of Rutger's College, N. Y. He has constructed a wooden wheel, six feet in diameter, but very slight indeed — its weight being only two pounds. This wheel is supported horizontally, the hub resting on a steel needle, in the same manner that a compass is supported. This needle fits into a glass socket. This apparatus being placed in a room free from currents of air and all disturbance, the motion of the earth around the wheel is perceptible; the wheel apparently performing the revolution in the proper number of hours. By this wheel it is said that the latitude can at all times be correctly ascertained. The experiment is not confined to a wheel of such large dimensions, but may be realized with smaller ones.

NEW METHOD OF DEMONSTRATING THE ROTATION OF THE EARTH.

The recent experiment of M. Foucault, giving direct proof of the earth's rotation, having excited so much attention, it seems remarkable that an equally striking one, devised and tried by M. J. Guyot, in 1836, should have been passed over or forgotten. That gentleman observed, that as a falling body deviates to the east, a long plumb-line ought to do the same. This experiment he performed in the dome of the Pantheon, at Paris, with a plumb-line, about 172 feet long, and determined the deviation to be four and a third millim. in 57 metres. His mode of experimenting was by small balls, one at the point of suspension, the other at the weight, whose images, strongly illuminated and reflected in a basin of mercury placed below, were viewed from above, and found to coincide when the eye was laterally distant four and a third millim. from the upper ball. The experiment might probably be simplified without the trouble of illumination, by making the suspension from a line passed across a small circular aperture in a flat roof, the light coming through which would probably give a sufficiently light image in the mercury below. The effect is also stated to be sufficiently *perceptible* with much less length than that above stated.

DEMONSTRATION OF THE ROTATION OF THE EARTH BY MEANS OF TWO PENDULUMS.

At the Institution of Civil Engineers, London, the following communication was read by Mr. Cox:—

"The demonstration of the rotation of the earth was usually made to depend on phenomena presented by the appearance of the heavens. Two mechanical experiments had, however, long been known, which demonstrated the fact that the earth revolved:— the one, the retardation of the pendulum by centrifugal force, a question discussed by Newton, Huygens, and others; the other, which was suggested by Newton, consisted in dropping, from a great height, a ball, which, by the diurnal motion, was moved somewhat to the eastward. The experiment had hitherto been performed with *one* pendulum; but, in the present instance, *two* pendulums were used, and were suspended at a sufficient distance apart to allow of the free vibration of each. The weights were held together by a thread, which, on being burned, released them, so that they were set vibrating, initially, in the same vertical plane; consequently, to the eye of an observer situated in that plane, the two pendulum wires appeared co-incident, one of them covering, or eclipsing, the other. In a short time, however, the course of the two pendulums visibly altered. As their planes of oscillation appeared to revolve the same way on the earth's surface, the wires no longer covered each other, but appeared to separate and alternately to cross each other. The advantages of this mode of operating were, first, the rapidity with which the deviation of the pendulums was manifested; for, as their planes revolved in the same apparent direction, their arcs diverged from each other twice as fast as either from its initial position; and, secondly, the apparent crossing and recrossing of the wires constituted, to the naked eye, a much more distinct and palpable test of the result than the apparent motion referred to a plane beneath *one* pendulum. — *London Athenæum.*

BOURDON'S IMPROVEMENTS IN GAUGES, BAROMETERS AND THERMOMETERS.

THE following is the principle of construction of M. Bourdon's improved gauges, barometers, thermometers, &c., which of late has attracted considerable attention: —

It appears that if a brass or thin sheet-iron or steel tube be nearly flattened, and afterwards coiled, the effect of an inward pressure of steam or water is to force it towards its original shape; the first effect produced being that of tension towards elongation, whether the flattened tube be coiled or twisted; and a contrary effect is produced by unresisted exterior pressure. Thus in shaping it, as we have said, a certain degree of elasticity having been given to the metal, as long as it is not absolutely forced beyond a given point of its acquired shape, it will act as a spring to the greatest perfection, and work from or back to its newly-acquired shape, as the pressure upon it may be applied. This law has been worked out with admirable ingenuity. Thus, a simple piece of well-made metal tube is first partially flattened in all its length, and coiled nearly to a circle. One end of it is stopped up, while the other end is left open, to receive the pressure of steam or water. To the end that is stopped a hand is fixed, which is so placed as to show the variations in the position of the tube upon a dial marking the degrees of pressure. Here is a most perfect pressure-gauge. of a simplicity hitherto beyond conception. A vacuum-gauge is made of the same simple piece of mechanism, reversing the application of pressure, and, consequently, the effect upon the tube. For instance, as exhaustion takes place in the tube, so does its power of resisting the pressure of the surrounding atmosphere, which acts upon it, vary, and it consequently again coils under that pressure in regular ratio with the variation of it, and is made to indicate the degree of vacuum in the condensers of an engine. A barometer is made in the same simple manner, by completely exhausting the air from the coiled tube, and hermetically closing it. As the pressure of the atmosphere varies, so does the tube give under it in proportion ; and thus, with the greatest accuracy, such an instrument indicates the smallest variations of atmospheric pressure, and forms one which, from its solidity and simplicity, we consider to be preferable to any sort of barometer as yet produced.

To form a thermometer the same shaped metal is employed ; or if for indicating the temperature of liquids, the tube is generally twisted in its whole length, instead of being coiled, and, being filled with alcohol, it is well closed ; and thus as the temperature varies so will the alcohol in the tube expand or contract, and force the tube to observe its action, and indicate the variations of temperature, either of the surrounding atmosphere, or of any body of fluid into which it may be plunged.

Steam pressure gauges, constructed upon M. Bourdon's principle, have been ordered by the French government to be applied to all locomotive engines in that country.

ALARM BAROMETER.

A BAROMETER has been constructed by Captain Ericsson, so adapted as to give warning itself of any remarkable atmospheric change. The principle of its construction is as follows :— when the column descends in the tube beyond any given altitude, the falling of the mercury causes a gong to be sounded, by means of a hammer impelled by a spring. The mercury, in its descent into the cup, disturbs the equilibrium of a lever, which disengages a catch connected with the hammer. This barometer will be of special benefit at sea, where a remission of watchfulness may peril the safety of the vessel.

HEIGHT OF THE ATMOSPHERE.

SIR JOHN W. LUBBOCK, according to the hypothesis adopted by him in his Treatise on the Heat of Vapors, shows the density and temperature for a given height above the earth's surface. According to that hypothesis, at a height of fifteen miles the temperature is 240° 6′ Fahr. below zero ; the density is .03573 ; and the atmosphere ceases altogether at a height of 22.35 miles. M. Biot has verified a calculation of Lambert, who found, from the phenomena of twilight, the altitude of the atmosphere to be about eighteen miles. The condition of the higher regions of the atmosphere, according to the hypothesis adopted by Ivory, is very different, and extends to a much greater height.

MICROMETRIC APPARATUS.

ONE of the most original contributions to the " Great Exhibition," was the so-called " Micrometric Apparatus," contributed by Messrs. Whitworth. It is the first attempt yet made in the mechanical world to establish a uniform standard of magnitude in machinery, so that

that uniformity may be as well understood as the uniformity of language or numeration. Suppose two metallic surfaces, by friction, or otherwise, are made so plain and smooth, that when laid upon one another every part of the surfaces is in equal contact; and then suppose a stratum, inserted between them, composed of particles of air, which act like perfectly smooth rollers, the surfaces will then move in contact with each other, in the most easy manner, owing to the lubricity of the air. If the air, however, is excluded by pressure, the contact becomes so complete that it is difficult to overcome. These surfaces are used as tests to other plane surfaces, and with these are tested the ends of a standard measure of metal, which is placed in a horizontal metallic bed, one end bearing against a metallic pin, while against the other end another metallic pin is urged by a screw; and if this metallic bar suffer a change in its length, amounting to even the millionth part of an inch, by temperature or otherwise, that change is instantly perceptible. And thus — the pin which bears against its extremity is moved by a screw, having ten threads to the inch. On the head of this screw is a wheel, consisting of four hundred teeth, worked in a worm by another wheel, the rim of which is divided into two hundred and fifty visible parts. As each thread of the screw corresponds to one tenth part of an inch, each tooth of the wheel upon its head will correspond to the four thousandth part of an inch, and each division of the wheel connected with the worm will correspond to the millionth part of an inch. A change in the position of the wheel attached to the worm, through one of the two hundred and fifty divisions, is, therefore, rendered sensible, at the point of the screw which bears against the standard bar, to the millionth part of an inch. The accuracy of this micrometric apparatus was proved by placing in it a standard yard measure, made of a bar of steel, about three quarters of an inch square, having both ends perfectly true. One end of the bar was placed in contact with the face of the machine; at the other end a small piece of flat steel was interposed between it and the machine, whose sides were also made perfectly parallel. This was termed the contact-piece. Each division on the micrometer represented the one millionth part of an inch, and each time the micrometer was moved only one division forward the experimenter raised the contact-piece, allowing it to descend across the end of the bar simply by its own gravity. This was repeated until the closer approximation of the surfaces prevented the contact-piece from descending, when the measure was completed, and the number in the micrometer represented the dead length of the standard bar to the one millionth part of an inch. Eight repetitions in a quarter of an hour produced the same results, there not being a variation of one millionth of an inch. This method was termed the "system of proof by the contact of perfectly true surfaces and gravity." By the application of this instrument standard gauges for axles, taps, and other parts of machinery, which it is desirable to maintain uniform, are constructed; and so minute is its operation, that magnitudes can be estimated that do not exceed the one millionth part of an inch.

A NEW METHOD OF MEASURING DISTANCES.

An invention, by Capt. Groetares, of the Belgian Engineers, has lately been tested at Greenwich. It is a simple means of ascertaining the distance of any object against which operations may have to be directed, and is composed of a staff about an inch square and three feet in length, with a brass scale on the upper side, and a slide, to which is attached a plate of tin, six inches long, and three wide, painted red, with a white stripe across its centre. A similar plate is held by an assistant, and is connected with the instrument by a fine wire. When an observation is to be taken, the observer looks at the distant object through a glass fixed on the left of the scale, and adjusts the striped plate by means of the slide; the assistant also looks through his glass, standing a few feet in advance of his principal, at the end of the wire, and, as soon as the two adjustments are effected and declared, the distance is read off on the scale. In the three trials made at Woolwich, the distance in one case, although more than 1000 yards, was determined within two inches; and, in two other attempts, within a foot. It is obvious that such an instrument, if to be depended on, will admit of being applied to other than military surveys and operations, and may be made useful in the civil service.

ON THE PROPER FORM OF THE MOULD-BOARD OF THE PLOUGH.

At the American Association, Albany, Prof. Hackley, of New York, stated that he had received a communication from the N. Y. S. Agricultural Society, requesting him to ascertain, if possible, the true theoretic form of the mould-board of the plough, so that it would offer the least resistance, and thoroughly perform the work; and to include, if it could be done, the modification suitable to produce the pulverization of the soil. Theory and experiment show that the angle of inclination of the edge of the share, which cuts off the furrow slice from the bottom, to the direction of the plough's motion, and that of the coulter, which cuts off at the side, to the horizon, are matters of little importance. The advantage of inclining them is, that they may act like a saw to cut off roots. The resistance to the action of these two portions of the plough is uniform, and is the chief resistance to the draughts. However, the general wedge-like form of the plough indicates that the greater its length, (since the breadth is fixed by the required breadth of the furrow,) the less the resistance, because the angle of the wedge would thus be rendered more acute. Four feet is the utmost length that would be consistent with the convenience of turning at the end of the field. The longest Scotch ploughs are not more than three feet nine inches, and the American ploughs are much shorter. The shares and mould-board form properly one continuous surface. After the furrow-slice is cut off by the coulter and front edge of the share, (which latter we may suppose a line perpendicular to the direction of the furrow and equal to its breadth,) the furrow-slice is to be lifted and turned over, revolving about its edge. As this effect is to be produced by the mould-board in contact with the whole breadth of the furrow-slice, it is evident that the surface of the mould-board must be a warped surface, generated by a right line, moving from the position of the front edge of the share, parallel to a plane director, which is perpendicular to the direction of the furrow; the generatrix, at the same time, revolving about its inner extremity, describing an angle of 135° or 180°, according to the position in which the furrow-slice is to be left, this whole angle being described when the generatrix has moved the prescribed length of the plough; four feet being the maximum. The only resistance to the turning over of the furrow-slice, after it is cut off, will be its movement of inertia and weight. The friction occasioned by the weight of the furrow-slice will impede the forward motion of the plough, but forms no part of the resistance of the furrow-slice itself to being turned over. But this friction is trifling, compared with that of the bottom of the plough, (which depends on its weight, and not on the length of the plough or the surface in contact with the ground,) and still more trifling in comparison with the resistance which the solid earth opposes to the cutting of the coulter and the share. The problem will then consist simply in determining the relation of the angular movement of the generatrix to its longitudinal movement, so as to produce a steady and constant pressure of the mould-board upon the furrow-slice till it is completely turned over into the required position. These conditions will insure both the least resistance, so far as the small resistance, arising from the weight and inertia of the furrow-slice, is concerned, and the best performance of the work. [For the equation, which expresses the relations of angular motion and time, or, in other words, the angular velocity of solid bodies about fixed axes under the action of various accelerating forces, see *Poisson*, *Traité de Mecanique*, art. 392, of the edition of 1833.] Professor H. then displayed upon the black-board an investigation involving the higher mathematical analysis, from which he deduced the law of generation, of the surface of the mould-board, and explained a practical method of constructing a model from wood, in accordance with his formula, so as to fulfil the conditions prescribed. For the purpose of producing the pulverization of the furrow-slice, there must be an elevation of the mould-board at its under-surface medium line. This elevation will act to the greatest advantage to produce the pulverization if made upon the forward part of the mould-board, where the surface is not so much warped. Experiments might be made with an excrescence of wood, which should be cut away until the degree of pulverization leaves the furrow-slice in sufficient form to be turned over and delivered in its place without too great scattering.

ON THE "NOMINAL HORSE-POWER" OF STEAM ENGINES—READ BEFORE THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, BY L. G. HEATH.

The inadequacy of the present term, "nominal horse-power," for giving a definite idea, either of the absolute or relative power of engines, was first examined by comparing the engines of H. M. S. Garland and Basilisk, which were both constructed on the same principle, with oscillating cylinders, and were both used to drive paddle-wheels. This comparison was made under three distinct heads; — the mean effective pressure, the number of revolutions per minute, and the size of the cylinders. It was urged that Watt's constant of seven pounds per square inch, for the mean effective pressure, was not only in itself inapplicable, but that no constant quantity could be universally applicable. Also, that the method of determining the number of revolutions per minute from a conventional speed, founded on the length of the stroke of the piston, was equally fallacious. It was, therefore, proposed that the term, "nominal horse-power," should be abolished; that engines should in future be designated by the cubic contents of their steam-cylinders, jointly with their nominal consumption of a standard description of fuel, during a given period of one hour. The system, it was contended, would be more in accordance with the present practice of construction, and would enable the relative size and power of engines to be more accurately estimated than by the present method. In the ensuing discussion, it was admitted that it would be very desirable to fix the nomenclature of the power of engines; for, though it was well known that James Watt did really take as his standard what he found to be actually performed by a powerful horse, drawing a weight over a pulley, viz., the equivalent of 33,000 pounds raised one foot high in a minute, yet, commercially, it had gradually become a custom among manufacturers to give a surplus of power, ostensibly as an allowance for friction and deficiencies of the machine, so that now the mere statement of the nominal horse-power had no definite meaning. It was, however, contended that the standard of 33,000 pounds should be retained; and that, supposing the workmanship to be equally good in two engines, it was only necessary to compare the areas of the cylinder, the effective pressure of steam on the piston, and the speed of the piston, to determine their relative power. This was, in fact, shown by the indicator, an instrument, the value of which was now universally admitted, and which, when skilfully used, did really give a true representation of the power of the engine. It was the universal custom of Boulton and Watt to calculate the power exerted by an engine by the speed of the piston, together with the average pressure of the steam, as shown by the indicator; and, although much vagueness and uncertainty had latterly been introduced into the subject, this was rather to be attributed to the assumption of arbitrary quantities to represent these results, than to any defect in Watt's standard horse-power, which definitely expressed both the measure of power and the space through which it acted. The proposed standard of comparison of the quantity of water evaporated in a given time, by a given amount of fuel, or the combustion of a given quantity of fuel in a given time, were shown to be of no value, as then, not only the generation of the steam, but the administration of it, must be considered, and these points merely tend to complicate the question. For pumping-engines in Cornwall, the term horse-power was almost unknown; engines being sold to raise a given quantity of water, which was a standard easily reducible to that of other districts, where 33,000 pounds was assumed to be the actual power of a horse. The commercial question, of what a manufacturer should give as a horse-power, could not be discussed; for the actual power was only a small element in the actual cost of an engine, that varying with every peculiar application of the machine. The surplus power now given by manufacturers has evidently arisen from a more perfect machine being now produced, by the use of tools in the manufacture, the introduction of metallic rings instead of hemp packing, more perfect valves, and numerous modifications, all of which were apart from, and independent of, the question of the original standard, which, it was admitted, could not be improved, and should not, therefore, be altered.

ILLUSTRATIONS OF LOCOMOTIVE SPEED.

Dr. Lardner, in his lately published *Economy of Railways*, thus endeavors to convey to the unpractised reader the enormous speed of a locomotive going at the rate of seventy miles an hour:—"Seventy miles an hour is, in round numbers, 105 feet per second; that is, a motion in virtue of which a passenger is carried over thirty-five yards between two beats of a common clock. Two objects near him, a yard asunder, pass by his eye in the 35th part of a second; and if thirty-five stakes were erected by the side of the road, one yard asunder, the whole would pass his eye between two beats of a clock; if they had any strong color, such as red, they would appear a continuous flash of red. At such a speed, therefore, the objects on the side of the road are not distinguishable. When two trains, having this speed, pass each other, the relative velocity will be double this, or seventy yards per second, and if one of the trains were seventy yards long, it would flash by in a single second. To accomplish this, supposing the driving-wheels seven feet in diameter, the piston must change its direction in the cylinder ten times in a second. But there are two cylinders, and the mechanism is so regulated that the discharges of steam are alternate. There are, therefore, twenty discharges of steam per second, at equal intervals; and thus these twenty puffs divide a second into twenty equal parts, each puff having the twentieth of a second between it and that which precedes and follows it. The ear, like the eye, is limited in the rapidity of its sensations; and, sensitive as that organ is, it is not capable of distinguishing sounds which succeed each other at intervals of the twentieth part of a second. According to the experiments of Dr. Hutton, the flight of a cannon ball was 6700 feet in one quarter of a minute, equal to five miles per minute, or 300 miles per hour. It follows, therefore, that a railway train, going at the rate of 75 miles per hour, has a velocity of one fourth that of a cannon ball; and the momentum of such a mass, moving at such a speed, is equivalent to the aggregate force of a number of cannon balls equal to one fourth of its own weight."

CHEMICAL SCIENCE.

DIVISIBILITY OF MATTER.

Many years ago, a curious calculation was made by Dr. Thomson, to show to what degree matter could be divided, and still be sensible to the eye. He dissolved a grain of *nitrate of lead* in 500,000 grains of water, and passed through the solution a current of sulphuretted hydrogen, when the whole liquid became sensibly discolored. Now a grain of water may be regarded as about equal to a drop of that liquid, and a drop may be easily spread out so as to cover a square inch of surface. But under an ordinary microscope the millionth of a square inch may be distinguished by the eye. The water, therefore, could be divided into 500,000,000,000 parts. But the lead in a grain of nitrate of lead weighs 0.62 grains; an atom of lead cannot weigh more than 1,310,000,000,000th of a grain, while the atom of sulphur, which, combined with the lead, rendered it visible (in the mass?), could not weigh more than 1-2,015,000,000; that is, the two billionth part of a grain.

But what is a billion, or, rather, what conception can we form of such a quantity? We may say that a billion is a million of millions, and can easily represent it thus: 1,000,000,000,000. But a school boy's calculation will show how entirely the mind is incapable of conceiving such numbers. If a person were able to count at the rate of 200 in a minute, and to work without intermission twelve hours in a day, he would take, to count a billion, 6,944,944 days, or 19,025 years 319 days. But this may be nothing to the division of matter. There are living creatures so minute, that a hundred millions of them may be comprehended in the space of a cubic inch. But these creatures, until they are lost to the sense of sight, aided by the most powerful instruments, are seen to possess organs fitted for collecting their food, and even capturing their prey. They are, therefore, supplied with organs, and these organs consist of tissues nourished by circulating fluids, which must consist of parts or atoms, if we please so to term them. In reckoning the size of such atoms, we must not speak of billions, but perchance of billions of billions. And what is a billion of billions? The number is a quadrillion, and can be easily represented thus:—1,000,000,000,000,000,000,000,000; and the same school boy's calculation may be employed to show that to count a quadrillion, at the rate of 200 a minute, would require all the inhabitants of the globe, supposing them to be a thousand millions, to count incessantly for 19,025,875 years, or for more than 3000 times the period for which the human race has been supposed to be in existence. — *Low's Inquiry into the Simple Bodies of Chemistry.*

OBSERVATIONS ON ATOMIC VOLUMES, WITH CONSIDERATIONS ON THE PROBABILITY THAT CERTAIN BODIES NOW CONSIDERED AS ELEMENTARY MAY BE DECOMPOSED.

PROF. DUMAS, at the British Association, alluded to the solubility of some substances, and the insolubility of others, giving many instances of the difference of this quality in regard to solution in water, sulphuric and strong acids, and referred to Berthollet's views and experiments on this subject. The measure of volume of bodies, he thought, might be represented with as much facility as the weight; thus, for example, magnesia and sulphuric acid may have their volumes numerically expressed before and after combination, and also graphically by lines. Magnesia with sulphuric acid showed a certain degree of condensation, lime a greater condensation, and barytes the greatest condensation; and these he could represent and reason on as well by lines of different lengths as by figures or by words. The degree of condensation had also relation to the quality or degree of solubility. Thus, sulphate of magnesia was very soluble, sulphate of lime but little soluble, and the greatly condensed sulphate of barytes was insoluble. He then pursued the analogy with the chlorides, comparing the chloride of sodium with the extreme case of the chloride of silver. After graphically expressing the solubility of bases with sulphuric acid by lines, he proceeded to show that the relative volumes of the elements chlorine, bromine, and iodine, could be perfectly represented by lines equal in length. Prof. Dumas said that when a number of metals are represented by lines, at first they seem in confusion, and it would appear like an impossibility to arrange them in a system of lines, to permit their relations to appear; but when considered in relation to the substitution of one property for another, or of the substitution of one substance for another in groups, then their arrangement became easy. Many examples were given of groups of bodies such as the alkalies, earths, &c., arranged in the order of their affinities. He also called attention, in the Triad groups, to the intermediate body, having most of its qualities intermediate with the properties of the extremes, and also that the atomic or combining number was also of the middle term, exactly half of the extremes added together; thus, sulphur 16, selenium 40, and tellurium 64. Half of the extremes give 40, the number for the middle term. Chlorine 35, bromine 80, and iodine 125. Of the alkalies, lithia, soda and potassa, or earths, lime, strontia and baryta, afforded, with many others, examples of this coincidence; hence this suggestion, that, in a series of bodies, if the extremes were known by some law, intermediate bodies might be discovered; and, in the spirit of these remarks, if bodies are to be transformed or decomposed into others, the suggestion of suspicion is thrown upon the possibility of the intermediate body being composed of the extremes of the series and transmutable changes thus hoped for. Prof. Dumas then showed that in the metals similar properties are found to those of non-metallic bodies; alluding to the possibility that metals that were similar in their relations, and which may be substituted one for the other in certain compounds, might also be found *transmutable*, the one into the other. He then took up the inorganic bodies, where substitutions took place, which, he stated, much resembled the metals. After discussing groups in Triads, Prof. Dumas alluded to the ideas of the ancients, of the transmutations of metals, and their desire to change lead into silver, and mercury into gold; but these metals do not appear to have the requisite similar relations to render those changes possible. He next passed to the changes of other bodies — such as the transmutation of diamonds into black lead, under the voltaic arc. After elaborate reasoning, and offering many analogies from the stores of chemical analysis, Prof. Dumas expressed the idea that the law of the substitution of one body for another in groups of compounds might lead to the transformation of one group into another at will; and we should endeavor to devise means to divide the molecules of one body of one of these groups into two parts, and also of a third body, and then unite them, and probably the intermediate body might be the result. In this way, if bodies, of similar properties and often associated together, were transmutable one into the other, then, by changes, portions of one might often, if not always, be associated with the other. Thus, in nature, where chlorine occurred, iodine and bromine might also be found, and always would be if they were transmutable the one into the other. Cobalt is thus mysteriously associated with nickel, iron with manganese, sulphur with selenium, &c. In the arts, during operations, when certain radicles were produced, analogous ones were found constantly to be associated. In the distillation of brandy, oil of wine is always an associated result. Dr. Faraday expressed his hope that Prof. Dumas was setting chemists in the right path; and, although conversationally acquainted with the subject, yet he had been by no means prepared for the multitude of analogies pointed out. Mr. Grove spoke of the importance of the views; as, by knowing the extreme compounds, it might serve as a guide in experiments, and as a check to the results. He adverted to the allotropic condition of substances when their principal characters were changed, but their chemical qualities were unaltered; thus, carbon in the state of diamond had a change of property so complete that it had one of the properties of metals given or transferred to it by its conducting power for electricity under these conditions, and its other forms were states resistant to electric passage. He thought this fact, of certain bodies having two sets of physical properties, with greatly differing character, might, with this law of the substitution of one set of chemical qualities for another in a compound group, give the hope of the great realization of some of the ideas embodied in the views of the possible transformation of one body, at will, so as to possess the properties of all others.

ON THE CHEMICAL NOMENCLATURE OF ORGANIC COMPOUNDS.

A PAPER with the above title was presented at the meeting of the British Association, 1851, by Dr. Daubeny. The object of this paper was to point out certain inconsistencies and anomalies in the received method of classifying and naming organic compounds, and thus, if possible, to induce chemists to agree on a set of rules, by adhering to which the compositions and relations of a body might be inferred from the termination of the word designating it. The professor first alluded to the nomenclature proposed by Gmelin, which imposed new names upon all known elements, and thus was at least as difficult as the acquisition of an entirely new language. Not conceiving that so intricate a system would ever come into vogue, he proceeded to point out the meaning belonging to the several terminations attached by eminent chemists to the names of bodies of their own discovery, as indicative of the class to which they belonged, and likewise their method of denoting the composition of a body by constructing for it a name made up of those expressive of its several ingredients. In order to introduce somewhat more of precision into this method of nomenclature, and also to render it, in some instances, more convenient and more applicable to daily use, the professor submitted to the Section the following suggestions: — 1. That the term *hydrocarbon*, when used to designate a class, should be confined to the compound radicals; the essential oils being regarded either in the light of hydrurets, from their containing an atom of hydrogen in a different state of combination from the rest, or of aldehydes, from their tendency to form acids by the addition of two atoms of oxygen. 2. That the term *ether*, as designating a class, should be restricted to the oxides of the respective compound radicals; and that the "compound ethers" should be named on the same principle that salts are, by terms expressive of their respective acids and bases. 3. That the term *cetone* should be retained for bodies produced from acids by the abstraction of a single atom of carbonic acid; 4. and that of *glyceride* for fixed oils. 5. That the termination *yle* for Liebig's compound radicals, and *ene* or *en* for carbohydrogens with equal atoms of the two elements, be retained. 6. That to the vegetable alkalies produced by natural processes, the termination *ine* should be confined; and to those artificially produced by substitution of hydrocarbons for the hydrogen atoms of ammonia that of *amine*. 7. That the names proposed by Hoffman for the alkaloids of his own discovery should be abbreviated by introducing only the first syllable of the name expressive of each of the hydrocarbons present, by which expedient the length of the word so compounded need rarely exceed six syllables. 8. That the termination *amide* should be retained merely for bodies formed by the replacement of the hydrogen atoms *when they are not alkalian;* and that the terms *imide* and *nitrile* should be no longer employed. 9. That the termination *am*, occasionally used for ammonia compounds, be discarded. 10. That the termination *al*, for aldehyde compounds, should be henceforward employed with more precision. 11. That the termination *ethane* should be used for those ether compounds only into which an acid does not enter. 12. That the termination *an* should be employed in a more definite sense than heretofore. 13. That the terminations *one* and *ole* should be respectively confined, the former to bodies produced from acids by the abstraction of one atom of carbonic acid, and the second by that of two atoms; so that the latter term should not be adopted to indicate the essential oils. 14. That where a name expressive of the composition of a body cannot be constructed, one should be formed having reference to some obvious physical or chemical property, and of which the Greek or Latin root can be readily apprehended. Such barbarous and unmeaning terms, therefore, as mercaptan, kapnomor, pittacal, parabanic acid, &c., should be rejected from the vocabulary of science. 15. That bodies produced by natural processes should, in general, bear a name recalling the source from whence they are derived. 16. And, lastly, that although bodies belonging to the same class or type should, in general, have the same termination, yet, that where a substance already familiar to us is shown to belong to a particular type, its designation ought not in that case to be altered, — so as to bring it into harmony with the other bodies with which it may be thus associated. The above suggestions are thrown out rather as embodying the views of the most eminent chemists, so far as these views can be inferred from their practice, than as expressive of any new methods or arrangements conceived by the author of the paper.

RELATION OF THE CHEMICAL CONSTITUTION OF BODIES TO SIGHT.

A PAPER with the above title was read by Prof. Horsford before the American Association, Albany, the design of which was to determine the extent of general principles in governing the colors exhibited by metals and other bodies. The following are Prof. H.'s conclusions. "The color of bodies depends upon the extent of surface of their small particles or groups of atoms. Transparency depends upon the arrangement of lesser atoms in certain order, constituting large groups. Whiteness depends upon such extent of surface of the grains of atoms as shall reflect a light; or upon the number of thin plates produced by pulverizing transparent bodies as will reflect all the light. Blackness depends upon the subdivision of grains to such minuteness, that they no longer reflect light, or, by producing interference, destroy it. Heat, by subdivision, causes darker shades."

ARTIFICIAL FORMATION OF MINERALS.

EBELMAN has published a second memoir upon this subject, containing many valuable additions to our knowledge, and throwing great light upon chemical geology and mineralogy. The method pursued in these investigations was the same employed by the author in his previous researches, and consisted in dissolving the constituents of the mineral to be formed in an appropriate solvent, and submitting the whole to evaporation at a high temperature in a porcelain furnace. Boric acid was the solvent commonly employed, but the author also used borax, phosphoric acid, and certain alkaline phosphates. Of the minerals belonging to the spinelle group, several were obtained by the author in his previous memoir; the experiments, however, have been repeated, and with better success as regards the size and perfection of the crystals obtained. Magnesian spinelle $Al^2 O^3 MgO$, was prepared by igniting a mixture of alumina, magnesia, chromate of potash and boric acid, the mixture remaining in the furnace eight consecutive days. The crystals thus produced were octahedrons, truncated upon the twelve edges, some of them three or four millimetres on the side; they were transparent, of great lustre, and of a more or less marked rose color. The angles measured, perfectly corresponded to the theory; the density of the crystals was 3.542. Gahnite, $Al^2 O^3 ZnO$, chromite of manganese, and other minerals of like character, have been also obtained in equal perfection. Rutile was obtained in long acicular prisms by igniting a mixture of titanic acid with phosphate of soda and ammonia; the crystals were transparent and of a golden yellow color; their density was 4.283, which agrees with that of rutile. — *Annalles de Chimie,* xxxiii. 34.

ON THE FORMATION OF DOLOMITE BY THE ACTION OF MAGNESIUM VAPORS. BY M. DUROCHER.

Pieces of a porous limestone and anhydrous chloride of magnesium were introduced into a gun-barrel, so that neither substances were in contact. The closed tube was then exposed for three hours to a dull red heat, in order to maintain an atmosphere of chloride of magnesium vapor round the limestone. At the end of that time the pieces of limestone were found to be covered with a crust of fused chloride of calcium and chloride of magnesium, mixed with a little peroxide of iron, and the oxides of the two earths. The chlorides were separated by washing with water, and the nuclei were then found to be partially converted into dolomite. Transparent groups of crystals were visible under the microscope; the mass had a white color passing into yellow and grayish-yellow, and was, like dolomite, full of cavities. Durocher is of the opinion, that the assumption of some geologists, that dolomite has been formed naturally by aqueous agencies, is proved by this experiment not to be absolutely correct, as it may also have been formed by magnesian vapors, issuing from the interior of the earth, and gradually converting limestone into dolomite. — *Comptes Rendus.*

ON THE CHANGES IN STRUCTURE OBSERVED TO TAKE PLACE IN SOLID ARSENIOUS ACID AND OTHER SOLID BODIES.

The most remarkable property of arsenious acid is this, that as an amorphous body, without any admixture, and without losing its solid state, it experiences a change which makes it assume a totally different aspect. It has long been known, from experiment, that the transparent arsenic glass gradually becomes opaque, until it resembles porcelain. The substance, at first colorless, becomes white, the transparency disappears, and it becomes completely opaque; the beautiful, vitreous lustre becomes feeble, and approaches the waxy. The specific gravity at the same time diminishes; that of the transparent being about 3.7, and that of the opaque 3.5. The hardness, also, is subject to change; the glass becoming somewhat pulverulent, so that its fracture is earthy, and the lustre quite wanting. Fuchs, in his work on Amorphism, has thrown out the conjecture that the glassy arsenious acid loses its transparency by virtue of a gradual change into a crystalline mass. Hausemann has, however, published the result of his examinations, in which he was unable to detect any trace of crystalline structure, even when examined under a magnifying power of 400. Professor Jameson, in the Edinburgh Philosophical Journal, April, states that he has recently become satisfied of the truth of Fuchs' conjecture in the most convincing manner. Masses of transparent arsenious acid selected for examination, were found, on assuming the porcelainous structure, to have become highly crystallized, "the sides of the masses being studded with great numbers of distinct, octohedral crystals, some of which were half a French line in diameter." Such a transformation of arsenic glass, says Professor Jameson, into a mass of well-formed crystals, is a most remarkable instance of molecular change in a rigid body, and is the more striking, since, apparently, it is not caused by any exterior circumstance, nor is attended by any change of constitution. It would seem that the molecules were put in motion by a tendency of the amorphous mass to pass from the condition of tension to that of repose and equilibrium, which is the characteristic condition of crystallization. This remarkable change also proves that nature can accomplish, in time, what she cannot effect in a shorter space; a truth deserving to be remembered in all physical inquiries, and especially in geology. Professor Jameson also observes, that in similar masses of arsenic glass there are differences of aggregation, which cause them to differ in their progress towards becoming opaque. On this it may depend, as well as on other determining causes, that generally the amount of change is independent of the length of time elapsed.

Similar changes in structure are observed to take place in calcareous minerals, and *probably* changes of the same description occur in many of the minerals, and also in rocks. Among artificial substances exhibiting such changes, we may particularize the confection called barley-sugar. This substance, when newly prepared, has a pale wine-yellow color, and is more or less translucent. Its fracture is conchoidal, with a shining vitreo-resinous lustre. If kept for a time, its translucency diminishes, and gradually the conchoidal fracture disappears, and in its place the whole mass of the substance assumes a beautiful stellular radiated structure. Geologically considered, this topic is of great importance. — *Edinburgh Philosophical Journal.*

ARTIFICIAL MARBLE.

The following is an account of the experiments and theories of a Mrs. Marshall, of Edinburgh, who has been engaged, with success, in the production of artificial marble, sandstone, conglomerate, &c.

So far back as 1840, Mrs. Marshall was struck with the odd idea, that the animal and vegetable remains, so universally found in the second and tertiary strata, might, by a chemical or electric influence exerted upon the disintegrated particles of these rocks, have been the cause of their aggregation. The result of numerous experiments, undertaken since that period, has, she states, satisfactorily demonstrated, that if the constituents of any mineral body, of which lime forms a part, be mixed in their true proportions, (the lime used being free from carbon in any form,) and these mixed with animal and vegetable remains, under circumstances of due moisture and heat, aggregation of their particles will take place at periods, varying with the substances under experiment, from a few minutes, to hours, weeks, and months; and these artificial aggregations (allowing for absence of time, and the incalculable amount of superincumbent pressure present in the natural phenomena) come so undeniably near, in appearance and qualities, to the products of nature, as to throw a totally new and interesting light on some of her hitherto most mysterious operations.

There are two problems which have justly been considered by geologists as among the most difficult in their science; the one is, that the nodules in strata containing fossils, particularly crustaceous relics, contain more lime — taking size for size — than the intervening spaces in the beds. The natural conclusion, at first sight, is, that the surplus lime accrues from the osseous fabric of the organism. But investigation proves that there is more lime contained in the whole nodule than this will account for. Mrs. Marshall's experiments and specimens show that bone or recent shell has, more than any other portion of the animal frame, a power of attracting or of *condensing* lime, while a counter power is exerted by the lime of hardening or solidifying the bone. This, of course, acts more powerfully and obviously when the bone and the lime come in immediate contact, as in the nodules of the crustaceous fossils, than in the case of the vertebrata, where the integuments interpose like a screen. Thus, if portions of bone, or recent shells, be placed in a heap of sulphate of lime, or of magnesia thoroughly free from carbonic acid, with a very small proportion of vegetable matter added, and the heap so prepared be kept in circumstances of moisture, the parts in contact with the bone will first begin to harden or condense, and this action will gradually radiate to an extent corresponding to the size and form of the osseous matter, while, at the same time, the bone, even the soft cellular portion, becomes hard and stone-like. The very same effect is produced by and on *coral;* for not only does the lime harden in an extraordinary degree round the coral, but in the same ratio the latter loses its dull opaque, and becomes semi-translucent. Whether "countless ages" would bring these to a perfect resemblance of natural fossils, it is hard to say; but a year and a half has sufficed to render them extremely curious, and worthy of attention. The experiments conducted with the constituents of sandstone and lias, lead to the very same results, but much more slowly than in the pure lime.

The other problem to which we allude is this: — From what cause has it arisen that many mineral substances, and even whole strata, are found identical in the nature and proportions of their constituents, yet totally different in their lithological structure? Such is the stratum

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frequently above coal and lime, and both above, and mingled with, sandstone. Mrs. Marshall's experiments show that if a mass, in imitation of such mineral bodies, be prepared, and one part of it left at perfect rest, while the other is agitated or disturbed, the one will harden in a few hours or days into a substance not distinguishable by the eye from the natural stone, and capable of resisting water and weather; while the latter will take as many weeks to harden, and then present a mass which readily degrades by exposure to either. The experiment may be varied thus: — Such masses always *set* or harden from the centre outwards; allow the mass to set till within half an inch of the surface; disturb what remains, and the result will be, that, on making a section, the centre will be found hard enough to take a fine polish, while the outer crust will be a mere crumbling mass of chalk or sand.

Mr. Hugh Miller, in his "Old Red Sandstone," conjectures that the curious outstriking of colors, which here and there occurs in that and some other formations, may have arisen from the action of decaying animal matter. Not only is this completely proved by this lady's experiment, but, what Mr. Miller seems not to have once suspected, that decaying *vegetable* matter has the same effect; and doubtless to this, rather than animal, are owing the more curious and grotesque forms in which these white and gray stains appear.

We were particularly interested by one specimen, in which, with the view of solving two problems by one experiment, there had been laid down upon the surface, while yet fluid, a few of the delicately-rounded leafstalks of the *Fucus vesiculosus;* of these some had sunk only half, and others wholly, under the surface. In course of time the vegetable matter shrinks to a film that can be blown out with the breath, and there then remain in the mimic stratum perforations which are lined with white, presenting the most perfect resemblance to those mysterious worm-like borings which occur in the face of compact limestone, and have given rise to so much discussion.— *Chambers' Journal.*

TO MAKE ARTIFICIAL MARBLE OR STONE.

The following is the condensed specification of a patent granted to St. Clair Massiah, and published in the May number of "Newton's Repertory of Inventions." The material of which the artificial stone is made, is plaster of Paris. After it has been prepared, and is of the right shape, it is dried in a room at about 80°. When completely dry, it is immersed in a warm solution of borax and glauber salts, prepared by dissolving one pound of borax and a quarter of an ounce of the salts in one gallon of water, as a ratio. After the casting is thoroughly wet in this, it is removed to the drying room, and exposed to a heat of 250° Fahrenheit, until all the watery parts are thrown off. It is then permitted to get nearly cold, when it is immersed in a strong hot solution of borax, to which has been added one ounce of strong nitric acid for every gallon of the borax solution. This solution is kept quite warm, and the castings kept in it until they are completely saturated, when they are taken out and dried, and found to have acquired a marble-like hardness. A day or two after this operation, the castings are slightly heated and covered over with a thin coat of Canada balsam, dissolved in turpentine, after which they are kept warm until the turpentine is driven off. Various colored substances may be used along with the materials specified to color the artificial marble, such as indigo for blue, and other substances for other colors. The marble may also be streaked and beautifully variegated. — *Scientific American.*

ON THE DISTRIBUTION OF MANGANESE.

At the American Association, Albany, the following paper, on the "Distribution of Manganese," was presented by Mr. David A. Wells, of Cambridge :—

"The occurrence of pebbles and water-worn stones in many of the streams and wâter-courses of New England, which have their origin among, and run over, igneous and metamorphic rocks, is by no means uncommon, and has doubtless attracted the attention of every observer. When the bed of a stream in which they occur, is examined, the colored pebbles and stones will be found at intervals, generally after or below a fall or rapid, and not immediately above. This coloring matter, which is wholly superficial, and of different degrees of lustre, is due to an incrustation of the black oxide of manganese, and occurs independently on almost every variety of stone.

"In the Edinburgh New Philosophical Journal, for July, 1851, Dr. John Davy calls attention to somewhat similar incrustations, in England, of which he says as follows : — 'Though always superficial, in one spot the incrustation is so thick as to be available for use ; and in this instance the black oxide of manganese acts as a cement, forming a bed of conglomerate several feet thick. Whence this incrustation is derived, or how produced, is not obvious. Restricting the view to the spots where it occurs, it might be supposed to be a deposit from running water. But when it is seen that the coloring matter is not to be detected on rocks *in situ* — the fixed rocks in the course of the stream — the idea ceases to be tenable, and the inference seems to be unavoidable, that the sand, pebbles and stones so colored have been incrusted with the oxide before they had been carried down to the spot where they are found loose ; or, when in the form of conglomerate, that the cementing oxide has been brought by water exuding from some rock or stratum containing manganese in a minor degree of oxidation, and acquiring the higher degree by the absorption of oxygen, and at the same time the cementing quality.' Dr. Davy also infers that manganese exists in the vicinity of these incrustations in large quantities, and advises special inquiry in search of it.

"Before the publication of the article referred to by Dr. Davy, the subject of these incrustations had attracted the attention of Dr. A. A. Hayes, of Boston, and myself, and we believe the following to be a full and satisfactory account of the origin of this phenomenon.

"The manganese exists in almost all the igneous and metamorphic rocks of New England, and I may say in other parts of the world, generally as a double carbonate of lime and manganese. When the waters of the springs, brook and rivers, flowing over these rocks, become charged with soluble organic matter, in the state of crenic, apocrenic, or humic acids, drained into them in consequence of rains or inundations, from swamps and peat meadows, the carbonates of lime and manganese enter into solution. At such times manganese may generally be detected in these waters, as has been done by Drs. C. T. Jackson, A. A. Hayes, and others. When the water holding the manganese in solution, becomes broken and thrown up in the passage of falls or rapids, consequently exposing it to the influence of the atmosphere, the manganese passes from a low state of oxidation to the insoluble peroxide, and is deposited for a considerable extent upon the rocks and pebbles below. It will thus be found, upon examination, that, at intervals in the bed of the stream, the stones are completely blackened or discolored, while in other places no such depositions exist. Beautiful examples of this phenomenon may be seen at some points on the Merrimac river, and, indeed, in almost every rivulet in New England.

"I have also noticed similar depositions between the divisional strata planes of sandstones in the valley of the Connecticut, thus showing that apparently the same agencies were at work during the deposition of these rocks as at the present day.

"As an example of the extent to which manganese exists in some of the older rocks of New England, I submit an analysis of an altered rock, occurring somewhat extensively in the neighborhood of Nahant. The analysis gives, $Si\,O^3$ 52,17, $Fe^2\,O^3$ 9,78, $Mn^2\,O^3$ 26,72, $Al^2\,O^3$ 8,43, $Ca\,O$, 0,37, $Mg\,O$, 0,60, HO, 2,02; total 100,09."

ON THE NEW METAL, DONARIUM.

In the Zircon Syenite, of Brevig, in Norway, Bergemann has discovered a mineral which, upon examination, proved to contain the oxide of a new metal, Donarium. The mineral in question is a hydrated silicate of donarium; and is represented by the formulæ, $Do^2\,O^3\,Si\,O^3 + 2\,HO$. It is readily decomposed by chlorohydric acid; and, after the separation of the silica in the usual manner, ammonia precipitates from the solution a hydrated oxide of donarium as a white voluminous mass, which, upon drying, becomes gradually yellowish and reddish yellow. The precipitate contains a little iron, from which it is freed by ignition and digestion with chlorohydric acid, which dissolves the iron. The oxide may then be dissolved by long digestion with sulphuric acid. From the sulphate the pure hydrate is obtained by precipitation with ammonia white, but becoming yellowish on drying. It is readily soluble in acids; in chlorohydric acid without evolution of chlorine. Metallic donarium was obtained from the oxide by heating with potassium. The decomposition takes place rapidly with evolution of light; and the metal is separated as a coal-black heavy powder, which, under the burnisher, assumes a metallic lustre, which it retains for several hours, even in moist air. Particles of the metal, scattered in the flame of a lamp, burn with a reddish light to oxide. Chlorohydric acid, hot or cold, has no action on the metal; nitric acid acts slowly on heating; nitro-muriatic acid oxidizes it rapidly to red oxide, of which a small portion is dissolved. The anhydrous oxide, obtained by strong ignition of the hydrate, is of a very deep red color. Its density is 5.576; it is soluble only in sulphuric acid, after long digestion and subsequent dilution with much water. The solutions of the hydrated oxide in nitric and sulphuric acids are colorless; that in hot chlorohydric acid, yellow, which color, however, vanishes on cooling. Potash, soda and ammonia, give, with solutions of the oxide, white precipitates, which are insoluble in an excess of the precipitant.

PLATINOID METALS.

PLATINUM is associated with several other metals in the platinum sand which is found in some gold districts. They have not been found as a distinct deposit in California; but have been observed in the United States Mint, in the operations of assaying and parting. These associated metals are palladium, rhodium, iridium, and osmium; to which we must add the lately discovered metal, ruthenium. They have a sufficient resemblance to be classed together, and are obtained by a similar hydrometallurgic treatment. The grains of iridosmin, found mixed with gold, have been qualitatively examined, and found to contain the new metal, ruthenium, as was observed by Claus in relation to the iridosmin from other localities. Palladium has been observed, and, at times, in sufficient quantity to render the gold brittle. The quantities of platinoid metals found in the California gold are small; about one and a half pound of iridosmin having been obtained from about 25 tons of gold, $\frac{3}{1000000}$; but the greater part has, of course, passed into the coin, the coarser grains only being left. — *J. C. Booth, U. S. Mint.*

EFFECT OF ZINC UPON IRON.

A LETTER from Mr. James Nasmyth to the London Mining Journal, communicates the results of some experiments recently made for the Admiralty, with a view of determining whether old iron, that had been galvanized, or coated with zinc, was rendered unfit for being worked up again. The result of these experiments seems to prove that the iron is improved, instead of being deteriorated, by the zinc combined with it. The following is Mr. Nasmyth's report of the experiments: — A piece of galvanized iron wire rope was welded up into a bar, and put to the most severe test. In the first place it was found that, although the iron wire was quite covered with metallic zinc, which although partially driven off in the process of welding, yet, so far from the presence of the metal, or its oxide, presenting any impediment to the welding of the iron, (as in the case of lead,) the iron wire welded with remarkable ease; and the result was, a bar of remarkably tough, silvery-grained iron, which stood punching, splitting, twisting and bending, in such a manner as to show that the iron was not only excellent, but, to all appearance, actually improved in quality in a very important degree. Encouraged by such a result, a still further and even more severe trial was made, namely, by welding up a pile of clippings of galvanized iron plates, or sheet-iron covered with zinc, as in the former experiments. The presence of the zinc appeared to offer no impediment to the welding, and the result was a bloom, or bar of iron, the fracture of which presented a most remarkable and beautiful silvery grain, as good, if not superior, in aspect to the finest samples of "Low Moor." Blooms of this iron were rolled out in rods, and tested in the cable-proving machine, and the result indicated from five to ten per cent. higher strength than the best samples of wrought-iron; thus establishing the fact, that, so far from the presence of zinc being destructive to the strength and tenacity of wrought-iron, the contrary is the case. I may mention, that bars of iron were heated to a welding heat in the usual manner; and, on drawing them from the fire for being welded, a handful of zinc filings was thrown on the welding hot surface, and the welding proceeded with. In this severe test no apparent impediment to the process resulted; the iron welded as if no zinc had been present.

ON THE CHEMICAL CHARACTER OF STEEL.

The following views, respecting the chemical character of steel, were set forth, some time since, by Mr. Nasmyth, of England: —

"Were we to assume, as our standard of the importance of any investigation, the relation which the subject of it bears to the progress of civilization, there is no one which would reach higher than that which refers to the subject of steel; seeing that it is to our possession of the art of producing that inestimable material that we owe nearly the whole of the arts. I am desirous of contributing a few ideas on the subject, with a view to our arriving at more distinct knowledge as to what (in a chemical sense) steel is, and so lay the true basis for improvement in the process of its manufacture. It may be proper to name, that steel is formed by surrounding bars of wrought-iron with charcoal, placed in fire-brick troughs, from which air is excluded, and keeping the iron bars and charcoal in contact, and at a full red heat, for several days, at the end of which time the iron bars are found to be converted into steel. What is the nature of the change which the iron has undergone, we have no certain knowledge; the ordinary explanation is, that the iron has absorbed and combined with a portion of the charcoal or carbon, and has, in consequence, been converted into a carburet of iron. But it has ever been a mystery that, on analysis, so very minute and questionable a portion of carbon is exhibited. It appears that the grand error, in the above view of the subject, consists in our not duly understanding the nature of the change which carbon undergoes in its combination with iron, in the formation of steel. Those who are familiar with the process of the conversion of iron into steel, must have observed the remarkable change in the outward aspect of the bars of iron after their conversion; namely, that they are covered with blisters. These blisters indicate the evolution of a very elastic gas, which is set free from the carbon in the act of its combination with the iron. I have the strongest reasons to think that these blisters are the result of the decomposition of the carbon, whose metallic base enters into union with the iron, and forms with it *an alloy*, while the other component element of the carbon is given forth, and so produces in its escape the blisters in question. On this assumption we come to a very interesting question — What is the nature of this gas? In order to examine this, all that is requisite is to fill a wrought-iron retort with a mixture of pure carbon and iron filings, subject it to a long-continued red heat, and receive the evolved gas over mercury. Having obtained the gas in question, in this manner, then permit a piece of polished steel to come in contact with this gas, and, in all probability, we shall then have *reproduced* on the surface of the steel a coat of carbon, resulting from the reünion of its two elements; viz., that of the metallic base of the carbon then existing in the steel, with the, as yet, unknown gas; thus synthetically, as well as by analytic process, eliminating the true nature of steel, and that of the elements or components of carbon."

COATING IRON WITH ZINC AND OTHER METALS.

Messrs. Gressel and Redwood, of London, have recently patented the following methods of coating iron with zinc and other metals. *To coat iron with zinc.* — The zinc is melted in an open vessel, and on its surface is placed a layer of the chloride of zinc, or a mixture of equal parts of chloride of zinc and chloride of potassium, in the proportion of eight of the former to two of the latter. When the salt is in a state of fusion, the metal to be coated is placed in the bath, and allowed to remain there till a coating of sufficient thickness has been obtained; it is then withdrawn, and any parts of its surface imperfectly covered are sprinkled with sal-ammoniac, and the sheet of iron again immersed in the bath. *To coat iron with tin.* — The tin is first melted, with a stratum of chloride of zinc and sal-ammoniac on its surface, and the iron or metal to be coated is immersed in the molten metal until sufficiently covered. *To coat iron with silver.* — The metal must be first amalgamated with mercury by the following process: 12 parts of mercury, 1 of zinc, 2 of sulphate of iron, 2 of muriatic acid, and 12 of water are mixed together, and heated in an open vessel to about 200° Fahr.; the iron is then immersed, and the mercury rubbed in its surfaces until amalgamation is effected. The silver or alloy is to be melted in a crucible, and the amalgamated iron placed therein, when a coating of silver or alloy will be deposited. *To coat iron with copper or brass.*— The copper or other coating is to be melted in a suitable vessel, and a stratum of borosilicate of lead placed on its surface; the iron is then to be plunged into the molten metal, and retained there until a coating is deposited on it. Iron coated with tin or lead may be treated in a similar manner. Another method of coating iron with copper is to place in a crucible a quantity of chloride of copper, upon which is laid the iron to be coated, and over that a quantity of charcoal. The crucible is then submitted to a red heat, and the chloride of copper fused, and a coating of copper deposited on the iron. Or the vapor of chloride of copper may be employed for the same purpose. The coating of copper, thus obtained, may be converted to one of brass by exposing the sheet of metal to the vapor of zinc in a closed vessel.

TO COAT IRON WITH COPPER.

It is well known that if a plate of iron be immersed in a solution of sulphate of copper, it speedily becomes coated with the copper in solution; but the copper thus deposited on the surface does not adhere firmly, and may be readily removed by friction. By means of the following process of M. Reinsch, the iron may be covered with a coating of copper as firm and as durable as in electrotype deposit. The process is as follows: — Polish the iron by rubbing it well with cream of tartar, and afterwards with charcoal powder, and place the metal thus polished in hydrochloric acid diluted with three times its volume of water, in which a few drops of solution of sulphate of copper have been poured; after a few minutes have expired, withdraw the iron and rub it with a piece of cloth, then replace it in the solution, to which add another portion of sulphate of copper. By following on this plan, and adding at each immersion a new supply of sulphate of copper, the layer of copper may be increased at pleasure. Lastly, introduce the iron, thus coated with copper, into a solution of soda, then wipe clean and polish with chalk. The coating thus obtained will be as firm and durable as that deposited by the electrotype process. — *Chem. Gazette, Jan.* 9.

MALLEABLE BRASS.

It is known that common brass containing from 27.4 to 31.1 per cent. of zinc, and from 71.9 to 65.8 per cent. of copper, is not malleable, but that articles of it must be made by casting. M. Machts, of Germany, has recently found that by melting together 33 parts of copper and 25 of zinc, or 60 parts copper and 40 parts zinc, alloys can be formed which possess malleability in a high degree. The alloy formed from the last-named proportions is harder than copper, very tough, and is, in a properly managed fire, quite malleable; so much so that a key was forged out of a cast rod. — *London Chemist.*

ZINC COMPOUNDS NOT INJURIOUS TO HEALTH.

At a late meeting of the Academy of Sciences, at Paris, M. Sorel, replying to some authors who, at preceding sessions of the Academy, had made observations tending to show that zinc was not innocuous, stated that for fifteen years he had employed in his establishments for the galvanization of iron several hundred workmen, a large number of whom were occupied with pulverizing and sifting the gray or suboxide of zinc, for galvanic painting, and in no instance had any of the workmen of the establishment, although in the midst of an atmosphere containing much of the oxide, suffered at all from it. The white oxide of zinc had also been fabricated for some months, without any ill effects, although the men breathe considerable quantities of the oxide.

NEW METHOD OF ASSAYING COPPER ORES.

Mr. H. Parkes, of the Burry Copper Works, Wales, communicates to the London Mining Journal a new method of assaying copper ores, which is stated to be of great advantage from its accuracy, and from the ease and facility with which it is conducted. It is based, he says, upon the decoloration of an ammoniacal solution of copper, by fine cyanide of potassium or sodium, or ammonia. or hydrocyanic acid, in a free state ; but I prefer to use cyanide of potassium, as being less subject to decomposition, and more readily obtained in a state of purity in commerce than the other substances named.

The method of operating is as follows : — Take a given quantity of pure copper, (say, for instance, 13 grains,) place it in a flask, and dissolve in nitric acid ; add ammonia in excess, and then make it into a bulk of about 2500 grs. by measure by the addition of water, although this is not absolutely necessary. Dissolve 1 oz. (Avoirdupois) pure cyanide of potassium, free from ferro-cyanide or sulphuret of potassium, in 5 ounces by measure of water, filter, if necessary, and place the solution in a well-stoppered bottle, till required for use. I then ascertain the quantity of this solution of cyanide of potassium required to decolorize the solution of copper by taking a given quantity, in any graduated vessel, as a burette, and pour it by degrees into the solution of copper, adding the last quantity drop by drop till decolorized. This is very easily perceived, as there is no precipitate to interfere ; and the operation is conducted at the ordinary atmospheric temperature. I mark down the quantity required (say 500 grains by volume.) After having established this date, it is very easy to estimate the quantity of copper contained in any ore or cupriferous product, by simply dissolving a certain quantity, (say 20 grains in nitric or nitro-muriatic acid,) with the assistance of heat, if required, as in the case of some sulphurets the addition of ammonia in excess is necessary ; and if any considerable quantity of iron, or alumina, was present in the sample, it should be allowed to digest at a gentle heat, under ebullition, to make sure that all the copper is taken up by the ammonia ; filter into a flask, wash the precipitate with water, and make into a bulk of 2500 grains, as when taking the standard of the solution of pure copper. All that now remains to be done is to allow it to get cold, and add the cyanide of potassium, until decolorized, noticing the quantity taken. I will suppose it required 400 grains by volume of the cyanide solution ; then from the proportion — 500 grs. K Cy. : 10 Cu. : : K Cy. 400 : Cu. 8 — the quantity of copper contained in the 20 grains of material taken for analysis, or 40 per cent. If the ore taken was a sulphuret, it is sometimes advisable to filter, in order to separate the sulphur, before adding the ammonia, or else to use a dilute solution of ammonia, and a gentle heat when digested, or small particles of sulphuret of copper might be re-produced, especially when the precipitate produced by the ammonia is a bulky one.

When manganese is present in the ore — easily ascertained by preliminary examination by the blow-pipe — it is best to employ carbonate of ammonia to form the ammoniacal solution, as the carbonate of manganese is very little soluble in this re-agent. The reason for this modification is, that, on adding cyanide of potassium to an ammoniacal solution of copper containing that metal, it assumes a slightly yellowish tint, which would interfere a little with the estimation of the last few hundredths of copper.

The above remarks also apply to arsenic, when present simultaneously with iron in the sample, as the nitric acid converts it into arsenic acid, and this forms with the iron a salt, arseniate of iron, soluble in ammonia. I have easily obviated this by adding to the nitric or nitro-muriatic solution of the substance a little proto-salts of tin, or sulphate of magnesia, as the arsenic is thus rendered insoluble, on afterwards adding the ammonia.

CERTAIN METHOD OF ASSAYING COPPER BY ELECTRO-CHEMICAL ACTION.

A GIVEN weight of the ore (as prepared for assaying by the dry way) is dissolved in an acid (*aqua regia* is best) evaporated nearly to dryness, redissolved in water, filtered, and then treated as the copper solution described a little further on ; take 250 grains of the crystallized bisulphate of copper, (or half the quantity,) which contains exactly 64 grs. of pure copper, dissolve it perfectly, add two or three drops of acid, and place it in an unglazed earthen pot, which will hold three fluid ounces ; place this in another, somewhat larger, glazed, in which there is a weak solution of hydrochloric acid. Introduce a copper cylinder (to which a wire is soldered, and whose exact weight is known) in the copper-water, and an iron cylinder (with a wire similarly attached) in the other vessel of acid and water ; amalgamate the ends of the wires with nitrate of mercury, and connect them in a cup of the same metal, or in any way, so that they are in perfect contact. As soon as the circuit is perfected the operation will commence, and will not cease until all the copper is precipitated on the copper cylinder, and which may be effected in from ten to twelve hours. Then take out the cylinder, dip it in water, dry and weigh it ; its increase in weight will be the percentage of the copper, and in this case (for half the quantity) it will be 32 grains heavier than before. The operation, when completed, can be known by taking one drop out of the solution and placing it on pure gold, or platinum, and touching it with a zinc rod ; if no copper be precipitated on the gold the solution will be free from copper. Thus, then, may every one interested in the produce of copper know the exact percentage of an ore according to the sample. By the dry assay there is considerable loss, as proved, by "check-samples," on many occasions, varying from $\frac{1}{8}$ to $\frac{3}{4}$ per cent., and yet the miner must sell by the dry assay ; and any one connected with the sale of ore knows (especially in those of low produce) what a difference one half per cent. makes in price. —*Chemical Gazette*, *March*, 1851.

ON THE PERMEABILITY OF METALS TO MERCURY.

THE following is an abstract of a paper read by Professor Horsford, before the American Association, Albany: —

Daniel observed that bars of lead, tin and zinc, became penetrated by mercury, when partially or wholly immersed in it. He noticed that a crystallized amalgam was formed in the case of each of the several metals. Prof. Henry modified the experiment of Daniel, in the case of lead, giving to the bar the form of a syphon, one end only of which was immersed in the mercury. He discovered the beautiful fact that mercury may not only be carried through the bar in this form, but that it will drop from the longer division of the bar, thus exhibiting the syphon experiment, employing a solid bar for the tube, and mercury for the liquid. These phenomena had been carefully examined and repeated by Prof. H., with the following results. It is uncertain whether the bars used for the transmission of the mercury increase in specific gravity, after cleaning, or not. Conflicting results were obtained.

In regard to the velocity of transmission, it was observed, by Prof. Henry, that the progress of mercury in the lead was much more rapid in cast than in hammered lead. Upon noting the progress from day to day, most unexpected results have presented themselves. In a vertical bar, with mercury at the bottom, the progress is at first rapid. It diminishes in velocity, however, from day to day, until, after several months, having reached a height of between six and seven inches, it is not one thousandth as rapid as at the outset. The mercury rose in another, in 69 days, a little more than six inches. It continued to rise with a progress perceptible only after several days. This was drawn lead pipe. In two cast bars it rose somewhat more rapidly, and to a total greater height, thus confirming the result already quoted from Prof. Henry.

To ascertain if this moderate elevation was influenced in any degree by gravitation, several experiments were made. Mercury was presented at the top of a bar 0.80^{m} in length. Its descent was astonishingly rapid. In ten hours it had penetrated 360^{mm}. The first quantity having all passed into the bar, it ceased to flow. Upon the addition of another portion the flow was resumed. In less than two days the mercury dropped from the bottom. Gravitation evidently facilitates the transmission of the mercury when flowing from above downward. It, of course, opposes its flow from below upward. To ascertain the further influence of gravity, a bar, about five inches long, saturated with mercury, was withdrawn from the cup and suspended. After a time a single drop of mercury oozed from the lower end and fell. Whatever the force that held the mercury in the bar, it was not strong enough to retain all of it in opposition to gravity. I should state that from several other saturated bars, of less length, similarly suspended, no mercury escaped.

The mercury that drops from the bar presents a film upon its surface, which, as in a sack of very considerable tenacity, encases the purer metal. Upon analyzing the drop, 1.98 parts of lead were found in it, leaving 98.02, mercury. This result was undoubtedly too low; it, however, proves the presence of lead in the mercury which has passed through the bar of lead.

One circumstance might be conceived to modify the flow of mercury amalgam in a given time, to wit, the extent of absorbing surface exposed to the mercury. To ascertain this, two bars of equal length and diameter were taken. They were bent into syphons, and the

shorter legs dipped in a solution of gutta percha and chloroform — a sort of collodion, which incrusted them with an impermeable envelope. After drying, the gutta percha cuticle was scraped from the end of one bar, and from the end and a nearly equal portion of the side of the other. The shorter legs of both were placed in the same cup of mercury, and the large legs in other weighed cups. Two drops fell from the bar having the larger surface before any fell from the other. After nine days the quantities were weighed. Through the bar having the greater absorbing surface there had flowed . . 3.8902 gr.
Through that having the less . . . . 2.1285 gr.

By increasing the length of the shorter leg beyond a certain measure the syphon action ceased. Some further results may be of interest. Two syphon bars were placed in mercury that had once run through lead ; in three days drops fell from both. Mercury in which lead had been standing for months, and which was viscid from the crystallized amalgam, was taken, and two bar syphons, one saturated with mercury and the other pure, were placed in it. In due time the amalgam fell from both. A drawn bar saturated with mercury became brittle, as Daniel has observed. It was so brittle as to be readily broken by an effort suddenly to bend it. Such a bar, scraped brightly and laid aside, in a few weeks lost its brittleness and peculiar texture, and recovered the properties of the original lead. It had lost its mercury by evaporation. A cast bar, the surface of which was not scraped, after a little time lost no more of its mercury. I have made successful experiments as to the permeability to mercury of gold, silver, cadmium and zinc, and have obtained, at ordinary temperature, negative results, with platinum, palladium, iron, copper and brass. The permeability of several of the latter metals to molten tin, silver and gold, and of iron to copper, is well known. The experiments with tin were of an unanticipated interest, although my research is not concluded. Mercury penetrates tin more rapidly than lead, and exhibits the syphon action. As the bar of tin becomes saturated, the whole mass begins to crystallize, and splits into irregular longitudinal fissures. If, at an early stage in this crystallization, the bar is bent, the outside cracks off, revealing a pith as distinct as if it had been at first cast and then a sheath cast around it. If the crystallization be permitted to go on, the fissures penetrate to the centre of the bar. Daniel observed, that a square bar split into triangular prisms, the separating fissures following the diagonal planes. If the top and bottom of the bar were right-angled terminal planes, the crystallization freed a pyramid at either extreme.

The bar being irregularly cylindrical, the fissures were formed, as in the case of the prism, along the lines of least resistance. In looking at these fissures, and the pith just referred to, and at the septaria which abound in the shales of the Genesee valley, in Livingston county, of which numerous specimens occur in various other widely separated localities, it is impossible to resist the conviction — first, that the concentric arrangement in the latter case may have been produced by a process illustrated in the experiment with the tin bar showing the interior pith, and not necessarily by aggregation ; and, second, that the fissures filled by brown carbonate of lime, giving rise, when waterworn, to the tessellated appearance of the tortoise shell, have been formed by expansion along radical lines, producing openings where there was least cohesion.

Prof. Henry gave an illustration of experiments which he had made himself with gold and other metals. He had placed a lump of silver on a piece of iron, and then put it in a furnace; but he did not find that it permeated. He subsequently inquired of a jeweller, what results he had perceived from a similar process, in which copper was used instead of iron, and he said he had often seen the silver disappear. The experiment was tried in his (Prof. Henry's) presence, and, sure enough, the silver was apparently gone, and the copper surface alone appeared. He immediately put it in a galvanic battery, and the silver reäppeared, which showed that it did not dissolve, but merely went down below the surface of the other metal.

NEW METHOD OF ENGRAVING.

Poitevin has described a method by which we may obtain, on plates, raised or sunk impressions from drawings or engravings. These plates, in their turn, may be used for multiplying the impressions. The engraving is exposed to iodine vapors, which only adhere to the black parts; the sheet is then attached to a silver plate, polished according to Daguerre's method, by means of slight pressure; the iodine is transferred to the silver, so that layers of iodide of silver are formed, corresponding to the shadows of the engraving. The plate is then immersed in a concentrated solution of sulphate of copper, and used as the negative pole of a weak battery; it is removed before the iodized portions are coated with copper. The plate is at once washed, and the iodide removed by hyposulphate of soda; the copper surfaces are then oxidized by heat until they become dark brown; the exposed silver surfaces are amalgamated after cooling, and the plate being covered with two or three layers of gold-leaf, the mercury is volatilized by heat. The gold is brushed off from those parts which are covered with oxide of copper, and to which it does not adhere. The oxide of copper is then dissolved by a solution of nitrate of silver, and the silver, as well as the adjacent copper, exposed to the action of dilute nitric acid. The parts covered with gold are not affected, so that the etching may be carried to any depth. The plate which is thus obtained may be employed for taking impressions in the manner in which wood blocks are used. In order to obtain plates engraved as deeply as the plates used for ordinary copper-plate engravings, a plate of gilt copper is employed. By proceeding as above, the light parts are covered with copper; and the shaded parts being deprived of the iodine, the gold amalgamated is removed from the shaded, and the oxide of copper from the light parts, by acid. The latter will then be protected against the further action of the acid by the gold, and we obtain a deep engraving.

STEREO-CHROMIE; A NEW MODE OF FRESCO-PAINTING.

A NEW mode of fresco-painting has been introduced in Germany, which appears quite likely to supersede the old method, and to yield remarkable advantages; in fact, to render such painting perfectly invulnerable to the effects of climate. The discoverer is Prof. von Euchs, of Munich, who has had to undergo all the opposition and jealousies incident to discoverers in general. Though now, in his old age, his invention is made use of in the new frescoes at Berlin, it is possible that he may die without reaping any personal benefit from it.

Stereo-chromie is, in fact, a preserver of the wall on which it is painted. By the chemical action of the solution sprinkled over the picture, whilst in progress, the whole ground on which it is painted and the picture itself becomes one hard, flinty mass, and the very colors are converted into the hardest stone. So hard, indeed, is it, that neither fire nor damp has the slightest effect on it. In the specimens exhibited, the pictures are upon pieces of wainscot covered with mortar, and the wall on which a stereo-chromie fresco is to be executed undergoes a certain preparation. Then the colors are not combined, as in *al fresco*, with lime, but with a solution of silex; and all the advantages of fresco painting are obtained without any of its disadvantages. This species of painting resists every influence of climate, and may be confidently used as an external coating for buildings in any part of the world. To the artist himself it offers the most important recommendations. He is not confined to time in executing it. He can leave off when he pleases, and for any length of time, which he cannot do in fresco work by any means, nor in oil-painting within certain limits. The highest advantage of all, however, is, that the same part may be painted over and over, as often as you please, which is not possible in fresco; and, consequently, in this new mode the most perfect harmony may be preserved throughout the largest possible painting. In fresco, the artist is the slave of his materials; here, he is their arbitrary master to the fullest extent. — *London Athenæum.*

ON WORKING AND MODELLING IN PLASTIC IVORY.

MADAME ROUVIER'S process is as follows:— Take the waste turnings of ivory, bone, horn, &c., and steep them in a vessel containing a weak acid solution. Nearly all the acids will do for this purpose, but the following are preferable — muriatic, nitric, tartaric, acetic, citric, and oxalic; also phosphate of lime. The solution is placed in a water bath, at a temperature of 35° to 40° C., (95° to 140° Fah.,) in order to obtain complete liquefaction. It is then passed through fine muslin, and about one fourth of the quantity of ivory gelatine is next added to absorb the solvent. When the paste is well prepared, the excess of liquid, and any foreign gases, are removed by means of an air-pump; it thus becomes homogeneous, membranous, and very close. In this state it would be difficult to run it for use; for this purpose, it must be dissolved in copal or lac varnish, and, in this state, it may be run into moulds. When the paste is in the moulds, it may be made to undergo pressure, to expel the air and prevent the formation of air-bubbles in the interior. Coloring matters may be added to the paste. — *London Patent Journal.*

NEW METHOD OF CONTRACTING THE FIBRES OF CALICO, AND OF OBTAINING ON THE CALICO THUS PREPARED COLORS OF MUCH BRILLIANCY.

At the British Association, Dr. Playfair called attention to a new discovery recently made by Mr. Mercer, of considerable importance in the manufacture of calico and other colored fabrics. Mr. Mercer's discovery may be stated in few words to be this: — A solution of cold but caustic soda acts peculiarly upon cotton fibre, immediately causing it to contract; and, although the soda can be readily washed out, yet the fibre has undergone a change, and water will take its place and unite with the fibre. In a practical point of view Mr. Mercer considered that the fibre might be considered by this action to have a sort of acid property to unite with soda and then with other bases. The effect of the condensation was said to be one fifth to one third of the total volume of cotton employed. Dr. Playfair showed some proofs of the influence of this new process upon our cotton manufactures: thus, taking a coarse cotton fabric, and acting upon it by the proper solution of caustic soda, this could be made much finer in appearance; and if the finest calico made in England, known as 180 picks to the web, was thus acted upon, it immediately appeared as fine as 260 picks. Stockings of open weaving were shown, and the condensation process made them appear as of much finer texture. The effect of this alteration of texture was strikingly shown by colors. The pink cotton velvet had its tint deepened to an intense degree by the condensation process. Printed calico, especially with colors hitherto applied with little satisfaction, as lilac, had strength and brilliancy, besides thus producing fabrics cheaply, finer than can possibly be woven by hand. The effect was shown of patterns being formed by portions of a surface being protected by gum from condensation. Thus patterns of apparently fine work can easily be produced. It was stated that the fabrics by this process have much strength given them; for a string of calico, one half condensed by caustic soda, will break by 20 ounces, while the unacted-upon string broke with 13 ounces.

Caustic soda, observes Dr. Playfair, has long been used in the process for bleaching cottons; but this power of altering the structure of the fibre, he says, only belongs to the cold solution. The degree of condensation is equal to from one fifth to one third of the total volume of cotton employed.

PATENT SAFETY PAPER.

The object of this invention is to manufacture a paper that will indicate, by discoloration of its surface, when an attempt has been made to extract written characters therefrom; and thereby to afford to bankers, merchants and others, protection against forgery or the tampering with checks, bills of exchange, and other important documents. The invention consists in the employment of iodine or bromine, together with ferrocyanide or ferricyanide of potassium and starch, either in the manufacture or preparation of safety paper. For this purpose, iodine or bromine is used in any of their ordinary combinations with bases; but iodine, being the cheaper material, is preferred to any compound of bromine. Of the compounds of iodine, the patentee employs in preference that known as iodide of potassium, such substance being most readily attainable in the market, and in no degree affecting the color of the paper. The mode of applying this substance is, by mixing it with the pulp or size, or the paper may be saturated with a solution of the metallic iodide. The ferrocyanide of potassium is mixed with the size, or it may be applied subsequently to the sizing, as in the case of the metallic iodide. The starch is preferred to be mixed with the pulp in the engine; but it may, like the other chemical ingredients, be used in an after stage of the process. The proportions for these several materials, used for rendering paper sensitive to the action of reägents, are by no means absolute; but, as a guide, it may be stated, that the following have been found to answer the purpose; viz., for a ream of post, weighing about 18 pounds, one ounce iodide of potassium, quarter ounce ferrocyanide of potassium, one pound starch. On the application to paper, prepared as above set forth, of reägents, to dissolve out or absorb any ink markings therefrom, the tendency will be to break up one of the salts named. Thus, on the application of chlorine or mineral acids, the iodine will be liberated, and, combining with the starch, will form an insoluble iodide of starch, of a dark color; and, further, the iron, which ink generally contains, being attempted to be dissolved by either vegetable or mineral acids, the ferrocyanide of potassium will combine with it in solution and form the well-known Prussian-blue compound, which will become diffused over the adjacent portion of the paper. — *Chemical Gazette.*

CLAUSSEN'S IMPROVEMENTS IN THE MANUFACTURE OF FLAX.

At the close of the year 1850, it was announced that M. Claussen, of London, had discovered a process, whereby the harsh and elastic fibres of the flax-plant might be converted into a soft down-like substance, analogous to the fibres of cotton, and capable of being treated in its after stages, in every respect, similar to it. The various processes by which this is effected appear to be somewhat as follows: — In the first stage, the stem of the flax-plant is, to a considerable extent, freed from its straw, leaving the fibre in a partially cleaned state. This is effected by a machine. Hitherto, the great difficulty with all growers of flax has been the preparation of the crop for market; the grower having been compelled either to resort to the tedious and precarious process of steeping his flax, or to dispose of it to factors as it came from the field, upon any terms which they might think proper to offer. This machine will enable the producer, without resort to any steeping process, to reduce the bulk of his flax, and, at the same time, admit of his returning to the soil, in the shape of the straw removed, a large portion of the nutritive matter extracted, and which, formerly destroyed in the steeping process, had given rise to an opinion, very generally held by agriculturists, that flax was an extremely exhaustive crop. The flax thus produced is, in this stage, adapted for the manufacture of sail-cloth, and other coarse fabrics, ropes, cordage, &c. It requires, however, a more minute separation of the fibres to adapt it for the manufacture of finer descriptions of fabrics. To make the subject perfectly familiar to the reader, it will be necessary to explain the structure of the flax fibre. The stem of the flax-plant consists of three distinct parts — the shove, straw, or woody matter which supports the plant; the fibres, which cover the outer surface of the straw; and the gum, or resin, by which the fibres are held together. The machine removes the straw only, and partially disintegrates the fibres held together by the resinous substance. Hence their coarseness and their suitability for coarse fabrics only. In order to adapt it for the linen manufacture, as also to carry it one stage further in the process of preparation for the cotton or wool spinner, it is necessary to obtain a more complete separation of the fibres. This object is to be accomplished by the removal of the resinous and glutinous substance which binds them together; and, as it does not appear that mechanical power will completely effect this, recourse is had to chemical action. These substances are, therefore, dissolved by the chemical action of fermentation which takes place under the ordinary modes of steeping, whether in hot or cold water; and the application of mechanical power in the process of scutching, afterwards separates the fibres, and leaves them in a fit state for the various manipulations required previous to flax-spinning. It is found, however, that the present process of steeping not only occupies a considerable portion of time, but that its effects are not sufficiently uniform to render it a fitting mode to be adopted in the preparation of flax for spinning on cotton machinery, and that, even when employed in the preparation of flax for the ordinary linen manufacturer, it possesses many disadvantages which it would be desirable to remove.

To obviate the difficulties attendant upon the ordinary method of steeping, the following process has been adopted by M. Claussen: — The flax, either in the straw as it comes from the field, or in the state in which its bulk has been reduced by mechanical means, is boiled in a weak solution of caustic soda. The action of the soda dissolves completely the resinous and other substances of the plant, while, by its combination with the oleaginous matters that it contains, it produces a soapy kind of liquid, which removes, at the same time, all the coloring matter from the plant, leaving it, unlike flax steeped in the ordinary mode, perfectly free from all stain and impurity, and thereby facilitating greatly the after processes of bleaching or dyeing, whether in the yarn or in the finished cloth.

The next step of the process is the reduction of the flax fibre to lengths adapted for spinning on cotton machinery. These required lengths are obtained by a very nicely adjusted piece of mechanism, similar in its principle to the ordinary chaff-cutting machines. It is here that the greatest accuracy is required, as, if any of the fibres exceed the required length, the yarn produced will "bite" in the rollers, and present the appearance of being "overworked," and will also be unequal in strength. The flax may be cut for this purpose either in the straw as it comes from the field, with its bulk partially reduced, or after it has undergone the boiling process. But in order to spin flax successfully upon cotton machinery, something more is required than the mere reduction of the length of the fibre. After having undergone the boiling or steeping process, and when the glutinous matter which binds them together is removed, the fibres, however fine, are still harsh, coarse, and elastic, when compared with cotton; and the quantity in length of yarn obtained from equal weights of flax and cotton, would be so greatly in favor of the latter, as completely to preclude the possibility of the former being substituted for it. For instance, one pound of fair bowed Georgia cotton, spun into 30's, will yield 25,200 yards; while one pound of flax spun into "line" of a number about equal to that of the cotton yarn, would produce but 21,000 yards, giving an advantage of 4,000 yards in the pound to cotton over flax. In addition to this, the yarn would be produced from the raw cotton, by cotton machinery, at an expense of less than three-pence, while that of the flax would be about ten-pence the pound when prepared by the flax machinery. This is a difficulty which has hitherto lain at the root of every attempt to spin flax successfully and profitably upon cotton machinery. A minute's attention, however, to the structure of the flax fibre, suggested to the Chevalier Claussen a mode by which it might be successfully overcome. The fibre of flax is cellular, and is formed by the union of bundles of smaller fibres, which may be compared to the Roman fasces. If by any process the character of the fibre could be altered — if the minute, hair-like, cellular substance could be further divided — it is obvious that the required increase in length and diminution of bulk could be obtained.

This achievement, apparently impossible, has been accomplished by M. Claussen, by a process exceedingly simple, and with rapidity. It has been already stated, that, in the processes required for the preparation of the flax for the flax-spinner, it was boiled in a solution of caustic soda. To still further perfect the flax for the cotton-spinner, it is placed in a vat containing a solution of carbonate of soda, where it is permitted to remain until the whole becomes thoroughly saturated with the salt. The mass is then transferred to a bath of weak acid; this coming in contact with the carbonate of soda, taken up and contained in the interior of the fibres, generates carbonic acid gas, which, by its expansive force, splits and divides the fibres into a vast number of ribbon-like filaments, the whole mass gradually being changed from the damp, rigid aggregation of flax, to a light, expansive mass of cottony texture, increasing in size like leavening dough, or an expanding sponge. This, when examined under the microscope, presents all the appearance of raw cotton. When carded and spun, it will be found that the produce in yarn of the pound of flax, thus treated, instead of being less in quantity than that of cotton, will be considerably more — the difference varying according to the character of the fibre operated upon, and the strength of the materials employed. One great advantage in connection with this mode of preparing the flax — and it is one of the highest importance to the agriculturist — is, that the flax will not be required to be pulled before it is fully and completely ripe, as is now the case where a fine flax is required. A valuable crop of fully ripened seed may therefore be obtained, in addition to the fibre.

At the Great Exhibition, various specimens of fabrics formed of flax, prepared by M. Claussen's processes, were exhibited. These specimens are thus described in the London Chronicle :— "The flax-cotton is shown, dyed in various colors immediately after carding. It is also shown dyed in various colors, in yarns spun entirely from flax, or mixed with various proportions of cotton ; and, in the case of the mixed yarns, no difference of color of the two substances is at all perceptible ; thus showing that the flax so prepared is capable of taking the same opaque dye as ordinary cotton. Some samples of yarn, prepared as silk, are also displayed, and, as illustrating the great command which the inventor has over this fibre, these are dyed in colors possessing all the glossiness and brilliancy of the most beautiful silk. Several pieces of calico, formed entirely of flax, and others formed of a mixture of flax and cotton, bleached and dressed as ordinary cloth, are exhibited. Specimens of yarn formed of a mixture of wool and flax-cotton were also noticed. Hitherto it has been found impossible to felt or mill yarns, or fabrics formed of a mixture of flax and wool, or even to produce a yarn formed of these two substances, as the flax naturally does not possess the same felting properties as wool. By this process of splitting the fibres, the difficulty has been to a great extent obviated. Indeed, some specimens of felt, formed of rabbit's hair and flax, are shown as illustrative of the great felting properties which the 'cottonized' flax fibre possesses. In addition to the mixed wool and flax-cotton yarn shown, there are displayed several pieces of excellent flannel, formed of those yarns, and pieces of broadcloth, gray and dyed, of a remarkably clean, bright and pure color, and of great strength and durability."

The various advantages of the processes adopted by M. Claussen, for the manufacture of flax, may be briefly set forth as follows : —

"In the first stage it will enable the farmer, by mechanical means, and with little trouble and expense, to reduce the bulk of his flax crop, so as to give him access to markets, and render it marketable. It will enable him at the same time to preserve, to be returned to the land, those portions of the crop which tend to exhaust the soil ; the produce being a description of fibre adapted to the coarser kinds of the flax manufacture. By the second, or boiling operation, the long, troublesome, and noxious process of steeping may be dispensed with, in the preparation of flax for the finer purposes, for which long fibre is spun in the ordinary way. Lastly, by reducing the flax to short fibre, and by splitting it up by means of the chemical process above described, a great extension of the demand for flax may be expected, to be spun on cotton, wool, and silk machinery alone, or in combination with any of those substances. All these results will have been obtained through the microscopic researches into the structure of the flax-plant, and the application of chemical knowledge to the improvement of old processes for preparing it for use."

ON THE MANUFACTURE OF SMALT.

THIS branch of manufacture is altogether foreign; and the chief material for it is almost entirely obtained from two small districts, one in Saxony, on the borders of Bohemia, and the other in Norway. The use of the ore from which smalt is manufactured, was discovered by one Schurer, a glass-maker, at Neudeck. He first collected some of this ore and tried it in his glass furnace, when he found, to his delight, that it communicated to glass a beautiful blue color. This was about the year 1540. Schurer made many trials of the new material, and at length succeeded in making of this blue glass *an enamel color*, well adapted to the use of the potter. This color found its way to Nuremberg, and at length to Holland, where it was highly appreciated by the Dutch artists. They sought out the humble glass-maker of Neudeck, and invited him, by large promises, to reveal his secret. He took up his residence, for a time, in Magdeburg, and had the ores conveyed thither for the purpose of his manufacture. But he afterwards returned to Neudeck, and constructed a mill for grinding the glass to powder. Meanwhile the Dutch became so expert in the preparation of the color, that the Elector of Saxony had to invite the color-makers of Holland to teach their methods to his people; after which, color mills rapidly increased in the neighborhood of the cobalt mines. Thus for a very long period this beautiful color continued to be manufactured from a mineral whose composition was unknown. It was not till the year 1733, that the Swedish chemist, Brandt, obtained from this ore the metal which he called *cobalt*, and proved that the coloring matter is the protoxide.

Metallic cobalt is a brittle metal, of a reddish gray color; it fuses with difficulty, and has a magnetic character. This metal has not been applied to any useful purpose in the arts, and the interest attaching to it is purely scientific. To obtain the oxide in a state of tolerable purity, requires much careful and laborious manipulation, varying somewhat according to the nature of the ore. The first process is *picking*, by which stony fragments are removed, and the ores are separated into different qualities, the richest being set aside for roasting with little or no previous preparation, and those containing nickel being reserved for special treatment. The larger bulk of the picked ore is, however, subjected to the next process, which is *stamping* in a stamp-mill. The stamp-troughs are furnished with a stream of water, which washes out the pounded ore and carries it down an inclined plane, where the sand and earthy matters, being much lighter than the metallic oxides, are carried farthest by the action of the stream, and are easily separated from the heavy and valuable particles. The ore thus washed is next *roasted* in a reverberatory furnace, provided with chambers for receiving and condensing the arsenic. The condensing tube is connected with chambers of several stories, where the arsenic is collected by men wearing a dress fitting tightly in every part, a helmet with goggles for the eyes, and a wet bandage or sponge tied over the mouth and nostrils. They are still further fortified for their dangerous occupation by drinking a glass or two of olive oil. Their food, also, is regulated, and consists chiefly of vegetables with abundance of butter. In the roasting of cobalt, the ore is wetted and spread over the sole of the reverberatory furnace, in a layer five or six inches deep; it is then cautiously heated for six hours; when the ore becomes red-hot the operation ends. The sand which was separated in the dressing is sometimes mingled in certain proportions with the ore in roasting, and the product thus obtained is the zaffre or saffre of commerce, a crude product. *Smalt*, on the contrary, is a valuable and carefully prepared vitreous compound, a rich blue glass in fact, to be afterwards reduced to powder and elaborated in the manner now described. Silica and potassa, both very carefully prepared, calcined, sifted, and preserved from moisture, are mixed with oxide of cobalt to form smalt, the proportions varying according to the commercial variety of the article required. The ingredients are intimately mixed and then transferred to the melting pots, which are built up in a furnace heated to the proper temperature, each pot being first charged with an inferior blue glass in powder called *eschel*, the effect of which is to give an interior vitreous lining to the pots. The smalt mixture is poured into the pots by means of iron ladles with long handles, and in about eight hours it fuses. When the pots appear at white heat, their contents are quite fluid, and the chemical combination of the materials has been effected. The pure glass is taken from the glass-pot in iron ladles, and, as the object of subsequent processes is to reduce the glass to powder, that process is facilitated by emptying the ladles into vessels of water, the water being constantly renewed. The glass being at a red heat when it first comes in contact with the water, is thus rendered, like Prince Rupert's drops, excessively brittle, granular, and easy to pulverize. The next process in the manufacture of smalts is the apparently simple one of reducing the blue glass to powder. But if we try the experiment of grinding to powder a portion of blue glass, we shall find that the substance, which by transmitted light had appeared so beautiful, is reduced, in its disintegrated state, to a light dingy powder; yet who can doubt that the same amount of coloring matter is present in the powder as in the glass? Therefore there are difficulties to be overcome in converting a sheet of blue cobalt glass into a powder of an intensely blue color, and in obtaining all those shades and varieties of blue which are found in our manufactures. The glass, after being crushed and sifted to the size of ordinary sand, is transferred to large vats full of water, and, in the course of a very few minutes, a separation of particles takes place in the powder. The heaviest, being those which are richest in cobalt, sink to the bottom, and this deposit constitutes one of the commercial varieties of smalts, known as *azure, coarse blue* and *streablau*. The water which holds the finer particles of the powdered blue glass in suspension, is drawn off into other vats, where it is allowed to subside for three quarters of an hour or more, according to the variety of smalt intended to be produced; this second deposit is called *farbe*, the German word for *color*. The water drawn off from this second deposit is poured into vats and allowed to remain for an indefinite time; its deposit is called *eschel* or *blue sand*. But the colors thus obtained are all again subjected to the action of water before they are fit for the market. The glass of cobalt appears to be a mixture of the less fusible silicates, in which *cobalt* prevails, and which resist most perfectly the action of water; and of the more fusible silicates, in which *potassa* prevails, and which are more susceptible of the action of water. The former silicates constitute the *azure* or coarse blue, and the latter are partially decomposed by water, which subtracts a sub-silicate of potassa and leaves a supersilicate of potassa in a minutely divided state. *Farbe* owes its tints to the subtraction of potassa, and *eschel* contains more silica and less potassa and cobalt than other varieties. The beauty of smalt is said to be heightened by what may be called accidental causes — the presence of four or five per cent. of arsenic and arsenious acids from six to nine per cent. of phosphoric acid, and minute particles of zinc, tin, antimony and nitre. On the other hand it is deteriorated by the presence of nickel, lead, iron beyond ten per cent., bismuth, borax, soda, the alkaline earths, alumina, felspar, fluorspar and sulphur.

IMPROVEMENTS IN THE MANUFACTURE OF ALUM.

Mr. James T. Wilson, of Middlesex, England, has recently patented a new process of manufacturing alum, which consists in subjecting aluminous shales to the direct action of a sufficient quantity of sulphuric acid to saturate, at a single operation, all the alumina contained in them, and convert it to the state of sulphate, the alum being obtained by subsequent crystallization in the usual way. The shale should be selected of a kind as free as possible from coal, or iron, lime, and other soluble impurities, and, after having been exposed to the air two or three months, to reduce it to small fragments, and then burned in a lime or other similar kiln, is to be placed in an open boiler, about 15 feet long, 5 feet wide, and 4 feet deep, lined with lead, and having a false bottom at a height of about 15 to 18 inches above the bottom, composed of lead of about 24 lbs. to the square foot, perforated with numerous holes of half an inch diameter, and supported on an iron framework, and provided with suitable conveniences for allowing the bottom of the boiler underneath to be examined and cleaned out. Into this boiler, which is to be placed over a furnace, in such a position that the flame does not rise to within a couple of inches of the false bottom, the shale is then deposited, the larger pieces being screened out, and laid immediately on the false bottom, and sulphuric acid of a specific gravity of 1.845, added in the proportion of 10 cwts. to every 12 cwts. of shale, with sufficient water to reduce the specific gravity to 1.35 or 1.4, and nearly fill the boiler. Heat is applied, and a gentle ebullition kept up for eight-and-forty hours, when the whole of the available alumina will have been dissolved, and the solution will be fit to be treated for crystallization, by using sulphate of potash or ammonia. The patentee has, however, observed, that, when alum is at once crystallized from solutions obtained as above described, a certain quantity of the acid in such solution remains in excess, and renders the purification of the alum a matter of difficulty. Now, to obviate this objection, he introduces into the solution either ammoniacal liquors of gas works, or condenses therein vapors containing ammonia which combines with the excess of acid, and renders the solution fit for immediate crystallization.

It does not seem necessary that this improvement, which is an important one, should be confined to merely aluminous shales, but it may also be applied to pipe-clay, or any convenient material abounding in alumina.—*Editor*.

IMPROVEMENTS IN THE MANUFACTURE OF SUGAR.

The following is the abstract of a patent recently granted to Mr. John Frazer, of London, for improvements in the manufacture of sugar.

The expressed cane-juice is poured into an open vessel through a sieve containing about one pound of quicklime. A similar quantity of lime is mixed with about a gallon of juice, in a vessel, and kept ready for use. This quantity of lime is sufficient for two hundred and twenty gallons of juice. When about one hundred gallons of juice are run into the vessels, the mixture of lime and juice in the vessel is put in along with half a gallon of sulphurous acid, of the gravity of 1.05, containing 30 volumes of gas to one of water. When the whole 220 gallons of juice are run in, $\frac{1}{4}$ of a gallon of the sulphurous acid is added, and the whole well stirred and allowed to settle. The clear liquor is then drawn off and boiled in an open pan. The scum is carefully removed, and the liquor gives out a peculiar odor, which decreases as the boiling is continued. The liquor is at first a deep brown, then green, then becomes a rich golden color throwing up yellow flakes. When the color is quite clear, the boiling is discontinued, and the liquor is then fit for evaporation and crystallization in the common way. The boiling may be done in the vacuum pan, care being taken to remove the scum when the liquor is about the density of 38° Baume.

M. MELSEN'S PROCESS OF REFINING SUGAR.

This process has been tried at Gaudaloupe, and a commission, appointed by the governor of the island, has reported thereon. The commission state that the only advantage possessed by the use of bisulphate of lime is that of arresting, or at least delaying, the fermentation of the cane-juice; that its faculty of decolorizing the syrup is annihilated by the necessity of employing a large proportion of lime; and that the relative return of sugar from a given quantity of juice is less than that obtained by the process at present in use. The commission therefore recommend the abandonment of M. Melsen's process. As the experiments previously made in France and Belgium failed in demonstrating the advantage of the use of bisulphate of lime in the manufacture and refining of beet-root sugar, and as the report of the Gaudaloupe commission is against the employment of this salt in the manufacture and refining of sugar-cane, we conclude that the merits of this much vaunted process have beeen fairly tested, and that its further employment is out of the question.

NEW PROCESS FOR THE MANUFACTURE OF SODA.

Mr. William Cook, C. E., of London, has recently taken out a patent for the following method of making soda. He places a solution of common salt between two metals, iron and copper, connected together in a voltaic battery; the salt is decomposed at the expense of the iron, its chlorine combining with the metal to form chloride of iron, whilst the sodium enters into combination with the oxygen of the water, forming caustic soda; the other constituent of the water, the hydrogen, passing off in the gaseous state. The caustic soda thus produced goes in the direction of the copper, and, in order to prevent the amalgamation of the two solutions, (chloride of iron and caustic soda,) a diaphragm, constructed of some suitable porous material, is placed between the iron and the copper, the solution of salt being placed in that part of the apparatus used to contain the iron, and clean water put on the sides in which the copper is situated, in order to receive the caustic soda produced by the decomposition of the salt. In order to insure the decomposition of the salt, two conditions are essential to be observed, viz., that the temperature of the saline solution be between 70° and 150° Fah., and the access of the atmospheric air prevented; otherwise the chloride of iron will become converted into oxide, and the salt be recomposed as fast as it is decomposed, thus rendering the process of no utility.

The following details are given by the patentee for the manufacture of a ton of soda-ash, according to his process: — For this purpose a cistern or tank is constructed of stone, slate, or other suitable material, not liable to be acted upon by caustic soda, the dimensions of which are eleven feet long, six feet wide, and three feet deep. It is divided into three compartments, by means of diaphragms, formed of some suitable porous material, such as biscuitware or unglazed earthenware. These diaphragms run the full length of the cistern, and are so placed, that the middle compartment is one foot wide, and the two outer compartments each 2½ feet in width. The cistern being thus ready for use, pigs of Scotch iron are placed in the two outer divisions or compartments of the cistern or tank, in such a manner that the salt water may touch as much of their surfaces as possible. A small portion of each pig of iron is also filed bright, so that perfect metallic contact between each piece of iron may be ensured, by placing the bright part of the pig in connection with the bright part of the one next adjoining.

The number of pieces of iron employed to be as many as will leave room for the addition of 324 gallons of salt water, which must next be placed in each of the compartments containing iron. Two plates of copper, of the same dimensions as the length and depth of the cistern, are to be placed at each of the two porous diaphragms, at a distance of a quarter of an inch from them. Either copper foil or copper plate, of any thickness, may be employed for this purpose, as surface only is required, no action on the copper taking place in the process. Each piece of copper must be connected with the pig of iron nearest to it, by means of a strip of copper bent over the diaphragm, and fastened by means of a screw, or other suitable means, in connection with the bright part of one of the pieces of iron in the outer compartments, with a view of ensuring that full metallic contact which is necessary for the success of the operation. For the manufacture of a ton of soda-ash, a solution of 2,489 pounds of salt in 474 gallons of water is employed, half of which is placed in one of the outer compartments containing iron, and the remainder in the other. The middle compartment, containing the copper, is filled with clean water up to the level of the salt water in the two outer compartments. In order to prevent all access of air, a cover is fitted to the decomposing vessel, and securely luted. A bent tube to carry off the hydrogen gas, liberated in process of decomposition of the water, is inserted in this cover, the end of the tube being conducted into a vessel of water, to prevent any access of air through the tube. The contents of the tank being continuously kept at 70° to 150° Fah., the decomposition of the salt will be effected in the course of seven days, when the two outer compartments will be found to contain a solution of chloride of iron, and the middle compartment a solution of caustic soda mixed with a small quantity of salt. The strength of the soda solution will depend on the quantity of water employed ; but if all the salt be decomposed, the solution will be found to contain 1,327 pounds of dry caustic soda.

IMPROVEMENT IN THE MANUFACTURE OF SOAP AND TURPENTINE.

A PATENT has been granted to Mr. C. J. Meinicke, of New York, for the manufacture of resin-soap and the purification of turpentine at one operation. The process is, to take a thousand pounds of crude turpentine and melt by steam, or otherwise, and add eight hundred pounds of tallow, grease or fat. When both are in a perfect liquid state, eight hundred parts of liquid soda, containing thirty per cent. of dry soda, dissolved, is added and stirred up, the temperature of the whole being increased at the same time to 108°. At this temperature the soap is instantaneously formed ; the acids constituting the resin of the turpentine, and those forming the grease being perfectly neutralized by the alkali, and thus converted into liquid melted soap. The essential oil of turpentine is set free at the same time, and, in order to obtain the same, a solution of common salt is added, which is necessary in the manufacture of all soap. The soap-kettle is then connected with a condensing apparatus, usually employed by distillers of the spirits of turpentine, and then the temperature of the whole is increased to the boiling point. The essential oil of turpentine and the steam pass into the worm and are condensed. The alkali sets the spirits of turpentine free, and in this manner two articles of useful manufacture are produced with less expense for fuel and labor. When all the essential oil is distilled over, the remaining soap is finished in the common way now practised by all soap-makers. — *Scientific American.*

IMPROVEMENT IN VULCANIZING INDIA-RUBBER.

A PATENT has been granted to Mr. McCurdy for improvements in vulcanizing india-rubber. In his specification he says : — My experiments have resulted in the discovery, that common commercial potash, mixed with rubber, in proportion as small as two ounces of potash to 16 ounces of rubber, when treated by mixing with the usual quantity of sulphur, say from five to seven per cent. by weight of the quantity of rubber used, will readily vulcanize, upon exposure to a heated atmosphere, say 260° Fah. The quantity of potash may be increased — the exact amount is immaterial; — but the best elasticity I obtain is, by the use of two ounces to sixteen of rubber. This preparation may be spread upon textile fabrics, fine figured or colored, and exposed to a heated atmosphere, without in the least discoloring or causing the loss of color to the fabric. It is free from offensive sulphur smell, and will not be affected by atmospheric changes. For making my fabric harder and with less elasticity, as also for purposes of cheapness, I combine whiting, lamp-black, and such other articles as are well known to give body and firmness to the rubber. These may be incorporated in the rubber and potash compound, by the usual methods, well known to manufacturers.— *Appleton's Magazine.*

OIL FOR LUBRICATING MACHINERY.

M. Boudet describes an oil, which the French call *liard*, used for greasing machinery. It is made by adding one part of caoutchouc, cut into small pieces, to fifty parts of rape oil, and applying heat until the caoutchouc is nearly all dissolved. This oil is more unctuous than most of the oils used for machinery, and is not so much affected by the rapid motion of the parts to which it is applied, or by other influences to which it may be exposed. It remains fluid at temperatures below the freezing-point of water, and offers little obstruction to the commencement of motion in the machines. M. Boudet suggests the following method of determining the proportion of caoutchouc contained in this kind of oil:— A weighed quantity of the oil is saponified with potassa, and the dry soap treated with spirit, which dissolves the soap with the aid of heat, and leaves the caoutchouc. The insoluble residue is washed with water containing a sixth part of spirit.

INFLUENCE OF OIL ON WATER.

Prof. Horsford, at the Albany meeting of the American Association, read a paper, entitled, "On the occurrence of placid water in the midst of large areas where waves were constantly breaking."

The Professor said he had noticed frequently that there were spaces of some extent, in places where the waves broke, which were very smooth; that though the swell, or rise and fall, of the water was just as great, yet there was no breaking of the waves, no white crest or comb; that he believed that these smooth spots were occasioned by oil or oleaginous matter, which had accidentally happened to be spread on the surface at such places. To test this, he had, himself, when there was quite a stiff breeze, with waves on the surface of the water, which broke with considerable of a comb or crest, emptied a vial of oil on the water from a boat. The effect was instantly seen. As far as the oil spread the water was smooth, and the waves did not break; and, what was very curious, the oil spread over the surface almost as rapidly to windward as it did to leeward. He had, therefore, inclined to the conclusion, that the smooth spaces, which might be observed in the midst of places where waves broke, were owing to the presence of oil, which might either come from decaying fish, or some other substance from which oil exuded.

Commodore Wilkes confirmed the statement and observations made by Professor Horsford. He cited the instance where he had seen the same effects in a violent storm off the Cape of Good Hope, from the leakage of a whale-ship. He stated it was very curious to observe over what a great extent a small quantity of oil would produce the effect spoken of.

Professor Henry stated, that almost every one knew the anecdote of Franklin stilling the sea, to the astonishment of the uninitiated, by stretching his cane over the side of the ship, the cane having a small vial of oil in the end of it. The subject was not new. It had been investigated very fully, some twenty years ago, by order of the Dutch government, and the results published. The philosophy of the phenomena was that, when oil was placed on water, the oil had more cohesion for the water than for itself, while with water it was different; it had greater adherence to itself than it had to the oil. If you attempt to separate the two by a disc placed on the surface of water which oil has covered, the break is not between the oil and water, but between oil and oil. He further stated, that he had made some investigations to find out the measure of the film of oil which spread over the surface of water he experimented on; and for that purpose he had spent a whole month, blowing soap bubbles. He thought the stillness of the waves was owing to the lubrication of their surface by the oil.

SUBSTITUTE FOR COLLODION.

Pulverized shell-lac is dissolved in highly rectified spirits of wine. The solution assumes, on cooling, a demi-solid and gelatinous consistence. This is the mixture used by upholsterers for polishing furniture. Spread on linen or silk and applied to the skin, it has all the properties of collodion. Thus, it is impenetrable to air, water, oil, and even to organic humors and secretions. It in no way irritates the skin, and adheres to it perfectly. Its adherence is so perfect that it might replace dextrine in cases of fracture. Wounds cure rapidly when covered with this mixture.—*Journal de Pharmacie, Aug.* 1851.

SUBSTITUTE FOR MARINE GLUE.

A transparent substance, well adapted to replace the marine glue of Jeffreys for many purposes, particularly where a transparent joint is required, as in the union of pieces of glass, has been invented by Mr. S. Lenher, of Philadelphia. The composition is as follows: — Caoutchouc 15 grains, chloroform two ounces, mastic half an ounce. The two first-named ingredients are to be first mixed; after the gum is dissolved the mastic is added, and the whole allowed to macerate for a week. More caoutchouc may be added where great elasticity is desirable. The convenience of its application with a brush, cold, recommends it for approval.—*Franklin Journal.*

ON THE PRODUCTION OF ARTIFICIAL MINERAL COAL.

An interesting communication was recently presented to the French Academy, by M. Cagniard Latour, relative to the production of artificial mineral coal. It is known that Sir James Hall, putting fir, sawdust, and horn into a gun-barrel, and subjecting them to heat, succeeded in melting this compound and converting it into a sort of coal. These experiments have recently been renewed by the gentleman above named, under different conditions and with better success. Instead of gun-barrels he used glass tubes, 14 centimetres (five and five eighths inches) in length and three millimetres (0.11811 inch) in diameter. The glass should be two or three millimetres thick. These dimensions were found, upon trial, to be the best adapted to enable the common glass tubes to support the degree of heat to which they were subjected. M. Cagniard Latour dispensed with horn and all other agents to facilitate fusion; and he operated not only upon fir, but upon a great variety of other woods — birch, poplar, sycamore, elm, oak, boxwood, lignum-vitæ. It is remarkable that the degree of heat used in these experiments was not superior to, indeed was hardly equal to, that of boiling mercury (660°.) The bits of wood were put in the tube, which was hermetically closed at both ends, and then placed in a spiral cylinder of iron wire, for the purpose of being conveniently held over a pan of burning charcoal. If, by this process, the heating seemed tedious, the tubes were plunged into boiling mercury. The result of the experiments was an artificial coal, varying in character, according to the age and hygrometric state of the woods employed. The wood of young trees was converted into a glutinous coal; the old wood, of dry fibre, into a dry coal. But these last, if soaked in water before being placed in the tube, gave a glutinous coal like the young wood; and, in some instances, a brown resin, very similar to asphaltum. The woods used in these experiments had been, by way of preparation, dried by a heat of 100°. "May it not be hoped," says the experimenter, in the conclusion of his communication, "that essays of this kind, suitably multiplied and varied, will lead to results of which geology may make most useful and important application?"

ON THE VALUE OF VARIOUS KINDS OF COAL FOR STEAM PURPOSES.

From the third report of the Commission appointed to examine and report upon the coals of Great Britain, as regards their applicability for naval steamers, we make the following extract. The commission consisted of Sir H. de la Beche and Dr. Lyon Playfair.

"Although the analysis of a coal shows, generally, that the quantities of carbon and hydrogen it contains materially regulate its economic value, still there are marked exceptions to this rule, showing that in all inquiries as to the real value of coal for fuel, its economic value as to its evaporative power, by actual trial under the boiler, should be ascertained. The coals, for instance, of the Newcastle district, are, in general, of very different composition from the Welsh coals. They are characterized by containing a smaller quantity of carbon, but a larger amount of hydrogen. This latter element exercises, in this case, a very essential importance in their heating powers, and must not be neglected in comparing the analytical with the economic results. As a general rule, subject to marked exceptions, the practical value of a coal rises with the increase of these two combustible elements. Nevertheless, the mechanical conditions of a coal very frequently modify the practical result to an extent which was scarcely to be expected. The physical condition of a coal, according as it facilitates or opposes the entrance of air for combustion, produces a most marked influence in its evaporative powers, and often determines the practical results obtained from it, more than the composition of the coal itself. It is, therefore, not a safe guide to rely wholly on the analysis, unless, at the same time, practical experiments are found to coincide with the approximative value indicated by analysis. — *London Patent Journal.*

ON THE USE OF RECTIFIED COAL-OIL.

A COMMUNICATION was recently presented to the French Academy, by M. Edward Robin, "upon the advantages of rectified aromatized coal-oil, (*huile de houille,*) employed for the preservation of animal and vegetable substances." He says:—

"I have the honor of submitting to the examination of the Academy a portion of flesh which, notwithstanding the presence of damp air, has been preserved by the vapor which coal-oil emits at ordinary temperatures. This mode of preservation, extremely cheap, keeps flesh, for an indefinite time, in all its freshness. In an economical point of view, as well as in the satisfactory character of its results, coal-oil has evidently many advantages over the liquors hitherto employed in our museums. The specimens which in the museums are kept immersed in these liquors are, it is true, preserved from putrefaction; but they undergo change — they are no longer fresh animal substances; whereas entire birds, with their feathers, fœtus of every age, placed in well-stopped bottles, at the bottom of which has been placed a little coal-oil, have experienced no change whatever. The conservative property of coal-oil is applicable, as I have said, to vegetable as well as animal substances. The botanist can use it for the preservation of fruits and flowers. Experiments now in process of execution seem to indicate that certain flowers may be thus preserved with the appearance of life, and without any very notable change of color. In all external applications, where the object is to ease pain and remove inflammation, this substance may be used as a substitute for the essential oils of plants, for ether, for camphorated alcohol, and even for chloroform and other costly substances which possess no known virtue rendering them superior to rectified and aromatized coal-oil."

PRESERVATIVE INFLUENCE OF CHLOROFORM.

M. AUGENDRE, in a paper before the French Academy, on the preservative and disinfecting influence of chloroform,* supposes that its

* See *Annual of Scientific Discovery*, for 1851, p. 217.

action in all cases is purely a physical one, consisting in a contraction of the fibre, or of the parenchyma, which is immediately induced — a contraction which expels the juices, and thus prevents putrefaction. The author concludes his communication by stating, as a fact worthy of notice, that the most powerful antiseptics we are acquainted with, such as the chlorides of sodium, zinc and mercury, and the chloride of formyle, are all chlorine compounds, and that they act on organized substances without yielding up any of their constitutent principles to these substances.

PRESERVATION OF BODIES.

At a late meeting of the French Academy, a paper on the above subject was presented by M. Falcony. "Having found that the various substances hitherto employed for preserving from corruption such parts of dead bodies as are needed for anatomical purposes were inefficient, he entered on a series of experiments, comprehending sulphate of soda, corrosive sublimate, chloride of zinc, alcohol, &c., and has come to the conclusion that sulphate of zinc, dissolved at different degrees, is the substance which is the most efficient for the purpose. An injection of four or five litres would, he says, perfectly well preserve a dead body, as is proved by the preparations belonging to the anatomical cabinet at Genoa. Bodies so prepared preserve all their flexibility at the end of forty days. It is only after that period that they begin to dry up, still preserving, however, their natural color.

ON THE CHEMICAL AND GENERAL EFFECTS OF THE PRACTICE OF INTERMENTS IN VAULTS AND CATACOMBS.

Although much has been said and written on the decomposition of the human body after interment in the earth, (the only proper mode,) but little has been known respecting the process and results of such decomposition when modified by the corpse being placed in a vault or catacomb. In order to arrive at some satisfactory conclusions upon this subject, Mr. Walter Lewis, of London, under the direction of the General Board of Health, undertook, in the years 1849 and 1850, an examination of the vaults and catacombs of that city, together with the analysis of the gases resulting from the decomposition of bodies in such receptacles. An article by Mr. Lewis, in the London Lancet, gives some account of his researches, which are the more interesting, as the results are contrary to opinions generally entertained even by chemists.

He visited the vaults of the principal churches of London, noted the external appearance of more than 22,000 coffins, and the contents of nearly a hundred, and several times tested or analyzed the atmosphere of the vaults. In no case did he discover the slightest trace of cyanogen, hydrocyanic acid, or phosphuretted, sulphuretted, or carburetted hydrogen, except a very minute quantity of sulphuretted hydrogen in the air of a single vault, which contained but few coffins. The corroded parts of old leaden coffins were always found to be carbonate of lead, with no trace of sulphate or sulphuret. Some of the coffins contained ammoniacal gas in large quantities, and others none at all; but, with this exception, the contained air was nearly alike in all, being composed of nitrogen, carbonic acid, common air, and animal matter in suspension. When ammonia was present, it overcame every other odor; when absent, the smell resembled that of very putrid moist cheese. The result was the same, whether the interment had been made a few weeks, or a century and a half previously, and whatever the cause of the decease, or the age at which it took place. Out of all the coffins examined, but twenty of the leaden ones had been bulged by the pressure of the gases generated in the interior. This is only about one out of a thousand, and shows that the gases are formed very slowly. Mr. Lewis, besides his own investigations, made diligent inquiries of all the clergy, churchwardens, sextons and undertakers in every parish, and could not ascertain that a coffin had ever been known to burst suddenly from the pressure of the confined air. When one becomes bulged, or, as the sextons say, "blown," it is customary to make a small aperture in it, to which a torch is applied as an antidote to the noxious effects of the escaping gases. Several persons, whom Mr. Lewis consulted, had heard of cases in which the gases caught fire; but, after searching inquiry, he could not find one who had ever seen them burn.

Mr. Lewis' experiments were confined to vaults and catacombs, where the process of decomposition goes on under very different circumstances from those that attend open exposures or interments in the ground, and it is only concerning them that we can draw our inferences — which are, that the deleterious emanations that haunt these depositories, may continue for a hundred years after they are closed; they are not rendered noxious by poisonous gases generated during the process of decomposition, but by the animal matter itself, with which, if ventilation is not allowed, the air finally becomes saturated; that nitrogen and carbonic acid, holding animal matter in suspension, steadily, but quietly, make their way through the pores of lead coffins, and, by some means, to the open air, so that, at the end of fifty or a hundred years, nothing remains but a few dry bones, though the coffins are still sound and unruptured. What their effect upon the living constitution is, Mr. Lewis sufficiently experienced in his own person. First, upon exposure, came nausea and vomiting, then diarrhœa, and the next day throbbing pain in the upper part of the head, great prostration, utter loss of appetite, and an unpleasant earthy taste in the mouth. After continuing his investigations for a long time, he was attacked by a series of biles, followed by erysipelas.

The complete decomposition of a corpse, and its resolution into its ultimate elements, takes place in a leaden coffin with extreme slowness. In a wooden coffin, the remains, with the exception of the bones, vanish in a period of from two to five years. This period depends upon the quality of the wood, and the free access of air to the coffins. But in leaden coffins, fifty, sixty, eighty, and even a hundred years are required to accomplish this. "I have opened," says Mr. Lewis, "a coffin, in which the corpse had been placed for nearly a century, and the ammoniacal gas formed dense white fumes when brought in contact with hydrochloric acid gas, and was so powerful that the head could not remain near it for more than a few seconds at a time." Mr.

Lewis, in conclusion, recommends, "that interments in vaults and catacombs be no longer permitted, as they are but so many active volcanoes, constantly emitting poisonous effluvia; and that the use of leaden coffins should be entirely discontinued." "To render the human body perfectly inert after death, it should be placed in a light wooden coffin, in a pervious soil, from five to eight feet deep."

REALITY OF SPECTRAL APPEARANCES TRACED TO NATURAL CAUSES.

Baron von Reichenbach, in his work on magnetism, thus attempts to account for the so-called spectral appearances, through the agency of natural causes. The baron refers, for example, to an authenticated instance in Germany, where a spectral appearance having been observed in a certain location, an examination of the spot was ordered, which resulted in the finding of the remains of a human body covered with lime. In explanation of this appearance, the reality of which he does not doubt, the Baron says: —"The explanation, it appears to me, belongs entirely to the domain of chemistry. A human corpse is a rich field for chemical changes — for fermentation, putrefaction, gasification, and the play of all manner of affinities. A layer of dry quicklime, compressed into a deep pit, adds its own powerful affinities to organic matters, and lays the foundation of a long and slow action of these affinities. Rain-water from above is added; the lime first falls to a mealy powder, and afterwards is converted, by the water which trickles down to it, into a tallow-like external mass, through which the external air penetrates but slowly. Such masses of lime have been found buried in old castles, where they have lain for centuries; and yet the lime has been so fresh that it has been used for the mortar of new buildings. The carbonic acid of the air, indeed, penetrates to the lime, but so slowly that, in such a place, a chemical process occurs which may last for many years. The occurrence, in such localities, of spectral appearances, is, therefore, quite according to natural laws; and, since we know that a continued emanation of the flames of the crystalline force* accompanies such processes, the fiery appearances observed are thus explained: — They must have continued until the affinities of the lime for carbonic acid, and for the remains of organic matter in the bones, were satisfied, and finally brought in equilibrium. Whenever, now, a person approached, who was, to a certain degree, sensitive, but who might yet be or appear in perfect health; and when such a person came within the sphere of these physical influences, he must necessarily have felt them by day and seen them by night. Ignorance, fear and superstition would now give to the luminous appearance the form of a human spectre, and supply it with head, arms and feet; just as we can fancy, when we will, any cloud in the sky to represent a man or a demon. Thousands of ghost stories will now receive a natural explanation, and will thus cease to be marvellous. In fact, it was, at all times, only the sensitive who could see the imponderable

* Luminous emanations from magnetized bodies, lately discovered by the author, which are visible in the dark to some persons of fine optical sensibility.

emanations from the chemical change going on in corpses luminous in the dark. And thus I have, I trust, succeeded in tearing down one of the densest vails of darkened ignorance and human error."

ANÆSTHETIC ACTION.

M. Aran has made experiments on the anæsthetic action of certain agents used as an external application to the skin, and has found that the best material for this purpose is chlorated chlorohydric ether. The sesquichloride of carbon may also be used; but, whilst the ether operates effectually in a few minutes, at least two hours are required to produce insensibility with the sesquichloride. To produce the desired effect, from 15 to 30 drops of the pure chlorated chlorohydric ether suffice. They are put upon the part in pain, or upon a piece of linen cloth, which is to be immediately applied to this part, and the contact is maintained by a bandage, and quickly the pain is relieved. A pomatum of this ether may also be employed, consisting of four grammes to twenty of suet; or if of the sesquichloride of carbon, four of the agent to thirty of suet: it may be used either with friction or without. The insensibility is not simply cutaneous, for it gradually extends to the parts beneath. The chlorated hydrochloric ether is obtained by the action of chlorine on hydrochloric ether, by which compounds containing chlorine in increasing proportions are formed, isomerous with the series of bicarburets of hydrogen, and identical with the same series in the density of the vapor for corresponding compounds. It is a colorless liquid, of an etheral, aromatic odor, analogous to chloroform, and a sweetish and even peppery taste at times; hardly soluble in water, but wholly so in alcohol, sulphuric ether, and most of the fixed and volatile oils. It is without action upon paper of tournsol; it is not inflammable; has a variable density and a variable point of ebullition, oscillating between 110° and 130° C., showing that the material is rather a mixture of several ethers than a single simple substance. All the chlorated chlorohydric ethers have the same anæsthetic properties, and they cannot be separated completely from one another. — *L'Institut.*, *No.* 886.

BROMHYDRIC ETHER.

M. Robin has called the attention of the French Academy to the use of bromhydric ether, as a new and safe anæsthetic agent. In his paper presented, he says:—"Bromhydric ether may be ranked among those agents which, even in the presence of humid oxygen, protect animal matters against slow combustion or decay, which exert an antiseptic influence after death, and are, according to the dose administered during life, sedative, antiphlogistic, or poisonous, producing asphyxia. Those of the agents moderating slow combustion, which belong to this class, are necessarily anæsthetic when they penetrate into the system in sufficient doses. When they have not an acid taste they are anæsthetic even by inspiration, if their point of ebullition, lower than 176° Fah., permits them to emit a considerable quantity of vapor at ordinary temperatures. If their point of ebullition is too elevated, they are merely anæsthetic *locally*, or by application. Bromhydric ether, which boils at 105° Fah., which possesses neither an acrid nor caustic taste, which emits a weak and very agreeable odor, unites, therefore, in my opinion, the conditions useful to constitute an anæsthetic agent by inspiration. Circumstances have permitted me to make the trial of it. Its properties are really such as theory would indicate. Its vapor quickly deprives birds of sensation; they readily assume the activity of life, and do not exhibit, either during or after the experiment, any sign of suffering. Birds, with which I have repeatedly experimented, four days ago, are now in full life. Bromhydric ether, therefore, is offered, for aught that at present appears, as one of the very best inspirable anæsthetic agents."

MATERIALS FOR ARTIFICIAL LIGHT.

There are few subjects of practical moment so interesting to the community, at this time, as that of artificial light. The *camphene* or *pine oil*, and the *spirit gas* or *ethereal oil*, have, to some extent, superseded the common oils, but the great number of fatal accidents resulting from their use will prevent their general introduction. Another drawback is also and most justly operating to exclude them from use, and that is the adulteration of the liquid. The pine oil, or camphene, is or should be a pure oil of turpentine, but is now so frequently loaded with the spirits of turpentine, or resinous matter, as to render it unfit for burning. The spirit gas or ethereal oil is not so easily adulterated, as it requires a very strong alcohol to mix well with the turpentine; but even this article is now so managed as frequently to burn but little better than alcohol itself. The fact is, it is difficult to get a pure article of anything at the present day. A pure sperm oil cannot be purchased; I say this not without authority. A large quantity of sperm and whale oil is now consumed to manufacture the celebrated cod liver oil, which, as now sold, is about one third part cod liver and other fish liver oils, and the remainder fish and whale oil. Lard oil is unfit for lamps, at least so far as we have had any experience in Washington. I have tried repeatedly that which has been most highly recommended, and have never yet found any that appeared to be suitable either for single draft or argand lamps. — *Page's Report on Patents.*

ON THE MANUFACTURE OF CANDLES.

The following is a *resumé* of a paper read before the Royal Society, London, on the manufacture of candles, by W. Carpmael, Esq.: —

Formerly, says this gentleman, the classes of candles manufactured in this country were wax, spermaceti, and tallow, the materials being used almost in their natural state. The manufacture of wax into candles has received no improvement, but is still a rude process, consisting of hanging a series of wicks (each composed of several yarns of Smyrna cotton slightly twisted together) around a hoop suspended in the air; the workman pours the melted wax on to the wicks in succession till the candles are about one third made, when they are allowed to cool for a time; then again the process of pouring on the melted wax is repeated, till the workman judges, by sight or by weighing, that the candles are about half made; when they are again allowed to cool and set for a time, after which the candles are rolled on a slab of marble. The upper part of the candle is formed by cutting away the wax down to a melted tag, which covers one end of the wick. The candles are then again suspended to hoops, the end of the wick, which had previously hung downwards, being now upwards; and the process of pouring on melted wax is again repeated, and the candles finished to the desired size, when they are again submitted to the process of rolling between two smooth surfaces; the lower ends are cut off, and the candles are finished. The bees-wax employed before being thus used, is bleached, and is generally mixed with a quantity of spermaceti.

The next class of candles to which attention was called, was spermaceti. This material in the manufacture of candles is mixed with about three per cent. of bees-wax, to prevent the spermaceti crystallizing. Formerly, spermaceti candles were inferior to those made of wax, the same class of wick being used. Some years ago, platted wicks were substituted for the twisted wicks before employed; this was a great step to improvement. Platted wicks have a tendency to turn out of the flame while being consumed, the effect of which is to cause the wicks to be burned away, rendering the use of snuffers unnecessary. Since that time, spermaceti candles, in place of being considered inferior, are preferred by many to candles made of wax. They are made by pouring the melted material into pewter moulds, in which platted wicks are first inserted, and retained securely to the centre of the moulds. Mr. Carpmael next called attention to the manufacture of tallow candles — "dips" and "moulds." The former are made, as is generally known, by suspending several wicks a short distance apart (each consisting of several cotton yarns) on a rod; the wicks are dipped several times into melted tallow; the coats thus taken up are allowed to cool and set. The mould candles are produced by pouring the melted tallow into pewter moulds in which the proper wicks (each of several cotton yarns) are first fixed centrally. These wicks require snuffing. A great improvement was some years back introduced into this manufacture by employing cords of cotton as wicks, which are coiled spirally round wires. The wires and the coiled wicks are introduced into moulds, and the wires are withdrawn when the tallow is set. These candles will, however, only burn in lamps, the turning out of the wicks melting the candles down on one side. This improvement introduced a new manufacture of lamps, called candle-lamps, which of late years have greatly increased in use; various sizes of candles being now made, some having as many as four wicks, and suitable for large table lamps. This manufacture has been greatly improved by the introduction of several means of making wicks which will turn out of the flame, and yet will admit of being introduced in a straight line within a candle. Attention was called to several descriptions of wicks for this purpose; they all act, however, on one principle, that of having a preponderance of strength on one side, which may be done in a great variety of ways. One of the most simple is the ruling of a line on one side with paste, which gives additional stiffness or strength to that one side, and such wicks in burning turn out of the flames. Following out this principle, the wicks may be modified to suit the various requirements of the different materials employed in candle-making, each of which requires a different character of wick. This was shown by several candles being burned, having wicks slightly differing from those which were best for each particular case, proving that great observation and skill are requisite in the manufacturer, in order to adjust the material and wick to each other in every case. Attention was also called to the fact, that, up to the present time, manufacturers have not been able to employ platted wicks in wax candles or tallow candles.

Ordinarily, in making mould candles, the wicks are placed by hand into the moulds, and the same are retained fast therein by pegs at one end and by wires at the other. A great improvement has been introduced into this part of the mechanical processes, by causing the candles, as they are discharged from the moulds, to draw fresh wicks into the moulds; and, on the candles being then cut off from the wicks, an instrument takes hold, simultaneously, of all the wicks, and retains them correctly in position in the several moulds.

About thirty years ago, a celebrated French chemist, (Chevreul,) when investigating the properties of fatty matters, discovered that they consisted of certain acids; and many efforts were made to introduce one of the acids (stearic acid) into the manufacture of candles, but with little if any practical effect, owing to its high crystallizing properties. In order to correct this properly, recourse was had to the use of arsenic, which was found to break up the crystals; and candles were extensively made and consumed, rivalling spermaceti in appearance, whilst they were sold at a much less price. But public attention having been called to the injurious effects produced by the vapors of arsenic thrown off by such candles, this greatly increasing manufacture met with a severe check; and, if the manufacturer had not discovered a means of employing stearic acid without arsenic in the manufacture of candles, the public would probably have ceased to purchase them. This, probably, is one of the most interesting events in the history of the manufacture. On investigation, it was discovered that the crystalline character found to prevail in stearic acid candles is consequent on the pouring very hot melted stearic acid into cold moulds; and it was found that by pouring the matter when nearly set into moulds warmed to about the same temperature as the candle stuff, and by using a small quantity of wax, candles of stearic acid can be made possessing very excellent properties. Hence, this class of candles has of late years very largely prevailed, which, being made with suitable platted wicks, like spermaceti candles, do not require to be snuffed.

Another class of candles, which came largely into use about the same time, was produced from the stearine of cocoa-nut oil; but this candle required snuffing. A great step of improvement in the manufacture of candles resulted from combining these two matters, viz., stearic acid of tallow with stearine of the cocoa-nut. It is found that stearic acid of tallow burns with a somewhat red flame and is liable to smoke; it contains too large a quantity of carbon; whilst the stearine of cocoa-nut oil contains too much hydrogen, and burns with a white flame. The effect of combining these two matters was to obtain a better flame than either, when used separately. The product is cheaper, and will also admit of the use of platted wicks; and the tendency of the stearic acid to crystallize is corrected by the employment of the stearine of the cocoa-nut.. These candles are known by the name of "composite," and have been sold in immense quantities.

Mr. Carpmael next called attention to the modern introduction of palm-oil in the manufacture of candles, the properties of which are peculiarly suited to candle-making. The *stearine* of it, even in its crude state, makes excellent "dip" candles, when the quality of the light only is considered; but they are of a bad color. The palm stearine also makes good lamp candles: but the great use of palm-oil as a candle stuff is when distilled for this purpose. The crude oil is first treated with acid to bring it into an acid state, and the same is then distilled by means of steam, which, in its passage from the boiler, passes through a series of pipes heated by a furnace, by which the steam becomes very highly heated, (600° Fahr.,) and in that state it enters into the still, and amongst and below the chemically prepared palm-oil, which is thereby caused to distil over, and is condensed in suitable apparatus; the product is pressed; and by these means a most beautiful material, closely resembling spermaceti, is obtained, and from which those modern manufactures of candles, now so largely and so well known as Belmont sperm and Belmont wax, are produced.

LIGHT FOR ILLUMINATION OBTAINED FROM THE BURNING OF HYDROGEN.

M. Gillard, of Paris, claims the production of a useful light and great heat from the combustion of hydrogen in contact with a coil of platinum wire — the hydrogen being produced by the decomposition of water. The apparatus employed is very simple, and consists essentially of one or more cylinders of iron arranged horizontally in a furnace, similar in all respects to the usual arrangement for the production of coal gas. The retorts are charged with wood-charcoal reduced to small fragments, of uniform size, and heated to an intense degree. Through each of the retorts steam is conducted in a tube pierced with numerous very minute holes, so disposed as to distribute the steam in a uniform and very gradual manner over the heated coal. The boiler for the production of the steam is conveniently situated in the same furnace employed for heating the retorts. Decomposition of water ensues of course, accompanied with the production of carbonic acid (CO^2), carbonic oxide (CO) in small quantity, of free hydrogen and a limited quantity of light carburetted hydrogen gas, (C^2H.) The mixture of these gases is conducted through a lime purifier to remove carbonic acid, and, without farther washing or purification, the product is ready for use. Consisting almost wholly of hydrogen gas, the flame of its combustion is of course very feebly luminous; to obviate this difficulty, it is burned in contact with a cage or net-work of platinum wire gauze surrounding an ordinary argand burner, protected by a glass chimney. This simple contrivance is perfectly successful, and the light given out from gas lamps of this construction is extremely vivid and constant.

This invention claims the following advantages in practice: 1. The gas so produced is cheaper than any other mode of artificial light, costing, as is asserted by M. Gillard, only about one sixteenth the average cost of coal gas. 2. The gas has no unpleasant odor, being entirely free from the volatile hydrocarbons which are so peculiarly offensive in oil and coal gas. 3. The products of its combustion are almost solely water, so little carbonic acid resulting in the combustion that practically it may be disregarded. 4. This mode of producing gas may be applied to any existing gas-works by a slight modification of the retorts, and without any essential change in other portions of the apparatus — the platinum cages being applied to the argand burners. 5. The cheapness of this mode enables us to apply it with great advantage as a fuel for cooking and for numerous purposes in the arts. For example, we saw, in the establishment of M. Christolef, the soldering of silver plate accomplished, in a rapid and remarkably neat manner, by a powerful jet of this gas, driven by a pneumatic apparatus. Its perfect manageableness, the ease with which an intense heat is applied locally and immediately when it is wanted, coupled with advantages of employing for such a purpose so powerful a deoxidizing agent as hydrogen, render this mode of soldering preferable to every other, and peculiarly suited for the process of autogenous soldering. 6. The nuisances resulting from the presence of large coal gas-works in populous districts are entirely avoided by this mode, which is as free from objection as a steam-engine. 7. The arrangements are so simple and inexpensive that every establishment, where it is desired to employ light and heat, may erect its own apparatus, even in the most isolated situation, all the materials employed being everywhere accessible.

We merely add that the result of M. Gillard's invention in one particular differs from the anticipation of chemists; that is, we should expect from the decomposition of water in this mode the production of carbonic oxide CO, carbonic acid CO^2, and light carburetted hydrogen C^2H, with a limited amount of free hydrogen. The result of his experience, however, seems to establish the statements already made. —*Communicated to Silliman's Journal, by Prof. B. Silliman, Jr.*

APPARATUS FOR THE EXPLOSION OF CARBURETTED HYDROGEN.

A LITTLE apparatus, constructed by Mr. Billows, has been exhibited at the London Polytechnic Institution, for the purpose of showing some curious phenomena characteristic of carburetted hydrogen. A file of 12 small glass tubes, about eight inches high and one quarter inch diameter, are placed in a plate of perforated zinc, and covered by a glass shade with an opening in the top; these tubes form so many open gas-burners, and, on turning the gas full on, burn steadily in the usual manner; but if the gas be lowered to such a point that sufficient hydrogen is allowed to enter the tubes, and, mixing with its atmospheric air within, form an explosive mixture, (which is about one of the former to eight of the latter,) a continuous series of explosions occur, and the burning gas is seen to descend in beautiful lambent green flames, sometimes tinged with red. As the gases get more heated, the explosions are louder, more frequent, and the colors more vivid, and the rapid and varied motion in all the tubes forms a very beautiful spectacle. Each may be considered a miniature representation of an explosion in a coal mine.—*Mining Journal.*

PERNICIOUS EFFECTS OF CARBONIC OXIDE.

Prof. Dumas, at the British Association, alluded to the great, and, indeed, almost unsuspected influence of carbonic oxide gas. The judicial investigations in France have disclosed the fatal effects of this gas as being much greater than carbonic acid gas. In the atmosphere produced by the burning of charcoal, one two-hundredth part of carbonic oxide was fatal, while with one third the volume of carbonic acid the animal was asphyxiated, but afterwards revived.

ON THE DETECTION OF SULPHUR.

Dr. Playfair's beautiful salt, the nitroprusside of soda, is justly recommended by its discoverer as the most delicate of all tests for alkaline sulphurets. Another application, which is very obvious, although not alluded to by Dr. Playfair, is to employ it not only as a direct test for alkaline sulphurets, but as an indirect one for sulphur in any of its compounds. Any substance containing sulphur will yield an alkaline sulphuret, if heated with carbonate of soda, either with or without the addition of carbonaceous matter, according as a deoxidizing action is required, or not. The magnificent purple which is then produced by the addition to the fused mass of a drop of the solution of the nitroprusside, will at once prove the presence of sulphur. This reaction is so easily obtained, and is so decisive, that the nitroprusside of soda must take its place among the most useful adjuncts of the blowpipe tests. By means of it the presence of sulphur in the smallest particles of coagulated albumen, horn, nails, feathers, mustard seed, &c., which can be conveniently supported on a platinum wire for blowpipe experiments, may be most distinctly shown ; and I have repeatedly obtained the characteristic purple tint in operating upon a piece of a single fibre of the human hair *less than one inch in length.* — *Prof. J. W. Bailey, Silliman's Journal.*

TEST FOR NITRIC ACID.

The following qualitative test for nitric acid is communicated to the Chemical Gazette, by James Higgins, Esq. : —

The methods in ordinary use of detecting nitric acid do not show very small quantities, and the liquid suspected to contain nitrates has generally to be concentrated before the presence of nitric acid can be ascertained. Being engaged lately in testing for nitrates in water, I employed the following method with perfect success : — It is founded on the immediate liberation of iodine from hydriodic acid by nitric acid, and its subsequent detection by starch. To insure accuracy, certain minutiæ have to be attended to ; and, these observed, the test becomes one of great delicacy. 1st. The solution of iodide of potassium must be very dilute, or iodine is liberated by sulphuric acid alone. 2d. The solution of iodide of potassium must not be added to the mixture of sulphuric acid and liquid till cold, or iodine is apt to be liberated without the presence of nitric acid. 3d. The proportion of sulphuric acid added to the suspected liquid must not be too great, or the most dilute solution of iodide of potassium gives iodine without nitric acid. 4th. As a solution of hydriodic acid, formed by the action of sulphuric acid upon iodide of potassium, is decomposed by the air in the course of an hour or two, and a blue formed with starch, unless a distinct color is produced in ten or fifteen minutes, it may be concluded that nitric acid is not present. I dissolve 25 grs. of iodide of potassium in 16 oz. of water for the test solution, which is too dilute to give iodine with sulphuric acid alone. To the suspected liquid, in a test tube, I add not more than one sixth of its bulk of concentrated sulphuric acid; heat nearly to boiling, and keep hot in the sand-bath for several minutes; cool the tube in cold water, and add a drop of starch-mucilage and a few drops of the test solution. If nitric acid is present, the liquid assumes a blue, very intense, with even one five-hundredth part of nitric acid. With one five-hundredth part by weight of NO^5, intense dark blue; one one-thousandth part of do. do., dark blue; with one five-thousandth part, do. do., dark blue; with one ten-thousandth part, do. do., paler blue; with one twelve-thousandth part, do. do., pale blue; with one sixteen-thousandth part, do. do., blue tint; with one eighteen-thousandth part, do. do., blue tinge; with one twenty-thousandth part, do. do., faint blue tinge, becoming decided in a few minutes.

It is remarkable that, even with the great excess of sulphuric acid present, the whole of the nitric acid is not liberated until after heating some time; thus, one sixteen-thousandth part required ten minutes heating before the test could indicate nitric acid; one eighteen-thousandth part I heated twenty minutes; and one twenty-thousandth part I found necessary to heat half an hour before testing. Probably, by observing the same method, the other tests for nitric acid, viz., protosulphate of iron, sulphate of indigo and gold-leaf, might become more delicate; but this I have not tried. Of course, some other acids would give the same results, as the chloric and chromic acids, &c.; but the absence of these is easily ascertained, and they seldom occur in analysis.

NEW TEST FOR THE NITRATES AND NITRITES.

At the American Association, New Haven, Mr. G. C. Schæffer furnished the following new test for the nitrates and nitrites: — To the solution supposed to contain a nitrite, add one or two drops of solution of yellow prussiate of potash; there should not be enough to give a perceptible tinge to the liquid. A few drops of acetic acid are then to be added, and immediately, or in a few minutes, according to the quantity of nitrite present, the liquid assumes a rich yellow tint; as the reägents used give nearly the same color spontaneously after some time even in pure water, it is better, when testing for minute quantities, to use two similar vessels, one containing pure water and the other the liquid under examination, to both of which the reägents are to be added in precisely equal quantities. The vessels should be equally exposed to the light with a sheet of white paper behind them. With these precautions, I have found this test astonishingly delicate, in fact ranking with those for iron, iodine, &c. Using fused nitre, I have detected the presence of 1 pt. in 617,000 pts. of water, a by-stander, wholly ignorant of the nature of the operation, pronouncing as to the color. Yet this salt contained about one half its weight of indecomposed nitrate. It should be remarked, that the presence of a large quantity of nitre has no influence upon this test, as with pure water it gives no color. The same reaction also answers for the hyponitrates. The next step is to convert this test into one for the nitrates. I find that nitrate of ammonia is readily decomposed in presence of metallic lead ; and, what seems surprising, nitrate of potassa is also decomposed, though not so readily. To test for the nitrates, we have only to agitate the slightly-warmed liquid for a few minutes with shavings of lead, and proceed as before. By a longer digestion, more of the salt would be converted into nitrate, and the color would be stronger. By using distilled water, I have been able to detect the presence of one part of nitre in about 60,000 of water, digesting with lead only a short time. Oxalic, tartaric and dilute hydrochloric acids may be substituted for the acetic, except when they produce precipitates, which would destroy the clearness of the liquid.

TEST FOR IODINE.

Lassaigne recommends chloride of palladium as a test for iodine. He states that two litres of water, containing two millionths of iodide of potassium, is still distinctly colored brown by chloride of palladium. After twenty-four to thirty-six hours, a floculent sediment of iodide of palladium was formed. If there be but a few flakes, a little fine silica is added after the water is poured off; the sediment is collected, dried, and then heated in a glass tube, which becomes filled with the vapors of iodine. — *Jour. de Phar.*

NEW METHOD OF TESTING OPIUM.

M. Desmedt proposes the following new process of testing opium. 60 grammes of raw opium are treated by 240 grammes of boiling alcohol at 71° C. It is decanted while hot, and the grounds put in the press after cooling ; the grounds are then treated in the same manner with 160 grammes of alcohol of the same degree ; these several alcohates are collected and hermetically sealed in phials, and left to deposit until the next day. A magnificent crystallization of narcotine is then found, which is separated from the alcoholic liquid. This liquid is put into a wide-mouthed phial, and four grammes of ammonia are added ; a considerable quantity of pure morphine will be thus obtained, which is to be separated from the liquor. This done, a small quantity of distilled water is added to the alcoholic liquor, keeping the phial at a temperature of 75° Fah. for two days. After this time a fresh quantity of morphine will be observed, less pure than the first, but free from narcotine. By the process of the exhaustion of opium by alcohol, the authors have obtained five grammes of morphine from 60 grammes of opium employed. — *Journal de Chemie*, 1851.

TEST FOR THE SOLUBLE CONSTITUENTS OF GUMS.

The so-called gums are complex natural products. In certain kinds two substances have been distinguished — the one arabine, soluble in cold water; the other cerasine, insoluble therein. The former constitutes the greater portion of the gum-Arabic and Senegal gum, whilst the latter predominates in cherry-gum and gum-tragacanth. For such gums as consist entirely or partially of arabine, Lassaigne recommends the persulphate of iron and tribasic acetate of lead as tests. The sulphate of iron precipitates the gum even from solutions of sugar, which has no influence upon the precipitate. This is yellowish, gelatinous and transparent. This result deserves especial attention, as there are other substances soluble in water, which are precipitated by alcohol and basic acetate of lead, but upon which the sulphate of iron has no influence. The precipitate produced by the lead salt and alcohol is liable to be confounded with dextrine, and other gum-like substances, which so frequently occur among vegetable products; the salt of iron distinguishes arabine from these decidedly. The soluble portion of gum-tragacanth, which is regarded as isomeric with arabine, is precipitated like arabine, by the sulphate of iron; but the precipitate by tribasic acetate of lead is white, floculent, opaque and caseous, whilst the gum extracted from tragacanth with cold water furnishes a transparent gelatinous precipitate, with basic acetate of lead. In syrup mixed with gum-Arabic the gum can be detected by sulphate of iron in the portion precipitated by alcohol. Dextrine, the gummy constituent which alcohol throws down from commercial starch-syrup, does not furnish with sulphate of iron a precipitate like arabine, so that an admixture of gum is easily detected. — *Lassaigne, Jour. de Chim. Med.*

ON SOME DISTINGUISHING REACTIONS OF ARSENICAL AND ANTIMONIAL SPOTS.

If a drop of bromine is placed on a saucer, and a capsule containing arsenical spots inverted over it, the spots take a very bright lemon-yellow tinge in a short time. Antimonial spots, under the same circumstances, are acted upon much more rapidly, (in about five seconds, at a temperature of 52° Fah.,) and assume an orange shade. Both become colorless if exposed to the air, and are again restored if treated with a strong solution of sulphureted hydrogen. The secondary yellow of the arsenical spots, as observed by Lassaigne, disappears on the addition of ammonia, whilst that of antimonial spots remains untouched. A concentrated solution of iodate of potassa turns arsenical spots of a cinnamon-red, and dissolves them almost immediately. On antimonial spots it has no visible effect within three or four hours. Solutions of the hypochlorites of soda and lime, and fresh chlorine water, dissolve arsenical spots instantaneously, leaving those of antimony. A concentrated solution of chlorate of potassa gradually acts upon arsenical spots, but not upon those of antimony. The nitro-prusside of potassium, on the other hand, slowly dissolves antimony, producing no perceptible effect on arsenic. — *J. W. Slater, Chem. Gaz., No.* 199.

EXISTENCE OF ARSENIC IN PLANTS.

M. Stein has estimated the small quantities of arsenic contained in various vegetable substances. He has made the following determinations: — 10,000 parts of old linen gave 0.11 of arsenic; 10,000 parts of rye straw, gathered in the vicinity of lead smelting works, contained 0.009 of arsenic, and 0.4 of metallic lead; 10,000 parts of cow-dung yielded 3,000 of arsenic. The arsenic was sought for in the ashes of these substances. — *Jour. Pract. Chemie.*

ON THE PRESENCE OF MINERAL POISONS IN THE NERVOUS SYSTEM AFTER DEATH BY ACUTE POISONING.

Dr. Roucher, of Strasbourg, has undertaken a series of experiments, by administering arsenic, lead, copper, and mercury to dogs, with a view of ascertaining if these poisons can, in reality, be detected in the cerebrum and spinal cord.

Arsenic was twice found in the substance of the brain; mercury was found in each instance of three experiments of poisoning by mercury. Copper was found in five instances out of six of poisoning by the sulphate. In three cases the proportion of the oxide varied from three to six thousandths. The brain of dogs, not poisoned, yielded scarcely an appreciable quantity. Lead was extracted, in the proportion of eighteen thousandths, from the brain of a dog, which died, at the end of three days, from acetate of lead. These facts induce the author to think that mineral as well as organic poisons exert a direct influence upon the nervous centres. — *Comptes Rendus.*

PRESENCE OF LEAD IN THE BRAIN AND LIVER.

M. Chatin and Bouvier, of France, being desirous of arriving at an opinion on this still controverted point of medical science, have instituted minute examinations of the brain and liver of a man, who had died by means of lead poisoning, from working in a white-lead factory. From these experiments it resulted that the brain, and especially the liver, contained lead. The process followed in the examination was that recommended by Orfila for detecting lead in cases of poisoning, to the exclusion of normal lead. — *Jour. de Chemie, Feb.*

ACTION OF WATER ON LEAD.

Mr. Noad, of London, in a recent communication to the Patent Journal, furnishes an instance in which a water, containing a large quantity of those salts which are generally supposed to exert a preservative action on lead, (earthy and alkaline sulphates and chlorides,) corroded a leaden cistern with remarkable energy. In the course of six months, holes were eaten through it, and the oxide of lead could be skimmed from the surface of the water in abundance. On testing the water beneath, taking care to avoid filtering, by which a very considerable quantity of the metal, even when in solution, may be removed, no signs of lead could be detected. This remarkable action Mr. Noad ascribes to the presence of an unusually large quantity of organic matter contained in the water.

Dr. Nevins, of Liverpool, in a recent publication, shows, from investigations, that, whilst hard waters of a certain kind exercise a protecting influence on lead, there are others which act energetically upon this metal. The conclusions at which he has arrived, from numerous experiments, are as follows :— Hard waters do not protect lead, simply from the fact of their being hard ; but this protection, when effected, is dependent, not only upon the nature of the salt causing the hardness, but also upon the proportion present; for, whilst all experience proves that a small amount of sulphate, at any rate of sulphate of lime, does protect the lead, a large quantity of sulphate of magnesia acted considerably upon it. It appears to be proved, also, that chlorides act upon lead, either with or without the presence of a sulphate ; but their action is not so great as that of soluble carbonates. These results do not practically affect the question of the safety of using lead for common waters, so far as sulphates are concerned, as the experience of years proves that no bad consequences result from the employment of lead for water containing sulphates.

ON THE ALTERATION WHICH WELL-WATER UNDERGOES.

The following results have been arrived at by M. Blondeau, from the examination of the water of a great number of wells :—

1. Well-water may be altered by two causes : by the presence of mineral salts held in solution, and by that of animal matters. 2. The mineral substances which occur in solution are, silica, alumina, carbonates and phosphates of lime and magnesia, potash, alum, chlorides of calcium, magnesium and sodium, with nitrates of the same bases. These different substances are not hurtful to the animal economy when they exist only in small quantity. Well-water, of which a litre contains only four to five centigrammes of these substances in solution, may be employed for all domestic uses, provided it does not contain too large a proportion of animal matter. 3. Water, of which a litre contains one gramme of the above-mentioned substances, may still be good for drinking, but it is not fit for cooking vegetables, or washing linen, when it contains 0.1 gramme of lime or magnesia. 4. Water, of which a litre contains 0.1 gramme of lime or of magnesia, and 0.1 gramme of organic matter, is improper for any domestic use. 5. It is of the utmost importance to state the existence and determine the quantity of animal matter held in solution in waters ; for, if they exceed the limits above stated, they act disastrously on the economy, and may occasion dysentery and various maladies which appear to be contagious, because the whole population acquire the seeds at the same sources. 6. The presence of magnesia in drinkable waters does not produce so hurtful an action as supposed by some persons. Waters containing on an average five times as much magnesia as the waters of the valley of the Iser, in Switzerland, are used in many places, and yet endemic diseases, as goitre and cretinism, are not known to exist in the same local-

ities. 7. The water of certain wells possesses a very disagreeable earthy taste. This taste is derived from alumina, held in solution by carbonic acid. It is observed that those well-waters which contain most of this base have the strongest earthy flavor. 8. It results from these experiments that a classification of drinkable waters, based on the relations which exist between the sulphates and the chlorides, must be a defective one ; for this relation varies with respect to the same kind of water within limits of considerable extent, and it is never certain that the water operated on has not met in its course, either above or below the soil, with substances which have altered and changed the proportions in which these salts enter into its composition. — *L'Institut.*, *No.* 851.

QUANTITATIVE SEPARATION OF POTASH AND SODA.

Rose has found that the fluo-silicates of potassium and sodium are wholly insoluble in a liquid containing alcohol. When fluo-silicic acid in excess is poured into a solution of a potash or soda salt, and a volume of strong alcohol, equal to that of the whole liquid, is added, the whole of the potash or soda present is precipitated in the form of a fluo-silicate, which is to be washed with strong alcohol, diluted with an equal volume of water. Baryta may be separated from its solutions in a similar manner ; a very small proportion of alcohol, however, suffices for its complete precipitation.

QUANTITATIVE SEPARATION AND DETERMINATION OF PHOSPHORIC ACID.

Reynoso has proposed a method of separating phosphoric acid quantitatively, based upon the fact that phosphate of peroxide of tin is insoluble in nitric acid, while other phosphates are soluble. A weighed portion of pure tin is to be introduced into a vessel with the phosphate, nitric acid added in excess, and the whole boiled. When the whole of the tin has been oxidized the mass is to be thrown upon a filter, washed, dried, heated to redness over a spirit lamp, and weighed. The difference between this weight and the weight of peroxide of tin yielded by the tin employed, gives the weight of the phosphoric acid. The filter must be carefully burned ; a few drops of nitric acid being added to prevent reduction. The flame of the lamp must also be carefully managed, so as not to mount too high ; and, finally, the mass must be rapidly weighed, as it is very hygroscopic. The process gave good results when applied to the analysis of pyrophosphate of soda, the only compound which Reynoso appears to have examined. — *Comptes Rendus*, 33, 358.

VOLATILITY OF PHOSPHORIC ACID IN ACID SOLUTIONS.

Mr. J. B. Bunce, of New Haven, publishes, in Silliman's Journal, the results of some experiments, made to ascertain the extent of loss experienced in analysis in consequence of the volatility of phosphoric acid. .554 grammes of phosphate of soda were dissolved in a gill of water ; hydrochloric acid was then added, and the whole evaporated in a water-bath to dryness, being afterwards heated gently to drive off any excess of acid. The residue was treated with strong sulphuric acid, and allowed to stand several hours in order to convert the pyrophosphate of soda into the ordinary tribasic salt. It was then carefully diluted, neutralized by ammonia, and precipitated as ammonio phosphate of magnesia; the weight of the salt after ignition was .0701 grammes, equal to .045 of phosphoric acid. The consequent loss of phosphoric acid in this experiment was 58.66 per cent. Another experiment, in which the chlorine, instead of the phosphoric acid, was determined, gives as the loss of acid 53.36 per cent. .2 grammes of phosphate of magnesia and ammonia were next taken, dissolved in hydrochloric acid, diluted until about a gill of fluid was obtained, and the whole was then evaporated as before. After precipitation and ignition, the residue weighed .1315, corresponding to 41.69 per cent. of phosphoric acid. The percentage of phosphoric acid in the ammonio-phosphate of magnesia, as determined by ignition, was 48.37 per cent. Consequent loss of phosphoric acid, 6.67 per cent. Another experiment, conducted in the same manner, with the exception that the pyrophosphate of magnesia was converted into the tribasic condition, by fusion with carbonate of soda, gave 8.35 per cent. as the loss. The loss of phosphoric acid, when the solution was acidified with sulphuric acid instead of hydrochloric acid, was greater, probably owing to the higher degree of heat required to volatize that acid. There was no perceptible difference between the action of hydrochloric and nitric acids. Phosphate of soda was completely converted into the sulphate of the same by three evaporations with sulphuric acid and water. Phosphates of alumina, iron, lime, and magnesia, were not perfectly converted into sulphates, even by a dozen successive evaporations. Phosphoric acid does not seem to be more volatile in the vapor of alcohol than in that of water. These experiments serve to show that the ordinary methods of analysis are not applicable to the analysis of phosphates, which must be dissolved in acid by the aid of heat. In the ordinary evaporations to separate silica by rendering it insoluble, a very considerable loss of this acid is occasioned. The estimated quantity of phosphoric acid in ashes, &c., must probably, in many cases, be much too low, owing to this loss from volatilization; and we may believe that, for this reason, many analyses must be regarded as almost valueless, with respect to the amount of phosphoric acid which they indicate.

NEW ALLOTROPIC MODIFICATION OF PHOSPHORUS.

SCHROTTER has demonstrated that the change of color produced in phosphorus by the action of light is independent of the presence of oxygen; that it occurs even when the phosphorus is surrounded with an atmosphere of pure dry hydrogen, carbonic acid, or nitrogen; and that it is due simply to the passage of the element into an allotropic state or form. Precisely the same change was produced by exposing phosphorus for some time to a temperature of 226° C.; the mass assumed a fine red color, and became gradually less fluid, darker, and finally perfectly opaque. The precise temperature at which the change takes place, could not be determined, inasmuch as a less degree of heat produces in a longer the same effect which a higher temperature produces in a shorter time. The joint action of heat and light was also found more efficacious than either of these agents separately. The author compares the two allotropic modifications of phosphorus with those of carbon; the diamond, when strongly heated, passing into an amorphous state and becoming black and opaque. Amorphous phosphorus is most readily prepared by exposing common phosphorus to the action of heat or light, and then dissolving out the unchanged substance by means of bisulphide of carbon and filtering, taking care to keep the filter full of liquid till a portion of the filtrate evaporated on a strip of platinum no longer leaves a trace of phosphorus. The substance on the filter is to be boiled with a solution of caustic potash, of density 1.30, and washed first with pure water, then with very dilute nitric acid, and finally again with pure water. The new modification of phosphorus is an amorphous powder, without lustre, and of a color which varies from scarlet red to dark carmine red, but which may become dark brown or brownish black; when washed, it becomes violet, recovering its original color when cold. Its density, at 10° C., is 1.964. Amorphous phosphorus is insoluble in bisulphide of carbon, alcohol, ether, naphtha and perchloride of phosphorus; boiling oil of turpentine takes up a small quantity of it; in the air it remains entirely unchanged. It is not luminous in the dark at ordinary temperatures, but becomes slightly so near the temperature at which it ignites. Schrotter considers it probable that the black phosphorus of Thenard is the same allotropic modification with that which he has described. Nitric acid readily oxidizes amorphous phosphorus, the increased surface of the latter forming many points of attack. Finally, neither copper nor other metallic substances are precipitated from their solutions by amorphous phosphorus. The author recommends this substance, in an economical point of view, for the preparation of friction matches and percussion caps, as it possesses over ordinary phosphorus the great advantages that it is neither affected by the moisture of the atmosphere, nor injurious to the health of the workmen. In a second paper the author fully confirms the results which he had previously attained, and adds, among other interesting facts, the remarkable one, that common phosphorus is capable of decomposing water at a temperature between 250° C. and 260° C. It should have been stated above that the amorphous modification of phosphorus is reconverted into common or crystallizable phosphorus when heated above its boiling point in an atmosphere of hydrogen or nitrogen. — *Pogg. Am.*, 1850, *No.* 10.

PHOSPHURET OF TUNGSTEN.

Wöhler has described a remarkable compound of tungsten with phosphorus, prepared and analyzed in his laboratory by Wright. Impure phosphoric acid, containing lime, is to be mixed in coarse powder with tungstic acid, in the proportion of nine of phosphoric to two of tungstic acid, and the mixture is to be ignited in a charcoal crucible for an hour, at a temperature at which metallic nickel becomes perfectly fused. On cooling, the crucible is found to contain a hollow mass of gray phosphuret of tungsten, lined upon the inside with the most brilliant crystals. These crystals have a dark steel color, with a remarkably brilliant metallic lustre; they are six-sided prisms, apparently of the same form as gypsum; their density is 5.207; they are perfect conductors of the electric current. In contact with zinc, in dilute acid, they evolve hydrogen, and in a solution of a salt of copper, they become covered with metallic copper. The phosphuret is unchanged at the temperature in which manganese fuses; heated to redness in the air, it undergoes scarcely any change; heated upon charcoal in a current of oxygen, it burns with great brilliancy, yielding a deep blue sublimate upon the coal. In the same manner it burns with fused chlorate of potash; acids exert no action upon it. Wright found the constitution of this compound to correspond with the formula $P\,W^4$. — *Ann. de Chemie und Phar.*

SULPHIDE OF NITROGEN.

Fordos and Gélis have published an elaborate investigation of the sulphide of nitrogen, obtained by the action of ammonia upon perchloride of sulphur, and concerning the constitution of which there has been much doubt hitherto. The authors prepare the substance in question by passing ammonia into a solution of perchloride of sulphur, in eight or ten times its volume of bisulphide of carbon. In this process sal-ammoniac is first deposited; then a cochineal-red compound, partly soluble in the liquid, but soon disappearing to give place to a brown matter, which, in its turn, disappears. When this happens the process is finished. The liquid is now to be filtered and allowed to evaporate spontaneously, when the sulphide of nitrogen crystallizes. The mother liquor contains sulphur; the mass on the filter is a mixture of sal-ammoniac and sulphide of nitrogen, which may be separated by treatment with boiling bisulphide of carbon. Sulphide of nitrogen, thus prepared, presents transparent crystals of a beautiful golden yellow; the crystals, according to Nicklès, belong to the right rhombic system. The powder of the sulphide of nitrogen has a brilliant yellow color; when rubbed or struck with a hard body, it explodes with great violence; brought into contact with an ignited body, it fuses without explosion; heated in an oil bath to 157° C., the sulphide explodes, yielding nitrogen and the vapor of sulphur. Sulphide of nitrogen has little or no odor, but it strongly irritates the mucus membranes, when brought into contact with them. In water it is insoluble; alcohol, ether and turpentine dissolve small portions of it; bisulphide of carbon is its best solvent. The composition of the sulphide of nitrogen was found to be expressed by the formula $N\,S^2$. Boiling water decomposes the bisulphide of nitrogen; the reaction is expressed by the equation

$$4NS^2 + 15HO = S^2O^2, NH^4O + 2\,(S^3O^5, NH^4O) + NH^3.$$

Caustic potash in like manner produces decomposition; the final products of action are expressed by the equation

$$2NS^2 + 3KO + 6HO = S^2O^2, KO + 2SO^2KO + 2NH^3.$$

The bisulphide of nitrogen unites directly with the two chlorides of sulphur, and forms with each several distinct compounds. The authors assign to three of these combinations the formulas $Cl S + N S^2$, $Cl S + 2 N S^2$, $Cl S + 3 N S^2$.— *Ann. de Chemie et de Physique*, xxxii. 389.

DETONATING SUGAR.

At a meeting of the Academy of Turin, 1850, Prof. Sobrero announced his discovery of a detonating sugar, obtained from that material, by means similar to the mode of preparing gun-cotton. Take powdered loaf-sugar and pour on it a mixture of two volumes of sulphuric acid (at Baruné 66) and one volume of nitric acid (at 43). Immediately the sugar is converted into a tenacious viscid substance, which is only partially dissoluble in the acids employed. On adding a large quantity of water (about twenty times that of the acids employed) the sugar is converted into a material with the following properties. It is very white, diffusible in the acid mixture, and absolutely insoluble in water, but very soluble in alcohol and sulphuric ether. When subject to a moderate heat, it melts and is decomposed without detonation; but if suddenly heated to redness, it explodes like gunpowder, producing gaseous emanations in which it is not difficult to recognize the nitrous vapor and that of cyanogen. By the blow of a hammer it also explodes, but feebly. The composition of this fulminating sugar it will not be difficult to determine — more easily than that of gun-cotton — from its more slow decomposition under a graduated heat, when it may be exposed to the action of oxide of copper.

ON A MODIFICATION OF THE METHOD OF PREPARING BUTTER.

If butter contained only the fatty parts of milk, it would undergo only very slow alteration in contact with the air. But it retains a certain quantity of caseum, which exists in the cream; this caseum is converted into a ferment, and this gives rise to butryric acid, to which the disagreeable taste of rancid butter is owing. The washings which butter is made to undergo can only imperfectly free it from this cause of alteration, for the water does not moisten the butter, and cannot dissolve the caseum, rendered insoluble under the influence of the acids which are developed in cream. A more complete purification may be arrived at by saturating these acids; the caseum would then again become soluble, and, consequently, the butter would retain only very small quantities, which would be removed almost entirely by washing.

The following method of proceeding is proposed by M. Chalambel: when the cream has been placed in the churn, pour in, by small portions at a time, and agitating the while, a sufficient quantity of milk of lime to entirely destroy the acidity; churn the cream until the butter is separated; it must not be expected that it will collect in lumps, as it generally does; decant the butter-milk, and continue to churn until it is sufficiently collected. By this method better products may be obtained, capable of being preserved for a longer time, than those obtained by the common processes. Butter, which has become rancid, may often be restored by washing in lime-water. The lime-water may be replaced by any other alkaline ley.—*Comptes Rendus.*

ON THE NATURE OF ALIMENTS.

At the American Association, Cincinnati, the following communication was presented from Dr. Emmons, of Albany, on the nature of Aliments: —

The popular doctrine of the day is, that these bodies sustain or nourish the animal system, in a ratio proportionate to the amount of nitrogen they contain; and that their value as nutrients may be expressed by numbers. This view of the subject, however, I have never been able to understand, and have never adopted it; for it appears to me that there are other bodies in combination, in all these nutrients, which are equally important with nitrogen, and which minister also to the support of the animal system. I shall not attempt to state in detail the objections to the doctrine that the value of nutrients is determined by the amount of nitrogen which they contain. I am satisfied with saying now, that the inorganic bodies, the salts of lime, (particularly the phosphates of that, as well as the other combinations of phosphoric acid,) must be of equal value with the nitrogenous compounds. In the analysis of many vegetable bodies, including the cryptogami, these inorganic bodies are invariably present. They are important, then, in the lowest as well as the highest forms of vegetable life, and more abundant in the class of nutrients than in those which are not reckoned as such.

But there is still another class of bodies, which are neither poisons nor aliments — indeed, seem to be far removed from both of these classes of bodies — and yet their influence is salutary upon the system, especially if taken with the nutrients proper. In combination with the nutrients or aliments, the amount of the latter need not be so large, in order to perform a specific amount of work. These bodies may include the milder class of astringents, or I may say, more correctly, that they are allied to them. In recoveries from sickness, when the system is reduced, those mild medicines which are denominated tonics, sustain the body more than can be accounted for by the common hypotheses which have been invented to explain their effects. Perhaps one of the most common bodies in use will illustrate more perfectly my views. Tea, for example, is often used in large quantities. Individuals who become accustomed to this beverage take comparatively little food, and yet perform as large an amount of work as if they had taken a full ration of nutrient proper. Opium-eaters consume but little food. Inebriates take but little food for weeks, and sometimes perform considerable work. Now, in order to obtain data upon which it will be safe to found correct views of the office of food and beverages, as well as some of the milder forms of medicines called tonics, it will be necessary to collect a larger stock of facts, and institute many additional experiments. Those inquiries should be made which have reference to the *eremacausis* which the system suffers under exercise and work, whether mental or physical — the direct influence, too, of the bodies which are called aliments or nutrients, in repairing the waste of the system; or, whether it is absolutely true that the system undergoes eremacausis necessarily in labor, mental or physical. So inquiries may be directed to a supposed class of bodies, which do not furnish nutrient matter, and yet do something in its place. Do they prevent waste, or, in other words, save it from waste? If so, may they be denominated *soterifics*, a word coined from the Greek *savior*. Probably there are many persons who would object to the word *saviors*, when applied to *tea*, *coffee*, *porter*, *spirits*, *opium*, etc.; still science must make her inquiries without prejudice, and if there is a class of bodies which save the system from waste, they may well be denominated, for aught I see, *saviors*. We have, without doubt, calorifics, purely so; and it is a class of bodies essential to the system, though by no means nutrients, in any sense of the word. We often see the system waste rapidly in *diabetis*, and observation supplies us with strong facts, which go to show that the system is sustained with a small amount only of the nutrients, and is capable of performing a larger amount of work, when aided in some way or other by certain beverages.

ON THE EXHALATION OF CARBONIC ACID.

The following is a summary of Scharling's important experiments on the exhalation of carbonic acid: — The carbonic acid was estimated by a very perfectly contrived apparatus. A man of thirty years old was found to exhale, when remaining quiet, 12.06 grammes of carbon per hour. The same man, wielding violently a heavy iron rod, perspiring profusely, exhaled as much as 42.2 grammes of carbon per hour. An immense increased development of carbonic acid occurs, therefore, during exercise. In two experiments with tipplers, who had taken brandy just before, the quantity of carbon was 7.045 and 10.83 grammes. In the last case, however, the individual was in exercise. Scharling also found (with Dulong and others) a greater consumption of oxygen than was accounted for by the carbonic acid, viz., over a fourth part. — *Caustatt's Jahres-Bericht.*

COOKED AND UNCOOKED FOOD.

In a communication from the society of Shakers, at Lebanon, N. Y., in the Patent Office Report, we find the following upon the relative value of ground and unground, cooked and uncooked, corn for feeding cattle, &c. "The experience of more than thirty years leads us to estimate *ground corn* at one third higher than *unground*, as food for cattle, and especially for fatting pork; hence, it has been the practice of our society for more than a quarter of a century to grind all our provender. The same experience induces us to put a higher value on cooked than upon raw meal, and for fatting animals, swine particularly, we consider three of cooked equal to four bushels of raw meal. Until within the last three or four years, our society fattened annually, for thirty years, from 40,000 to 50,000 pounds of pork, exclusive of lard and offal fat, and it is the constant practice to cook the meal, for which purpose six or seven potash kettles are used."

ON THE EXISTENCE OF ORGANIC MATTER IN STALACTITES AND STALAGMITES, FORMING CRYSTALLIZED AND AMORPHOUS CRENATE OF LIME.

The following paper was read at the American Association, Albany, by Mr. David A. Wells, of Cambridge: —

In the eighth chapter of Liebig's Agricultural Chemistry, edited by Playfair, there is given the result of some examinations of stalactites from caverns in Germany, and from the vaults of old castles upon the Rhine, made with the view of ascertaining the fact of the presence or absence of organic matter in these bodies, either combined or uncombined.

The result may be stated in the words of the author, Prof. Liebig. The stalactites from the caverns "contain no trace of vegetable matter, and no humic acid, and may be heated to redness without becoming black." In the stalactites from the vaults and cellars of old castles, he says, "we could not detect the smallest traces" of humic acid. "There could scarcely be found a more clear and convincing proof of the absence of the humic acid of chemists in common vegetable mould." Under the term humic acid, Prof. Liebig undoubtedly means to include all those organic acids arising from the decomposition of vegetable matter, and which have received the names of crenic, apocrenic, geic and humic acids.

Having been informed by Dr. A. A. Hayes, of Boston, that he had, in numerous examinations, arrived at results directly opposed to those of Prof. Liebig, I was induced, at his suggestion, to make an examination of a large number of stalactites and stalagmites obtained from various localities, with reference, solely, to the presence or absence of organic matter in these bodies.

The specimens examined were all from caverns, or rock formations, and were obtained from various parts of the United States; from Trieste in Austria, Malta, and the Sandwich Islands. In color, they varied from an almost pure white, to red, yellow and brown, of different shades; and in crystalline character, from a structure resembling arragonite, to a variety entirely wanting in symmetrical arrangement, or a mere incrustation. The specimens were dissolved in dilute hydrochloric acid, the flocculent matter separated, collected and washed, boiled in caustic potassa, carbonate of ammonia or carbonate of soda, and then tested in the usual way for crenic and apocrenic acids by acetate of copper and carbonate of ammonia. In all the varieties, with one exception, abundant flocculent organic matter was separated, which, on testing, gave evidence of crenic acid in considerable quantities, with doubtful traces of apocrenic acid. The exception alluded to was the specimen examined from Trieste, which did not afford any absorbable flocculent matter on dissolving in acid. The greatest quantity of organic matter was found in stalactites of a deep yellow color, highly crystalline and uniform in character, and in the portions examined perfectly homogeneous and free from layers, or intervening bands indicating different periods and changes in deposition. As the presence of iron could not be found in the acid solution, it is inferred that the color of these yellow stalactites must be owing, in great part, to combined organic matter, existing as crenate of lime. In specimens like the spar ornaments from the Rock of Gibraltar, with which all are familiar, the coloring and delicate shading are also probably due to organic matter.

Dr. Hayes informs me that he has also found organic matter in arragonite in sufficient quantity to separate in flakes, while the specimen was dissolving in acid.

From these statements it must, I think, be inferred, contrary to the view of Liebig, that organic matter does exist in stalactites generally, as an acid combined with the lime, and imparting to them their various colors. I would by no means call in question the accuracy of the experiments of Prof. Liebig, further than that as far as my observations extend, crenic acid in the presence of lime, and combined with it, passes over like oxalates, upon heating, into carbonates, without perceptible blackening.

It may here be added that Prof. Johnston, of England, describes a compound of alumina with crenic acid, occurring in caves of granite upon the coast of Cornwall. This mineral has received the name of Pigotite, and is observed in places where the surface water trickles down over the granite rocks. From this it may not be inappropriate to apply the term *Crenite* to those lime formations in which crenic acid occurs in considerable quantities.

Results similar to those announced above have been obtained by Dr. C. T. Jackson, as well as by Dr. Hayes, of Boston. Dr. J. Lawrence Smith informs me that he has frequently met with crenic acid in lime concretions from Asia Minor, and its existence in stalactites was also announced by Dr. Emmons, of Albany, some years since. My results can therefore be considered but as the verification of those obtained by others.

GYPSUM AS A MANURE.

M. Mene recently read a communication before the French Academy, on the results of certain experiments made by him with a view of ascertaining the part which gypsum plays in vegetation. Seed sown in pure gypsum, and watered every day with pure water, germinated after a few weeks, as in the ordinary soil; but the progress of the growth of the plants was not in correspondence with the commencement, for they gradually decayed, and, in fifteen days after their flowering, completely withered. In a mixture of equal parts of gypsum and marl, the seed germinated better than in gypsum alone, but always less favorably than in ordinary soil. Seed thrown on manure covered with gypsum, not only germinated rapidly, but the plants obtained a most extraordinary development and vigor. A few drops of acid accidentally thrown on the gypsum covering the manure gave rise to an effervescence, which furnished M. Méne with an explanation of what was passing before him. The carbonate of ammonia produced in the layers of dung, volatilized by the action of the sun, became decomposed in its passage through the gypsum, forming carbonate of lime and sulphate of ammonia.

Several experiments proved to M. Méne, that the results were obtained by these means, and, having watered some flower-pots containing dung, in which some grass-seed was sown, with sulphuric acid, sulphate of potassa, hydrochloric acid, chloride of manganese, nitric acid, phosphate of soda, acetic acid, sulphate of magnesia, sulphate of iron, and nitrate of soda, he found the grass developed rapidly, and that fixed ammoniacal salts ran off through the bottom of the flower-pots in which the experiments were made. Gypsum, therefore, has not of itself any fertilizing quality; it only acquires a fertilizing property when it comes in contact with those ammoniacal salts which it is capable of decomposing. It would appear from this that sulphate of lime might be replaced by any other salt possessing the property of retaining ammonia in a fixed state at ordinary temperatures.

MINERAL THEORY OF BARON LIEBEG IN RELATION TO AGRICULTURE.

At the British Association Messrs. Lawes and Gilbert presented the results of an extensive series of experiments on the growth of the principal crops entering into a rotation, as well as on the chemistry of plants in relation to the soil and atmosphere; all of which experiments they consider conclusive against the "Mineral Theory" of Liebeg, which asserts that the crops of a farm rise or fall according to the supply within the soil of the mineral constituents indicated by the analysis of the ashes of the plants. The results selected in justification and illustration of their views, were those of the field experiments on wheat, grown continuously, on a previously exhausted soil, for the last eight years, and in each season, by means of many chemical manures, by the side always of one or more plots unmanured, and one manured continuously by farm-yard manure. From this it appeared that mineral manures had scarcely increased the produce at all when used alone, whilst the effects of ammoniacal salts were very marked, even when repeated year after year on the same space of ground from which the entire crop, corn and straw, had been removed. Indeed, in this way, a produce had been attained, even in the sixth and seventh succeeding years of the experiment, exceeding by nearly two thirds that from the unmanured plot. It was then shown that the mineral constituents of the soil continued to be in excess, relatively to the nitrogen available for them from natural sources. The history of several plots was then traced down to the last harvest, (1850,) and it was agreed that the statement assailed by Liebig, viz., that ammonia was specially adapted as a manure for wheat, was fully borne out when speaking of agriculture as generally practised in Great Britain. In other words, that in practice it was the defect of nitrogen rather than of the mineral constituents that fixed the limit to our produce of corn. The authors next called attention to the fact of the exhalation of nitrogen by growing plants, as proved by the experiments of De

Saussure, Daubeny and Draper, and they referred to some experiments of their own, with the view of showing the probability that there is more of the nitrogen derived from manure given off during the growth of cereal grains than by leguminous and other crops ; and hence might be explained the great demand upon nitrogenous manures observed in the growth of grain. The authors suggested that here was an important field of study, and that we have, in the facts alluded to, much that should lead us to suppose that the success of a rotation of crops depends on the degree in which the restoration of the balance of the organic constituents of crops was attained by its means, rather than on that of their mineral constituents, according to the theory of Liebig; whilst the means adopted to secure the former were always attended with a sufficient supply of the latter. It was next shown, by reference to what happens in actual practice as generally followed in Great Britain, where corn and meat constitute almost the exclusive exports of the farm, that the mineral constituents of the crops, taken collectively, that is, as shown by the analysis of their ashes, could not be considered as exhausted ; of these, however, phosphoric acid was lost to the farm, in much larger proportion than the alkalies; whilst the latter would generally, by the combined agencies of disintegration of the native soil and import in cattle food, be liable to diminution in but a very insignificant degree, if not in some cases to accumulation. Practical agriculture had, indeed, decided that phosphoric acid must be returned to the land from sources external to the farm itself, viz., by bones, guano, or other means. But, on the other hand, artificial alkaline manures had generally been found to fail in effect. Indeed, taking into careful consideration the tendency of all experience in practical agriculture, as well as the collective results of a most laborious experimental investigation of the subject, both in the field and in the laboratory, it was the authors' deliberate opinion that the analysis of the crops is no direct guide whatever as to the nature of the manure required to be provided in the ordinary course of agriculture from sources extraneous to the home manures of the farm — that is to say, by artificial manures. Reviewing, then, the actual facts of practical agriculture, the authors could not agree with Baron Liebig, when he asserted that our grand object should be to attain an artificial mixture to substitute for farm-yard manure, which he admitted to be the universal food of plants. The very practice of agriculture itself, as followed in this country, necessitates the production of farm-yard manure, and all our calculations should be made on the supposition of its use.

FERTILITY OF NILE MUD.

Ehrenberg, as the result of a careful microscopic examination of the alluvial deposits of the Nile, has determined that the great fertility of these depositions is not so much owing to any peculiar mineral constitution, or to the presence of any great abundance of vegetable matter, as it is to the vast accumulation of extremely minute forms of microscopic animals, which, by their decomposition, enriched and fertilized the soil. — *London Athenæum.*

PEAT AND MUCK.

The following remarks, by Prof. J. P. Norton, of New Haven, are taken from the Albany Cultivator. — In the United States there is comparatively little real peat. Our extremes of temperature seem not to be favorable to its growth, and, so far as my experience extends, it is only to be found on certain parts of the New England sea-board, where the climate somewhat resembles that of those parts of Europe where peat formations abound.

Our natural boggy or swampy accumulations are for the most part included under the term *muck*, and are a species of vegetable deposit in low grounds, rather than a regular vegetable growth, such as may be seen in Scotland, uplifting the surface of a peat moss even above that of the surrounding and drier land. This muck has not by any means the indestructible nature of true peat; on exposure to the air, in place of becoming a hard, insoluble mass, as is the case with peat, it soon crumbles away, and decomposes into a rich vegetable mould. This process is especially rapid if it is mixed in a compost, or laid in the bottom of a barn-yard. Here, then, in the outset, our farmers escape one great difficulty with which those of Scotland are obliged to contend. We have to do with a mass of rich vegetable material easily convertible into manure; they with the same material as to its ultimate composition, but in a present form which, if once dry, bids almost entire defiance to the ordinary action of the elements. Their most advantageous method of forming a soil upon the surface of a peat bog, is, in many cases, to burn by successive parings to a depth of one, two, or three feet, and to mix the ashes thus formed with clay or earth brought up from under the remaining peat. Such processes, and, in fact, all processes for forming what must be for the first few years an almost wholly artificial soil, are always expensive and tedious. It is therefore fortunate for us that our farmers, in reclaiming their swamps, are not, in a great majority of instances at least, obliged to have recourse to them. As soon as our swamps are drained, natural influences commence their work upon the surface, and alter it in such a manner as soon to form a soil capable of bearing valuable crops.

Much has been said, of late, respecting the value of peat charcoal. The preparation of this charcoal, and its uses in absorbing ammonia, have been always put forward as a prominent advantage connected with the various projects for reclaiming bogs by partial burning. It has been generally supposed that any form of charred vegetable matter possessed, in a considerable degree at least, the same powerful absorbent properties, with regard to ammonia, which exist in wood charcoal. Experiments, however, made by Prof. Anderson, of Scotland, show that this is not the fact; peat charcoal acts as a *deodorizer*, but not powerfully as an *absorbent*. This charcoal also, or any charcoal, cannot, in itself, hold a high rank as a manure, its value being less than an equal bulk of any common vegetable substance, on account of its undecomposible nature. As an absorbent of ammonia, Prof. Anderson, from the results of careful experiments, does not recommend peat charcoal. Peat itself was found to be extremely valuable as an absorbent of ammonia; in experiments made it was found to be capable, in a moist state, of absorbing fully two per cent. of ammonia, without acquiring an alkaline reaction, and, when exposed to the air until it had become tolerably dry, of *retaining* no less than about 1½ per cent. Prof. Norton says, that he sees no reason why the same action is not to be expected from our more easily decomposible muck, nor why some of its well known beneficial effects in composts may not be thus clearly explained. The material from the Scottish swamps becomes hard when dried, and requires considerable power to reduce it to a fine state of division; ours crumbles naturally away, and might easily be dried if spread out in the hot sunny weather of summer. It would then be in the most advantageous state for mixing with manure heaps, spreading over the bottom of barn-yards, or soaking up the liquid of tanks.

MOLECULAR STRUCTURE OF THE ORGANIC BASES.

Hofmann has communicated to the Royal Society, England, a series of researches on the constitution of the organic bases, which have thrown a flood of light upon this department of organic chemistry. In a former memoir the author had demonstrated that the three equivalents of hydrogen in ammonia are susceptible of being successively replaced by the radicals of the ethyl series, yielding a series of ammonias, represented by the general formula, N, (X, Y, Z,) in which formula, X, Y, and Z represent either hydrogen or an ethyl radical. The combination of these new ammonias with acids may be regarded as *ammoniums*, in which one or more equivalents of hydrogen are replaced by methyl, ethyl, &c. Hofmann now finds that the *four* equivalents of hydrogen in ammonium are susceptible of replacement by other radicals. In the present memoir, eight new ammoniums are described, in all of which hydrogen is completely replaced by other radicals. An oxide of a new base, N (C^4, H^5) 4O, has been obtained, which possesses remarkable properties. As a liquid, it exhibits the strongest analogy to the caustic alkalies, potash and soda, possesses a pungent bitter taste, and, when concentrated, acts upon the epidermis, which it destroys like caustic potassa; like this, too, it saponifies fats, decomposes oxalic ether into oxalic acid and alcohol, expels ammonia from its salts, even in the cold, and may be substituted for potassa in Trommer's well known test for sugar. In its action upon metallic salts, the new oxide is also exactly analogous to caustic potassa. It yields, however, no amalgum corresponding to the well known butyraceous ammonium compound.

In conclusion, the author directs attention to the important theoretical bearing of the new alkaloids. In the first place, it is to be observed that the action of the bromides or iodides of the alcohol radicals upon ammonia give rise to not less than four distinct groups of organic bases; three of these — ammonias — are volatile; the fourth — ammoniums — are fixed. The passage from a volatile to a non-volatile organic base, may, therefore, be simply due to the fixation of a single equivalent of a radical capable of replacing hydrogen; and the production of volatile bases by the action of caustic potassa upon the fixed alkaloids, quinine, morphine, &c., naturally encourages the attempt to reproduce the latter from the former by simple substitutions. In the next place, the new fixed bases lend the most powerful support to the ammonium theory of Ampére and Berzelius; the oxides of the new bases perfectly correspond to the hypothetical oxide of ammonium, and are stable; again, it has always been urged against the theory of Ampére, that in the formation of sal-ammoniac, for instance, the hydrogen of the $H\,Cl$ could not reasonably be supposed to leave the chlorine, for which it has so powerful an affinity, in order to convert the ammonia $N\,H^3$ into ammonium $N\,H^4$; moreover, in the action of lime upon sal-ammoniac, we must, according to the ammonium theory, suppose that the chloride $N\,H^4\,Cl$ is first transformed into an oxide $N\,H^4\,O$; then this oxide is resolved into ammonia and water. Now, in some of the decompositions effected by Hofmann, precisely those changes take place, which, in the ammonium theory, appear most improbable.

EFFECTS OF HIGH-PRESSURE STEAM ON ORGANIC BODIES.

In a discussion which took place at the last meeting of the British Association, on the employment of high-pressure steam for the production of carbon for gun-powder, Mr. Mallet alluded to the astonishing effects of high pressure in the process of preparing peat. It appears that, in Prussia, steam at 60 lb. pressure is used and passed through hot pipes to obtain at least 600° of heat, and is then thrown into compressed peat, where it produces the effect of a "fiery sponge," robbing the peat of its water, carbonizing the material, and effecting the complete distillation of many substances. The texture of the peat is so far changed and peculiar, that it is rendered pyrophoric, and takes fire by exposure to air, so that it is necessary to cool down the charcoal in an atmosphere of steam.

THE FIRST PUBLIC APOTHECARIES' HALL.

With the fall of the Roman empire, through the invasion of northern nations, arts and sciences left Europe, and found a shelter among the Arabs, who preserved them for more propitious times; and, though their genius never has equalled that of the Greeks and Romans, nevertheless, chemistry and pharmacy are much indebted to them. They discovered several chemical preparations, and introduced several new medicines, still employed by all physicians. They established, in the eighth century, the first public Apothecaries' Hall in Bagdad. We owe also to the Arabs for the first legal dispensatories, in the ninth century, namely, for the one of Abn Sahel; and, in the twelfth century, for that of Ebn Talmid. Whilst chemistry and pharmacy were cultivated industriously in the East, Europe was plunged in darkness and ignorance, when, at length, a new light was kindled by Constantine of Carthage, who established the first regular pharmacy in Europe, namely, in Salerno. He called these establishments stationes, and the dispensing chemists, confectionarii. — *Annals of Pharmacy and Practical Chemistry.*

NEW METHOD OF PREPARING POWDERS TO BE USED IN MEDICINE.

Tinctures, as is well known, generally possess the most active properties of the drugs from which they are prepared, but the amount of spirit they contain often renders their employment objectionable. Wittke, of Erfurt, therefore, mixes tincture of hellebore, cinchona, &c., with an equal quantity of sugar, evaporates to dryness, and powders the residuum. In this manner, he succeeds in concentrating, in a very small bulk, the active portion of a very large quantity of the drug, and he prescribes the powder as saccharized cinchona, &c. These preparations bear some analogy to conserves, over which, however, they have a great advantage in being free from mucilage, vegetable albumen, and other inert matters.

IODINE IN THE ATMOSPHERE.

M. Chatin, of France, in the continuation of his experiments on iodine, publishes the following observations on its presence in the atmosphere. The constant dispersion of iodine, through the slow, spontaneous evaporation of the waters which contain it, and its more rapid volatilization when heat is applied to these; its elimination from hard waters, which is so speedy that it can seldom be detected therein, even when they spring from highly iodined soils; and the results, though incomplete, which have been obtained by operating on rain-water, are so many circumstances which have led M. Chatin to conclude that this substance must exist in the atmosphere. He estimates the 4000 *litres* of air which traverse the lungs of a man in twelve hours, as containing one forty-fifth milligramme, i. e., the same quantity that is found in a *litre* of potable water, moderately iodined. This iodine becomes fixed during the act of respiration; the expired gases exhibiting about one fifth of the iodine contained in the inspired air. The atmosphere of ill-ventilated and crowded places is, in part, deprived of its iodine. The proportion of iodine contained in the waters of a given locality indicates approximatively the quantity contained in its atmosphere. Rain is notably more iodined in the interior than in the vicinity of the coast, inasmuch as the iodine of fresh waters is much more completely dispersed than is that of sea-water. Great differences, due to causes not yet appreciated, exist in the amount of iodine contained in the rain of the same locality; the proportion, however, always diminishing when the rains are very prolonged. As rain always loses its iodine on falling, this might be fixed for useful purposes by placing in cisterns a millionth or half-millionth part of carbonate of potash. Snow is iodined; but, *cæteris paribus*, less so than rain. Dew contains iodine. Additional observations are required to decide whether iodine exists in the air in the free state, as hydriodic acid, as hydriodate of ammonia, or as forming a volatile combination with certain organic elements. — *Gaz. Med.*, 1851, No. 19, p. 300.

NEW METHOD OF OBTAINING OXYGEN FROM ATMOSPHERIC AIR.

Lavoisier resolved atmospheric air into its constituents by keeping a confined portion, for twelve days, in contact with mercury, heated to its boiling point. Bousingault has attempted to use baryta for the purpose of extracting oxygen from the atmospheric mixture in larger proportion. The method is simple. The air is conducted over pieces of baryta, at a dark-red heat, until it has become converted into peroxide of barium; the oxygen is, subsequently, again expelled, by the application of a more intense heat. The moisture and carbonic acid, usually present in the air, do not materially interfere with the process. The baryta, however, contained so much alumina and silica, that, after repeated use, it became caked, and hence no longer of any use. Pure baryta was free from this inconvenience. According to Bousingault, on a large scale, on using ten kilogrammes of baryta, which absorb 730 litres of oxygen, and should again part with it, 600 litres is the quantity always obtained in practice. Hence, with furnaces in which 100 kilogrammes of baryta, distributed in eight to ten tubes, can be heated at once, from 24,000 to 30,000 litres of oxygen may be produced in twenty-four hours.—*Comptes Rendus*, vol. xxxii.

NEW METHOD OF DETERMINING THE AMOUNT OF OXYGEN IN THE ATMOSPHERE.

Liebig, in the *Annales*, recommends the employment of an alkaline solution of pyrogallic acid, the rapid absorbent capacity for oxygen of which has been long known, as a means of determining the amount of oxygen in atmospheric air. When a solution of caustic potassa, and then a solution of pyrogallic acid, is conveyed into a tube filled with mercury, the liquids mix without alteration; but, when a bubble of oxygen or air is passed into the tube, the liquid immediately acquires a blackish-red, or nearly black color, and the oxygen is as rapidly absorbed as carbonic acid is by caustic potassa. The quantity of oxygen which is absorbed, under these circumstances, by one part, by weight, of pyrogallic acid, is enormous. According to experiments, one grm. of pyrogallic acid, in an ammoniacal solution, absorbs 0.38 grm., or 260 cub. centim. of oxygen; this is more than the quantity absorbed by one part in weight of sodium, on its conversion into oxide, which only amounts to 236 cub. centim. In one experiment, which was made with special care, a solution of one grm. of pyrogallic acid in caustic potassa absorbed 189.8 cub. centim. oxygen. Since one grm. hydrate of potassa, (KO, Aq,) in order to pass into neutral carbonate, absorbs, at 32°, 192 cub. centim. carbonic acid, the absorbent capacity of pyrogallic acid for oxygen, it will be seen, is not less than that of potassa for carbonic acid. Gallic acid may be employed instead of the pyrogallic acid, and with the same result; but its employment has this inconvenience, that the absorption of the oxygen requires at least one and a half or two hours, instead of as many minutes. Owing to the sparing solubility of gallic acid in water, it must be previously converted into gallate of potassa, a cold saturated solution of which is employed.

Dr. Stenhouse has described a most excellent method of preparing pyrogallic acid. He obtained, by sublimation from the dry aqueous extract of gall nuts, precisely in the same manner as benzoic acid is prepared from benzoin resin, above ten per cent., in sublimed acid of the weight of the extract.

CONSTITUTION OF THE ATMOSPHERE.

M. Lewy has presented to the French Academy the result of a series of researches on the constitution of the atmosphere, made in Europe and in South America. The comparison of the results obtained in these investigations with previous ones, shows that the constitution of the atmosphere is nearly the same in the New and Old World. However, on examining carefully all the experiments hitherto made on the constitution of the atmosphere, it is readily seen that the constitution of the air is not absolutely constant. Perceptible differences exist, which vary with the meteorological conditions; thus, after a long rain, the carbonic acid and oxygen are always in smaller proportion than after a long drought; however, these differences are only appreciable when the analysis has been carried out with very great accuracy. In the New World, where the seasons are more defined than in Europe, these variations are more easily detected. During the fine season the normal air always contains a little more oxygen and a little more carbonic acid than in the season of the rains. The difference which exists between the atmospheric air of the two seasons is, therefore, on an average, 0.751 for the carbonic acid, and 2.653 for the oxygen, in 10,000 volumes of air. The difference between the maximum and minimum observed is somewhat greater, being 1,434 for the carbonic acid, and 4.167 for the oxygen. M. Lewy has also observed that the amount of carbonic acid is somewhat greater on the high mountains than in the valleys and on the sea-shore. With respect to the analyses of the air collected on the ocean, they have yielded a very interesting result. In the day-time, this air contains a little more oxygen and a little more carbonic acid than during the night. The difference becomes more perceptible as we leave the coasts; and it is probably owing to the solar rays, which, heating the surface of the sea during the day, disengage a portion of the gases which sea-water holds in solution, and which, as is well known, contains more oxygen and carbonic acid than atmospheric air. The difference between samples of atmospheric air collected on the Atlantic, 400 leagues from land, on the same day, and with the same wind, at 3 A. M. and 3 P. M., were 2.074 for the carbonic acid, and 9.960 for the oxygen, in 10,000 volumes of air.

The analyses of the *abnormal* air of New Grenada, S. A., present us with results of great interest. From time to time, once or twice in the year, the atmosphere of New Grenada contains an extraordinary proportion of carbonic acid, which coincides with an appreciable decrease of oxygen, and consequently alters the constitution of the atmosphere in a very marked manner. The great number of volcanoes which exist in the New World, and the clearing of forests, which are effected every year in this country, may cause alterations. It is, in fact, during these clearances that the constitution of the atmosphere experiences the extraordinary changes which have been just mentioned. These clearings, which are effected by vast conflagrations, produce considerable quantities of carbonic acid, which, mixing with the atmosphere, alter its composition. The amount of carbonic acid found in this air was from ten to eleven times greater than in air in its normal condition. The diminution of oxygen amounted sometimes to 68.35 in 10,000 volumes of air. On the other hand, the air of the plain of Bogota sometimes presents an amount of carbonic acid far greater than the atmosphere of the *tierra-caliente*. This difference may be explained either by the existence of volcanoes, which are situated not far from Bogota, or by the more or less active influence of the solar light. It will be conceived, in fact, that, in the tierra-caliente, where the temperature is very elevated, the decomposition of the carbonic acid, by the green parts of vegetables, must be effected in a far more rapid manner than on the high plain of Bogota, where the temperature is not higher than from 57° to 64°, Fah. It is, perhaps, allowable to suppose, on observing this enormous quantity of carbonic acid appear from time to time in the atmosphere of the New World, and, considering the large number of volcanoes which exist in the country, that a portion of the carbonic acid of the air in other countries is due to them, and that they thus contribute in part to nourish the vast and beautiful vegetation of the tropics. — *Comptes Rendus.*

ON A NEW METHOD OF DETERMINING THE QUANTITY OF HYGROMETRIC MOISTURE IN THE AIR.

Dr. Andrews, at the British Association, stated that he had found on trial, that several powders, when well dried, would rapidly and completely take up the moisture of damp air passed through them, as effectually as the fused chloride of calcium, which is too troublesome in the making, preserving and using, for common use. For instance, he had found that well dried oxide of manganese — and a still more universally attainable substance, powdered alabaster, or sulphate of lime, as dried and prepared by plasterers, or by those who make casts — being inclosed in a small siphon, a measured bulk of air passed through either, at a very quick or at the slowest rate, would be so effectually deprived of all its hygrometric moisture, that another siphon, filled with coarser fragments of fused chloride of calcium, gained no weight sensible to a balance which turned with the one-thousandth part of a grain: the measured portion of damp air being in succession drawn through the siphon containing the alabaster and that containing the fused chloride of calcium.

ON THE ASSUMED EXISTENCE OF AMMONIA IN THE GENERAL ATMOSPHERE.

To the proceedings of the American Association, New Haven, 1850, a paper of great value on the above subject was communicated by Dr. A. A. Hayes, of Boston. After presenting a summary of the evidence supporting the assumed fact of the general existence of ammonia in the atmosphere, Dr. Hayes draws the following conclusions: —

"1st. That ammonia, in some form of combination, is always present near the earth's surface. 2d. That no experiments have been as yet published which prove its general presence in the mass of the atmosphere.

"While pursuing inquiries in this connection," continues Dr. Hayes, "I have constantly found in the atmosphere a volatile matter, of complex composition, which, for some years, I supposed to be due to local exhalations; but multiplied observations, in different and distinct localities, have established its general existence. More lately, this substance has been found by different observers in Europe and this country, coloring and contaminating the salt obtained by the evaporation of rain and snow. Liebig notes its presence in the samples of water he operated upon; but Zimmermann had earlier observed it, and after partially separating it from other substances, called it *pyrrhine.* This substance, so widely diffused, has characters which lead me to assign to it important influences; and, connected as it is with ammoniacal products, I deem its study a subject of general interest. It is to this body that we may trace the properties of rain, as distinguished from other waters.

"When about 50 pounds of recently obtained rain-water are exposed, at a low temperature, in a closed space, to the absorbing action of 150 pounds of dry caustic lime, all those substances, not very volatile in an atmosphere formed in part of their own vapors, remain. Successive portions of rain-water may be thus concentrated, and the fixed parts obtained nearly dry. Generally we find a residue of a gum-resinous appearance, brown or yellow in color, and not wholly soluble in water. In the mass are the remains of animalculæ, spores of fungi, and atmospheric dust. Water extracts other substances in mixture with pyrrhine, mineral and ammoniacal salts, if they exist. Alcohol and ether extract parts, but evidently alter the composition of the substance. Obtained from carefully filtered solutions, pyrrhine appears as a brown-yellow, adhesive substance, having a strong odor of perspired matter. Repeated evaporations render it insoluble partly, and it evidently is a changing body, having no fixed composition. In solution, its instability becomes its most marked character, and, like water which has dissolved yeast, the solution has the power of conferring motion and change of composition on other bodies. This character is displayed when it is mixed in solution with vegetable juices, weak syrups, and gum-water. After its solution has been freed from ammoniacal salts, the changes following in its fermentation produce ammonia. It reduces the salts of silver and gold, blackens in concentrated sulphuric acid, forming with this and other strong acids, salts of ammonia.

"When fertile soil is undergoing fermentation, the vapors by condensation afford a substance much like pyrrhine. Arable soil has also in its mass a body closely connected with pyrrhine; but the state of admixture here renders it more compound than where it is obtained from the atmosphere through the aid of falling rain. The constant presence of this body in the atmosphere, the ease with which its constituents unite to form ammonia under the presence of acids, leads to the supposition that it has been one, if not the chief source, from which experimenters have obtained ammonia salts. Dissolved in rain-water, and falling on the surface of the earth, this substance can induce changes under the vegetable covering which cannot result from any solution of ammoniacal salts. It has that influence which alone can impart motion, or cause fermentation, and without which neither germination nor nutrition can be sustained. In New England, whatever may be the attention bestowed on preparing the soil, vegetation languishes or ceases during some weeks of the season, when the temperature of the torrid zone is exceeded, and the length of the day's heating prevents any great reduction of temperature during the night. With a dew point almost unnaturally high, there is not usually any condensation as rain, and no copious deposition as dew. Fields covered with grass become scorched; the uniform tint of ripening precedes the appearance of a dessication, which permits the winds to disperse the most of the covering, and no green color relieves the eye. If, after the grass has thus perished, and nothing but chaff-like remains can be found, rain falls for some hours, the effect is almost miraculous; the temperature of the earth near the surface does not fall; germination, more active than that of the torrid zone, succeeds, and repeatedly crops have been observed which matured on the tenth day after the rain commenced. It must be evident, to every reflecting mind, that no mere salt or saline compound can give to water such power as this. Salts and their compounds cannot maintain the high temperature of the earth under the cooling effect of evaporation; and experience has, through ages of observation, shown that those additions made to the soil, intended as food for plants, must be in a fermenting state, or be eminently fitted to assume such conditions. The more fertile a soil, either naturally or as resulting from judicious cultivation, the more in quantity of matter, having the character of a ferment, we always find in our analysis.

"It is, therefore, in view of the character which pyrrhine possesses in mixture with other bodies, of entering into a true fermentation, that I have ventured to give it so much significance as a constituent of our atmosphere, and to show that all the influences which atmospheric ammonia has been supposed to exert, may, with more propriety, be ascribed to pyrrhine. In a strictly chemical view, the fact that our atmosphere has an excess of carbonic acid always present, that this excess is found in fertile soils, is opposed to any conclusions of a salt of ammonia acting in vegetation, except as a carrier of carbonic acid, either directly or by decomposition with humid compounds."

SCHONBEIN'S OZONE.

The following is a report of a lecture recently delivered before the Royal Society, by Professor Faraday, on the properties and nature of ozone. This name had been given by Schonbein to a substance or condition of matter which manifested itself under very peculiar and widely different circumstances. Schonbein regarded it as an independent body, and a constituent of the atmosphere; but in his (Prof. Faraday's) opinion it was nothing more than an allotropic condition of oxygen. It was never manifested except where oxygen was present, and where, at the same time, water in a liquid or vaporous condition was found. No substance had ever been separated from the atmosphere where ozone existed; but its presence was manifested, not merely by the strong smell peculiar to it, but by certain well-marked chemical properties, which the atmosphere containing it possessed. When electricity is produced from a powerful machine, and allowed to be discharged by a point, there is a feeling of a current or aura as of vapor escaping, and at the same time a remarkable odor. If, during the passage of the electricity, a piece of paper, moistened with a solution of iodide of potassium and starch, be brought near, the discharge causes the production of blue iodide of farina. The blue color thus produced is the result of the oxidation of the potassium by the *ozone*, and the setting free of the iodine. This is one of the best tests of the presence of ozone. It was formerly supposed that nitric acid was produced by the discharge of the spark, and that the decomposition of the iodide was occasioned by this acid as a result of the union of oxygen with nitrogen in the air; but this theory will not account for the smell and other properties of this extraordinary agent. Schonbein produces ozone in very large quantities by introducing into capacious bottles, with glass stoppers, pieces of cut and cleanly scraped phosphorus, with a small quantity of water, so that the phosphorus may be partly in and partly out of the liquid. A vapor slowly rises in a current. After ten or twelve minutes the ozone is produced, and may be procured in a mixture with oxygen and nitrogen by removing the phosphorus at a water-bath, and thoroughly washing the interior of the bottle with water, in which ozone is insoluble. This body is thus separated from the vapor of phosphorus and phosphorus acid.

A remarkable property possessed by ozone is its bleaching power. Some ounces of a solution of indigo being poured into a bottle containing ozone, and shaken, the color is as completely destroyed as if chlorine was present. A very small quantity of ozone would thus entirely discharge the color of a very large quantity of sulphate of indigo. It has already been stated to be so little soluble in water, that a bottle containing it may be repeatedly rinsed with water without losing its ozone contents. If, however, the stopper be removed, and it is exposed to the air, it soon passes off. Ozone appears to be entirely destroyed by heat; or, at any rate, its production by electricity ceases when sparks are received from a red-hot metallic point. This fact was ingeniously illustrated by insulating a small galvanic battery, capable of raising at pleasure a platina ball to full redness; the battery was made part of the machine, and the platina ball the terminal point from which the discharges of electricity were received. The machine was set to work, and it was clearly and distinctly proved by Prof. Faraday that the discharges from the red-hot platina ball produced neither the aura, the smell, nor the decomposing effects on iodide of potassium and starch, which were immediately manifested when the ball was allowed to cool, and the electric fluid was then passed through it. The oxidizing properties of ozone are indicated upon metals which in practice it is rather difficult to convert to oxides — namely, silver. A piece of polished silver had been placed in a bottle of ozone for several hours, and had acquired a distinctly brown tarnish, not from sulphur, but from a process of ozonation, or, in other words, oxidation. Polished lead similarly treated was also oxidized. Ozone had always a tendency to bring metals and metallic oxides to their highest degree of oxidation. In this respect it was the most powerful oxidizer that was known. A tube containing several rings of metallic arsenic had been placed for a short time in a bottle of ozone. The metal had entirely disappeared, and had become transformed into arsenic acid. Paper wet with a solution of proto-sulphate of manganese was introduced into a bottle of freshly prepared ozone, and, in the course of a short time, black spots appeared over the surface, proving that the manganese had passed to a higher degree of oxidation. Nitrogen and sulphur are easily oxidized by it. Schonbein succeeded in procuring a quantity of nitre by the agency of ozone in contact with nitrogen and potassa. Sulphur was also converted to sulphuric acid. Paper stained with sulphuret of lead was immediately bleached when exposed to an ozonic atmosphere. Some curious experiments of Schonbein's were shown, in which portraits and inscriptions were seen in white letters on a dark ground, as a result of placing stencilled metallic plates on papers which had been exposed to light and air, or insulated. The result was that in these spots the sulphuret of lead had entirely disappeared, having been converted to colorless sulphate of lead by the oxodizing action of ozone. The alleged bleaching properties of solar light on colored articles are thus probably due to the agency of ozone — in other words, to a process of oxidation and alteration of color. Sulphuretted hydrogen and all foul effluvia are speedily oxidized and destroyed by ozone. It is, therefore, the great purifier of the air; and owing to its continued exhaustion by oxidating processes, it is difficult to discover the presence of ozone in large and populous places or in close and crowded dwellings. In the open air of the country, and on the sea, it constantly exists in a proportion which is probably subject to great variations, although ruled by laws which are at present unknown. Schonbein has contrived an *Ozonometer* for testing the amount contained in air. It is prepared by immersing paper in a solution made of one grain of iodide of potassium, ten grains of starch, and two hundred grains of water. The paper is dried, and, when intended for use, is exposed for some time to the air. There is no change until it is wet with water, when, if ozone was present in air to which it had been exposed, a blue color will appear, the intensity of which varies according to the quantity of ozone present and the length of exposure. The ozonometer consists of a series of papers thus colored in different degrees, and bears some analogy to the cyanometer long since proposed by Humboldt.

Prof. Faraday stated that he had detected ozone in the currents of air coming over the sea near Brighton. When he examined the currents of air coming over the town, no ozone could be detected, but when he again returned to the windward side, and received the air before it reached the town, ozone was distinctly manifested. It was thus established that in populous places there was a constant consumption of this principle. As the working of the electrical machine produces ozone, so does the current generated from a galvanic battery. It is also evolved in numerous chemical processes. If pure ether, mixed with water, be introduced into a wide-mouthed bottle, and the vapor allowed to become diffused, it will afford none of the reactions for ozone. But if a glass rod be made hot in the flame of a spirit lamp, and then introduced into the vapor, litmus paper, held above the rod, becomes at once reddened, and the iodide of potassium paper intensely blue. In the oxidation of ether, at low temperature, ozone is evolved. Essential oils are thickened by long exposure to light and air; they become ozonized and their properties changed. This was illustrated by reference to oil of turpentine. Freshly rectified and pure oil of turpentine was proved, by admixture with sulphate of indigo, to have no bleaching power. A small quantity of oil, which had been exposed to air and light, destroyed the color in a few minutes, like chlorine.

It cannot be doubted that ozone exerts an important influence on the atmosphere, and, therefore, on the health of animals and vegetables. If it be an allotropic condition of oxygen, it is impossible to say what regulates the conversion of the one condition of the element into another. Chemical agency, electricity, and magnetism, may be the constant sources of its production. Decay, disease, and death, affecting alike animals and plants, may be the means by which ozone is consumed; but what power is it that *regulates* the quantity produced, and so adjusts it that it shall conduce to health and life? This is a profound mystery. It is obvious, from what is already known, that by an over-conversion of oxygen in the atmosphere into this allotropic condition, every living thing would perish; and it is not improbable that the arterialization of blood may be due, not to oxygen in its ordinary, but in its allotropic state.

The oxidation of the metallic sulphurets by ozone throws a curious light on the probable cause of the destruction of photographic drawings. If any sulphuret of silver be left in the finished drawing, the drawing is slowly bleached, and the sulphuret converted into sulphate of silver. In drawings which have been framed, the change is observed to commence on the external margin, and slowly spread to the centre. — *Medical Gazette, and London Chemist.*

ON THE ORIGIN OF THE OZONIC ODOR PRODUCED BY THE ATTRITION OF SILICEOUS SURFACES.

At a meeting of the Franklin Institute, April, 1851, Dr. Hare submitted an apparatus for ascertaining whether the phenomena attending the attrition of pieces of silex, when rubbed together, had anything in common with the supposed new halogen body, ozone. In regard to the odor produced in the manner referred to, nothing can be more unaccountable. That it cannot be due to any organic matter entering into the composition of the quartz, must be evident; in the first place, because the smell is produced by the purest and most transparent specimens of rock crystal in the regular form, and, in the second place, because ignition to bright redness does not destroy, nor even diminish, the property. One thousand grains of cellular horn-stone or French burr, on ignition, as above stated, lost five grains — that is to say, one half per cent. of its weight, without, however, losing the property of producing light or smell. It occurred to me that it might help to remove the mystery were an apparatus constructed by which the attrition of siliceous masses might be made more efficaciously than could be effected by an operator, unaided by mechanism. A machine for this purpose was accordingly constructed. Two pigmy mill-stones, each seven inches in diameter, made of cellular horn-stone, known vulgarly as French burr, and resembling those used in grist-mills, were procured and supported in the usual way, one above the other; excepting that the upper one hangs, by means of a bolt, upon a spiral spring of brass wire, sustained by a cross of iron, resting upon screw nuts, upheld by four iron rods, each inserted at its lower end in a circular plate of cast-iron, so as to be equidistant from each other. The surface of the iron plate is turned true, so as to enable it to serve as an air-pump plate. It rests upon four columns, which elevate it from a base-board sufficiently to admit of a pulley-band and wheel to work in a parallel plane below that in which the plate is situated. There is also room for a lever, from which a stirrup hangs as a support for the spindle of the pulley, on the apex of which plane, extended upwards through a perforation in the axis of the plate, the lower mill-stone rests. The spindle passes through a stuffing-box, so as to be air-tight — the stirrup allowing it to retain its perpendicularity, notwithstanding the curvilinear movement of the lever when employed to raise or lower the stone.

In order to put the apparatus in operation, the lower stone is made to revolve by means of the pulley, band and wheel; while, by means of the lever, the stone is so raised as to produce sufficient contact with that suspended above it. Under these circumstances, scintillation and the odor, which is the object of inquiry, resulted. In no way, however, could I produce the chemical effects of ozone upon iodized starch or guaiacum. On directing a jet of hydrogen between the stones, it took fire forthwith; but I could not, by means of an electrometer, detect any electricity. When the upper stone was removed, and a piece of an old file, of a large size, made to scrape over the surface of the lower stone, a conducting connection between the file and an electrometer was productive of no electrical indication. The plate being ground to fit a large receiver, the stones were in successive experiments made to revolve in vacuo, in hydrogen, and in a vacuity previously replete with gas, without any diminution of the luminous phenomena. These, it seems, from the inflammation of the jet of hydrogen, constitute a simple case of ignition. During the collision of flint with steel, a portion of the metal, being struck off, takes fire, and thus is enabled to convey ignition to tinder or punk. The incapacity of two pieces of quartz to produce fire, in like manner, arises from the incombustibility of the particles struck off from them, which consequently cool before they meet any mass with which they are not in contact at the moment when the ignition supervenes.

As the burr stones are opaque, the light is much less advantageously seen when they are both employed, than when the upper one is replaced by a comparatively small mass of transparent quartz. The concentration of the frictional force and the transparency of the mass under which the ignition is effected, make the corruscations very brilliant in a room otherwise darkened. I have lately been informed that in English potteries, where flint is employed as an ingredient in the ware manufactured, the grinding of this material is productive of intolerable fœtidity. In an atmosphere thus imbued with fœtidity, chemical effects ought to be observable, if there be any connection between the source of this fœtidity and that produced by ozonizing agents. It is long since it occurred to me that as the phenomena of light, under all the various hues which it is capable of producing, are ascribed to the undulatory affections of an ether pervading the universe ; so the still greater variety of odors which influence our olfactory nerves may be due to vibratory agitation of the same medium. Consistently it may be conceived that the odor produced during ozonification, during the attrition of quartz, is due to an odoriferous ethereal agitation.

OBSERVATIONS ON OZONE.

Dr. Polli forms his ozometer by dipping papers in the following solution : starch, 10 parts ; iodide of potassium, 20 ; water, 400 ; provided they are kept folded up or in close vessels, they preserve their power for months. When one of these slips was suspended by a thread in the air, outside the window, it became strongly colored in a few hours ; while a similar one, suspended within doors, remained white for days, and only began to be colored after several ; and this was the case in whatever part of the house it was suspended, as in well-ventilated passages and corridors. The slip exposed out of doors became still more speedily and deeply colored when freely exposed at a distance from the house. To ascertain how far a frequent renewal of the body of air might influence the appearance, one of two slips, placed out of doors, was fastened firmly at both ends, and the other allowed to fly about freely. Both became rapidly colored, and with equal intensity. A portion of a slip was introduced within a phial, and a portion allowed to remain externally, the air, however, having access to the former. On exposure to the atmosphere, the portion external to the phial became intensely colored, while that within remained unchanged, so that mere vicinity of another body prevents action. If ozone irritates the air-passages, we can see, from the above experiments, the importance of invalids suffering from a delicate state of them, keeping the house, or protecting themselves when they quit it. So, too, some light is thrown upon the injurious operation of drafts and currents of air, by the fact that strips, suspended near cracks and fissures within doors, only become colored opposite those. If slips of paper are covered before exposure with layers of silk, wool, linen and cotton, of the same size and thickness, those covered by the silk, wool, and linen, remain uncolored, while those covered by the cotton become colored. If a piece of linen and a piece of cotton are immersed in a solution of starch and iodide of potassium, and then exposed, the cotton becomes deeply colored, while the linen becomes so only feebly, after a long time. Will this aid in explaining the irritating effect of cotton handkerchiefs compared to linen, when applied to the nose and eyes during catarrh ? Humidity does not impede the appearance of ozone. The direct rays of the sun favor it, and it is less developed if these are shaded by dark-colored glass and during the night. When snow fell, Dr. Polli observed its action to be very powerful, as also during the prevalence of northern winds, and rainy and cloudy days. When fine weather had lasted many days, the air became loaded with ozone, but immediately after heavy showers it disappeared; slips which before the rain appeared were colored in a few hours, then remaining white for days. After the rains have ceased the ozone reäppears, and continues increasing. That the rain-water, and especially the first drops, contain it abundantly, is seen by the deep color of the slips exposed to its aspersion. In the stalls of stables, in which the air is moist and ammoniacal, the slips do not change color, or do so very slowly as compared with those placed in empty stables. Will this explain any benefit phthisical patients were once supposed to derive from breathing such air?

Dr. Heidenreich made a series of daily observations upon the relation of the amount of ozone to the nature of the prevailing diseases, from March 16 to May 22. He found that a strong ozonic reaction coincided with an exacerbation of the symptoms of catarrh and the appearance of pulmonary phlegmasiæ, while a diminution of these took place when it was feeble. On the other hand, affections of serous membranes, as the arachnoid, and of the synovial, as also various cutaneous affections, appeared during very feeble signs of the presence of ozone. Rheumatic affections seemed connected rather with a large, than a small amount, while pleuritis was as often met with in the one case as the other.

Dr. Faber (with other German observers) doubts the existence of any connection between the development of ozone and the prevalence of catarrhal affections. A year's observations, during 1848, failed to confirm the accuracy of Schonbein's conclusions upon this point. He found, too, the color both strong and weak, whether the barometer was low or high, but perhaps oftener weak when it was high, and strong when it was low. — *Cmedee Annali.*, vol. 130, p. 155.

GEOLOGY.

ON THE ELEVATION OF THE COAST OF SWEDEN.

M. Nilsson, in a work on the existence of man in Scandinavia previous to the historic age, furnishes some interesting data relative to the elevation of land in that region. A prominent rock in the harbor of Fyellbacka has offered opportunities of careful examination; and hence it has been established, that in 1532 the rock was two feet below the surface, in 1742 two feet above the surface, and in 1844 four feet above water. Thus it has risen six feet in 300 years, or at the regular rate of one foot in fifty years.

SUBSIDENCE OF LAND IN INDIA.

Dr. W. Buist, at the British Association, stated that evidences of upheavals and depressions of land exist all around the shores of India, from Calcutta to Bombay. They are met with in clearing out docks and tanks, in which beds of loamy soil are found, full of the roots and stools of trees, at a level below the mean level of the sea, and covered by sea-sand and shingle. At Bombay these ancient forests are covered by a concrete of shells and gravel, and, in some instances, beds of fresh-looking coral have been found. The lignite contains sulphate of iron, which effloresces so abundantly as to have been collected and sold to dyers. The roots are often much worm-eaten, the borings being lined with carbonate of lime. Similar phenomena have been noticed in the Gulf of Cambay, and at Karachee. The sea-margin of Western India is almost everywhere an expanse of level ground, from three to ten feet only above high water, consisting of loose or cemented gravel, with sea shells.

ISTHMUS OF SUEZ.

An interesting discussion on the topography of the Isthmus of Suez has lately occurred in the London Institution of Civil Engineers; the occasion being a paper on that subject, in connection with the Ancient Canals of Egypt, by Mr. Glynn, C. E. It appears, from recent levelings and careful examination, that the levels of water in the Red Sea and the Mediterranean are identical, and, therefore, that the project for a line of canals, based on a presumed difference of upwards of thirty feet between the seas, is not feasible. The error in the levels, computed by Le Père, may be accounted for by the fact of the work being executed under the orders of Napoleon, during the campaign in Egypt, a period of war of the most harassing description. The ridge now existing at the end of the Red Sea, towards the Bitter Lakes, is found to consist of tertiary strata, the fossils of which are identical with those of the London Basin, and the hill of Montmartre, Paris; and has no doubt resulted from a geological upheaval which materially changed the features of the district.

RECOGNITION OF A MATHEMATICAL LAW IN GEOLOGICAL SCIENCE.

M. de Beaumont, in a communication to the French Institute, announces a discovery which may probably lead to important results in geological investigations. It is a well-known law in geometry, that if a number of cylindrical bodies be compressed parallel with their axis, by forces acting at right angles thereto, they assume the form of hexagonal prisms, the simple cause of which law is, that a plane can only be exactly divided, without loss of space, by three regular figures — the equilateral triangle, the square, and the hexagon — of which figures the hexagon has the least perimeter, which form the bee, from natural instinct, adopts for its honey cells; and, by the same law, the basalts in general assume the shape of six-sided prisms. If a spherical body be submitted to equal pressure in all directions, a similar law is called into action, but with different results, a sphere being only capable of division into a series of dentagonized triangles. The fifteen great circles which divide a sphere into as many regular pentagons, possess the minimum of lineal extent, which constitute the most complete equation of lines. In availing himself of this law, M. de Beaumont attempts the explanation of an ingenious theory — of the regularity of the angles of the great mountain chains upon the globe. It was known that the principal direction of these systems follows that of the great circles of the earth; and the author, in studying the direction of twenty-one mountain chains of Europe, has found that the angles formed by these circles towards each other, have an almost constant value, and the chains are assembled in groups, forming nearly right angles. Comparing those angles with the simple pentagonal net which envelops the sphere, and dividing it into 120 scalene triangles of equal magnitude, he found the angles by which the fifteen great circles are intersected to be 36°, 60°, 72°, and 90°. These facts, in connection with other geographical phenomena, have led M. Beaumont to consider these formations as the result of the folds, or plications, caused by the successive contraction of the mass of the globe in the process of refrigeration.— *London Mining Journal.*

ON THE PLICATION OF STRATA.

At a meeting of the Boston Natural History Society, March, 1850, Prof. H. D. Rogers called the attention of the members to the following question in geology, viz.: Why are curves in the earth's strata not symmetrical, but always more abrupt on one side than the other, as seen in the great mountain chains of America and Europe? He suggested, as the explanation of the phenomenon, the forward pressure of the lava wave beneath, which he supposed to have produced the curve, in the progress of an earthquake. If a horizontal stratum were acted upon by a perpendicular force from within the earth, it would be raised in a symmetrical arch; but if this force had a horizontal as well as a perpendicular action, the result would be the formation of a curve such as is really found to exist. A railroad bar, breaking under the weight of a passing train, is fractured towards the extremity farthest from that on which the pressure commences; and in the same way the points of fracture in the curves of upheaved strata are at the most abrupt portion of the curve, towards the termination of the wave. The point of fracture in the railroad bar is nearer to its remote support in proportion to the speed of the passing train. Prof. Rogers supposes that there is a horizontal thrust acting upon the bar, through the principle of adhesion, in addition to the perpendicular action of gravity.

Mr. Desor stated, as an illustration of the rapid progress of geological science, that the plication theory, which was hardly known fifteen years ago, was now almost generally adopted; and, with few exceptions, might be found even in the text-books. This great result, he thought, was due chiefly to the investigations of Prof. Rogers, in the Alleghany chain. As to the cause of the plication, several theories had been proposed since that of Prof. Rogers. Prof. Studer, of Switzerland, thought that the plication of the Jura was the result of a lateral pressure, caused by the upheaval of the Alps. Mr. C. Prévost ascribed the plication to a bulging up caused by the depression of vast areas.

Prof. Rogers said his own and his brother's views, in regard to the upheaval of the mountain ranges, had been fully confirmed in his own mind by visiting the Alps. He gave it as his opinion that the Jura range was raised by a force from the direction of the Vosges, as the plications all lean *towards* the Alps, not *from* them, as would be the case if they had been caused by a lateral pressure, caused by the weight of the latter, as supposed by Prévost. In many of the observed plications, the upheaved strata preserve their shape by means of trap dykes, veins of greenstone and quartz, which are always found in great numbers, occupying the fissures on the abrupt surface of the curve; and which, filling these fissures in a liquid form, harden on cooling, and act as keys and braces to prop up the bent strata. —*Proc. Boston Nat. Hist. Society.*

ON THE PASSAGE OF ANTICLINAL AXES INTO FAULTS.

Prof. H. D. Rogers, in presenting a communication to the American Association, at Albany, under the above title, referred to the peculiar structural features of the great south-eastern Appalachian belt, which has its continuation in the district of New York, east of the Hudson, and in Western Vermont. The series of folded axes or plications of the strata in this prolonged zone, were first recognized and reduced to a general law by Profs. H. D. and W. B. Rogers, more than ten years ago, at the same time that the various phases or gradations of anticlinal and synclinal axes were made the subject of examination. Prof.

R. showed, by a series of figures on the black-board, the successive features of an anticlinal, just when it forms a normal arch, then steepening more and more on its western side, until it becomes a folded axis. He then pointed out the passage from this latter into a fault, by the fracture of the strata, and the folding down and engulfing of some of the rocks belonging to the western half of the anticlinal. In this way the rocks of the eastern side of the mountain are, in certain cases, made to over-ride and lie upon the edges of the newer strata. In other cases, as shown by the Professor, the dislocation, joined to subsequent denudation, has given the appearance of an unconformable deposition of the newer upon the older rocks. Prof. R. referred to various marked instances in the Appalachian belt, in which an anticlinal axis, when traced longitudinally, passes by the gradations just described into a fault. In some cases, the fault thus produced is continued for a long distance, as in the great lines of dislocation which pass from south-western Virginia into Tennessee, and are thus prolonged for several hundred miles. In other cases, the line of fault, by a reverse order, passes again into an anticlinal axis. Similar phenomena were described in regard to synclinal axes. But in this case, the east side of the axis or trough became engulfed. Prof. R. stated it as the law that, in the Appalachian anticlinal axes, the fracture occurs always on the west side of the axes' plane. In synclinal, it occurs on the east side.

In conclusion, Prof. R. enforced the great importance of attending to these phenomena of dislocation, and pointed out the fact that extensive lines of unconformity, in the south-west and elsewhere, in the Appalachian belt, which are clearly due to the fracture and movement before described, are liable to be interpreted as lines of original unconformability, and have been so regarded by other observers. Thus, along the base of the Cumberland mountain, in south-western Virginia and eastern Tennessee, the coal rocks are seen abutting against the steep dipping lower Appalachian rocks, as if deposited after the disturbance of the latter. Yet Prof. R. has actually traced these features into an anticlinal axis.

ON THE ORIGIN OF STRATIFICATION.

The following paper, on the "origin of stratification," by Mr. David A. Wells, of Cambridge, was read at the meeting of the American Association, Albany :—

The general idea respecting the origin or cause of stratification, as expressed in geological text-books, or as inferred from the writings of geologists, seems to be this : that strata, or the divisions of sedimentary matter, have been produced either by an interruption of deposition, or a change in the quality of the material deposited. This idea is well illustrated by the deposition of matter of tides or inundations, its subsequent consolidation, and a renewed deposition on the plane of the former deposit. That such is really the cause of stratification, in very many or most instances, I do not dispute ; but that there are other causes which tend to produce and have produced stratification, equally extensive and varied, is, I think, clearly shown by the following observations.

My attention was first drawn to the subject during the past summer, while engaged in the analysis of soils. By the process adopted, the soil was washed upon a filter for a considerable number of days, in some cases for a period as long as two weeks, and subsequently dried at a temperature of 250° Fah. The residue of the soil left upon the filter, consisting chiefly of silica and alumina, was found, after drying, in every instance, to be more or less stratified, and that too by divisional planes in some cases not at all coincident with any division of the materials, although this is apt to take place. The strata so produced were in some instances exceedingly perfect and beautiful, not altogether horizontal, but slightly curved, and in some degree conforming to the shape of the funnel. The production of laminæ was also noticed, especially by the cleavage of the strata produced into thin, delicate, parallel plates, when moistened with water.* These arrangements, it is evident, were not caused by any interruption or renewal of the matter deposited, or by any change in the quality of the particles deposited, but from two other causes entirely distinct, and which I conceive to be these : — first, from a tendency in earthy matter, subjected to the filtering, soaking and washing of water for a considerable period, to arrange itself according to its degree of fineness, or perhaps according to the specific gravity of the particles, and thus form strata ; and, secondly, from a tendency in earthy matter, consolidated both by water and subsequent exsiccation, to divide, independently of the fineness or quality of its component particles, into strata or laminæ. The tendency of this earthy matter is generally to divide on drying along the lines formed by the arrangement of the particles according to their nature or quality. This is not, however, always the case, as was proved by the observations noted, and which is also conclusively shown by the examination of almost any stratified rocks. At the clay slate quarries, near Charlestown, Mass., the lines formed by differences in the quality of the component particles are beautifully marked on almost every slab, yet the divisions into layers are not coincident, and there is not a tendency to divide along the lines of arrangement.

At some points in the valley of the Connecticut, where the sandstones remain unaltered in any degree by heat or dislocation, the stratification produced by these several causes may be clearly seen and studied. On the western edge of this deposit, opposite Springfield, we have rocks composed of layers, which would at once be referred to the production of tides or inundations by the most inexperienced observer. The strata here vary, from the fraction of an inch to an inch in thickness ; they are also covered with mud-cracks, and the various markings which are usually found upon a shore or beach. In other portions of the valley we have strata divisions, occasioned by the lines which separate materials differing either in quality or nature ; as the shales from the sandstones, the conglomerates from the fine sandstones, or the highly bituminous shales from those less bituminous. And then, upon the extreme eastern edge of the sandstone deposit, we find strata,

* The laminæ so produced were not always parallel to the strata divisions, although parallel to themselves.

the leaves of which measure from one to two, and in some instances three feet in thickness, some layers embracing in themselves matter ranging from a coarse conglomerate to the finest sand; and yet none of this collection of materials, within the limits of the particular layers in which they are included, exhibits the slightest tendency to break or divide in any one direction more than another.

The observations here stated, I am happy to find, have been also noticed, to some extent, by others conversant with the subject of stratification. Sawdust, subjected to the filtering action of water, has been observed by Prof. Agassiz to assume a regular stratified appearance. The same has also been noticed by Dr. Hayes, of Boston, in the vats in which clay used for the manufacture of alum is washed. Dr. Emmons, of Albany, has referred me to an instance of a clay bed, in which the strata of one portion are distorted and inclined, apparently from a force acting laterally or from below, but which force evidently could not have so acted from the perfectly regular and undisturbed condition of the surrounding clay strata; the inclinations must, therefore, according to Dr. Emmons, be referred to a peculiarity of deposition, or a subsequent division at an angle on consolidation. I have also noticed regular stratification in the dried deposit of a puddle in the streets, where no apparent change in the character of the materials deposited could be noticed, and where there was certainly no interruption of deposition.

If the divisions of stratification or lamination which I have thus pointed out be admitted, it is not improbable that many cases of what are now considered disturbed and tilted strata, are in none other than their normal condition.

ON THE ORIGIN OF CONGLOMERATES.

Messrs. Foster and Whitney, in their report on the geology of Lake Superior, consider the vast beds of conglomerate in those regions to have their origin in igneous ejections beneath the surface of the ocean. The editor of Silliman's Journal, in noticing this conclusion, says, "that, judging from known effects of igneous action, this supposition is undoubtedly correct. The action of the waters of the ocean on a lava stream was exhibited on a grand scale at the eruption of Kilauea, (Hawaii,) in 1840, where the fused rock, on reaching the sea, as Mr. Coan states, 'was shivered like melted glass into millions of particles, which were thrown up in clouds that darkened the sky, and fell like a storm of hail over the surrounding country,' and, as a result, three conical elevations were thrown up in a few days, the smallest 150, and the largest 250 feet in height. The same effects would take place in the depths of an ocean, only far more vast, when the opened fissures lie their whole length exposed to the waters; and the results would vary, according to the condition or progress of the eruption, the currents that were in action at the time, and the character of the region around. Adding also the friction of the eruptive rock against the walls of the opened fissures, as suggested by von Buch, and we have a sufficient cause for the formation of the fragmentary beds."

ON THE EXISTENCE OF DILUVIAL AGENCIES DURING THE EARLIER GEOLOGICAL PERIODS.

THE following is an abstract of a paper, read at the American Association, Albany, by Dr. F. M. Hough :—

The abrading and polishing action of moving masses of rock, upon superficial strata, has usually been considered as peculiar to the drift period and other still later epochs in our earth's history. The object of this communication is to state a few facts, tending to prove that the causes which produced these appearances have operated in exceedingly remote periods, and at great intervals.

An instance is mentioned by Professor Emmons, in which polished and ground surfaces occurred between strata of Trenton limestone on Lake Champlain. In these cases, the rock above is stated to be in lithological characters and fossils similar to that below, and that the inferior surface of the upper layer presented an exact cast in relief of the one below.

I have observed several instances of a similar character in Northern New York, which, from the evidence they furnish of the action of denuding causes in early periods, are worthy of special record. One of the most interesting of these localities is at Deer River Falls, one mile below the village of Copenhagen, Lewis county, N. Y. The river is here precipitated down a chasm in the Trenton limestone, to a depth, it is said, of 270 feet. Near the bottom of these cliffs, the sections in the strata present, in several places and at *different levels*, a peculiar waved line, produced by the removal of portions of the upper surface of a stratum, the lower side of which remains level. The uniformity of stratification is not disturbed either above or below. In several instances the rock above has been removed, presenting continuous furrows, three or four inches deep, and a foot broad, with an uniform and parallel course in this instance, varying but little from west to east. The depth and uniformity of these grooves, with the want of polish upon their surface, would indicate that the rock had not acquired solidity at the time of their formation. Quite a number of waved lines may be seen intervening on the face of the precipice at this place, with intervening level strata many feet in thickness, thus indicating a repetition of the causes, with intervening periods of repose. A more interesting and characteristic locality of furrowed surfaces underlaying rocky strata, occurs at Ogdensburg, near the St. Lawrence river, and between strata of calciferous sandstone. The deeper and older grooves extend from north-north-east to south-south-west, while the slighter and more recent ones extend from 10° west of north to 10° east of south. The marks of attrition are quite as distinct as is ever noticed on superficial rock, and were evidently made after the stratum had acquired a solidity quite equal to that which it now possesses. At one locality the furrows are seen passing horizontally under an abrupt terrace of the coarse limestone about twenty feet high ; but the exact point of contact was not seen, it being covered by a wall. The surface of the rock above, exhibits here no marks of abrasion ; although, elsewhere, it preserves them with great distinctness. After a careful study of the locality, I have not the slightest doubt but that the terrace of limestone overlays the grooved and polished rock in question. These instances, although insufficient to decide the disputed question of the manner in which the abrading forces acted, at least indicate that they existed, and operated with the same effect, and doubtless under the same circumstances, during the eras of the calciferous sandstone and Trenton limestone, as in the drift period.

PARALLELISM OF THE DRIFT DEPOSITS OF EUROPE AND AMERICA.

At the Boston Natural History Society, April, the following remarks, on the above subject, were made by Mr. Desor :—

The main difficulty which we encounter, when we attempt to parallelize the detrital deposits of Northern Europe and America with those of Switzerland, where they have been first and most minutely investigated, is the position of the bones of the mammoth and other animals. In this country, and in the North of Europe they are limited to the most recent formations, such as peat bogs, swamps and river alluvium. In Switzerland and Italy, on the contrary, they occur in gravel deposits, (diluvium,) which are said to have been deposited previous to the scattering of the Alpine boulders over the plain of Switzerland and the Jura, and previous, also, to the furrowing and polishing of the rocks. It is plain, from these facts, that, in taking as a point of reference the transportation of boulders and the polishing of the rocks, which are similar in both countries, the mammoths of Switzerland and Italy must have lived long before those of the North of Europe and America, being moreover separated from them by the most important event of the quaternary period, the transportation of boulders and furrowing of the surface rocks. According to some geologists, it was an event of such magnitude that it caused the destruction of all the living animals, which were supposed to have been suddenly frozen to death ; and, in support of this view, we are referred to the elephants which are found frozen in the mud along the rivers of Siberia. Other geologists take a different ground. They contend that, since the mammoths of the North of Europe and America are identical with those of Italy and Switzerland, (*Elephas primigenius*,) they cannot but be of the same geological age, and, rather than refer them to different periods, they prefer to oppose the assumption of a simultaneous transportation of boulders in both countries ; thus assuming two glacial epochs instead of one. This is especially the ground taken by M. D'Archiar. In reference to this question, Mr. D. read the following extract from a letter from M. Martins, Professor of Geology at the Sorbonne, at Paris :—

"I do not see why you consider it absolutely necessary that the mammoths of Italy and those of the North of Europe and America should have lived at the same epoch. I, for my part, do not feel compelled to that conclusion. I go farther, and say that *a priori* the contrary opinion appears as the most warrantable. There, (in America,) you have a vast continent, which is undergoing upheavals and subsidences even during the actual period ; here, (in Switzerland,) you have a country with high mountain chains, which, since the Pliocene epoch, has never been invaded by the waters of the sea. What, then, is there strange in the fact, that the one should have had mammoths at a time when the others had none? Thus far I do not see any reason for assuming, with M. D'Archiar, two epochs of striæ and furrows. What is the law, either paleontological or zoological, which proves that the same animals have lived everywhere at the same time and epoch?"

M. Martins, as will be seen, enters here upon an entirely new ground, by setting aside one of the broadest principles of geology, which was almost a creed. Mr. D. said that he was not prepared to meet the question on this new ground, which could not fail to attract attention, and will undoubtedly give rise to many interesting discussions.

ON THE EXISTENCE OF DUNES ON THE SHORES OF THE AMERICAN LAKES.

At a meeting of the Boston Society of Natural History, March, 1851, Mr. Desor made some statements in relation to the existence of Dunes on the shores of the upper American Lakes. He said that they were peculiarly interesting as being the only ones of any consequence, so far as his knowledge went, which had been noticed on the borders of an inland sheet of water. On the eastern shore of Lake Michigan they are several hundred feet high. On the north shore, at Point aux Chiens, they are from 80 to 100 feet high, the highest being half a mile from the Point. They gradually diminish in size, extending along the shore to the west some six miles, until they are reduced to heaps not more than 25 feet high. They present no signs of stratification, nor do they contain pebbles, except a few in the depressions between the hillocks, where they have been thrown by the waves in severe gales. The back slope has an angle of 32°. In those positions where the ridges are perpendicular to the coast line, the steep side is always opposite to that of the prevailing wind. This feature is also noticeable at several places along the shore of Lake Superior. A peculiarity of the dunes of Lake Michigan is, that they are often covered with trees of considerable size. A white pine, growing on the top of the highest ridge, was found by Mr. Desor to be eight feet in circumference, showing that, at this spot, the dune has remained unchanged for a considerable time. The existence of these dunes on the borders of fresh water refutes the opinion hitherto held by geologists, that the action of the tide is necessary for their formation, enough sand drying, during the ebb, to be borne off by the winds. On the other hand, as they occur only on flat coasts, where the waters are subjected to considerable motion, either from currents or from the action of the winds, or both combined, it is fair to regard these as the agents by which they have been formed.

ON THE GEOGRAPHY OF CENTRAL ASIA.

Capt. Strachey, at the British Association, 1851, presented a communication on the general configuration of Central Asia, in which he pointed out that the elevated region known as Tibet formed the summit of a great protuberance above the general level of the earth's surface, of which the two mountain chains, known as the Himalaya and Kouenlun, were nothing more than the north and south faces, having no special existence apart from the general mass. The plains of Northern India extend along the entire southern edge of the Himalaya, over about 500,000 square miles, nowhere exceeding in elevation 1,200 feet above the sea. From these rise the mountains suddenly, and in a well-defined line. The exterior range, called the Siwaliks by Dr. Falconer and Col. Cautley, is of no great elevation, hardly exceeding 3,000 feet. The characteristic tracts of swamp and dry forest that occur along its southern face, known as Tarai and Bhâbar, and the longitudinal valleys called Dún, along its northern slope, were described. Immediately above these rise the first ranges of the great mountain region that extends to the north, over a breadth of upwards of 200 miles. The loftiest peaks, some of which exceed 28,000 feet in height, are usually found along a line of 80 or 90 miles from the southern edge of the chain, which, in Kumáon, neither is coincident with the water-shed, nor forms a continuous ridge, but is broken up into groups, separated by deep gorges, and connected by transverse spurs with the water-shed range that runs 20 or 30 miles further to the north. On crossing this water-shed, which forms the boundary between Tibet and the British Provinces, the traveller finds himself, not without astonishment, on a plain of 150 miles in length, and 30 or 40 in breadth, the elevation of which varies from 16,000 feet along its southern edge, to 14,500 feet in its more central parts, where it is cut through by the river Sutlej. It is everywhere intersected by stupendous ravines, that of the Sutlej being nearly 3,000 feet deep, which are furrowed out of the alluvial matter of which the plain is composed. The mountains that bound this plain to the north hardly enter the region of perpetual snow; the famous peak of Kailás, which is nearly 22,000 feet in altitude, being the highest point. In regard to the geology of this region, it appears that, from the Siwalik range, which was before known to be of tertiary age, the mountains are formed of metamorphic rocks, until we pass the line of greatest elevation. We then again find fossiliferous rocks, which form a regular sequence from the lower Silurian to the tertiary formation. Fossils from all of these beds have been collected and brought to this country by Capt. Strachey. It is of the tertiary beds that is composed the great plain already described, and in them have been found fossilized remains of elephant and rhinoceros at an elevation of between 14,000 and 15,000 feet above the sea. From a general consideration of these circumstances, it was inferred that the present wonderful development of the Himalaya and of the elevated regions of Tibet dates no further back than the tertiary period; being, in fact, one of the most recent changes that the surface of the earth has undergone. Glaciers abound in all parts of the mountains covered with perpetual snow, descending as low as 11,500 feet. The snow-line, the height of which has given rise to much discussion, was stated to descend to about 15,500 on the southern face of the Himalaya; while it was pointed out that, as we advance to the north of the great peaks, and stand on the mountains bordering the Tibetan plain, the snow line has receded to 19,000 or 20,000 feet. This phenomenon was shown to depend chiefly on the fact that the quantity of snow that falls to the north of the great Himalayan peaks is far less than that which falls on their southern slopes.

ON THE AZOIC SYSTEM.

The following is an abstract of a paper presented to the American Association, Cincinnati, by J. W. Foster and J. D. Whitney, U. S. Geologists.

The term *Azoic* was first applied by Murchison and de Verneuil, to designate a class of crystalline rocks which occur around the Gulf of Finland, whose geological position is below the Silurian system. In it, they include not only gneiss and mica slate, but the igneous rocks, such as granite and syenite, by which they are invaded. We adopt the term, but limit its signification, by applying it to a class of rocks supposed to be detrital in their origin, and to have been formed before the dawn of animal or vegetable life. It comprises the most ancient of the strata which form the crust of the earth, and occupies a distinct position in the geological column; being below the Potsdam sandstone. In this district the rocks consist, for the most part, of gneiss, hornblende, chlorite, talcose, and argillaceous slates; interstratified with beds of quartz, saccharoidal marble, and immense deposits of specular and magnetic oxide of iron. Most of these rocks appear to be of detrital origin, but to have been greatly transformed by long-continued exposure to heat. They are sub-crystalline, or compact, in their texture, and rarely present unequivocal signs of stratification. They have been subject to the most violent dislocations. In one place the beds are vertical; in another reversed; and in another, present a series of folded axes. Intermingled with them is a class of rocks whose igneous origin can hardly be doubted, and to whose presence the metamorphism so characteristic of this series is, in a measure, to be ascribed. They consist of various proportions of hornblende and feldspar, forming traps and basalts; or, where magnesia abounds, pass into serpentine rocks. They appear, in some instances, to have been protruded through the preëxisting strata, in the form of dykes or elvans; in others, to have flowed in broad, lava streams, over the ancient surface; and, in others, to have risen up through some wide-expanding fissure, forming axes of elevation.

Since the theory of metamorphism has been generally recognized, many of the rocks which were formerly regarded as igneous, are now referred to aqueous agency, and the transformation which they may have undergone traced to the presence of erupted rocks. It is reasonable to suppose that there was a time in the history of our planet when its crust was subject to constantly recurring volcanic paroxysms, when mephitic vapors were escaping through extensive fissures communicating with the interior, and when the waters were in a heated condition, and differed perhaps chemically from those of the existing oceans. Under such conditions, we ought not to look for any types of animal or vegetable life.

Many eminent geologists maintain that the lowest stratified rocks are but portions of the Silurian system, and that, from long-continued exposure to heat, the lines of stratification have become obscure, and all traces of organic remains obliterated. Our observations in this district (they remarked) have led us to a different conclusion. If the Potsdam sandstone rest at the base of the Palæozoic series; if from that epoch we are to date the dawn of organized existence, there is, in this district, a class of rocks, detrital in origin, interposed between the lower Silurian system and the granite; rocks distinct in character, unconformable in dip, and destitute of organic remains. If we found these crystalline schists, and beds of quartz, and saccharoidal marble, graduating into clay-slates, sandstones, and limestones, as we receded from the lines of igneous outbursts, and enveloping the remains of plants and animals, we would be led to a different conclusion; but so far from it, the evidence is ample that the base of the Silurian system reposes upon their upturned edges, and that the causes by which the metamorphism of the former was effected had ceased to operate before the deposition of the latter. Between the two systems there is a clear and well-defined line of demarcation. It forms one of those great epochs in the history of the earth, where the geologist can pause, and satisfy himself of the correctness of his conclusions. On the one hand he sees evidence of intense and long-continued igneous agency, and, on the other, of comparative tranquillity and repose.

The Azoic rocks occupy an almost continuous belt along the northern shore of Lake Superior, — subject, however, to occasional interruptions, — and have thence been traced, by Logan and Bayfield, to the coast of Labrador, forming the axis between Hudson's Bay and the Valley of the St. Lawrence.

They are also extensively developed on the southern shore, forming the water-shed between the respective river-systems of Lake Superior, Lake Michigan, and the Mississippi. Wherever the junction between the Azoic and Silurian systems has been observed, the one is found to repose, unconformably, on the other. As the Silurian system on Lake Superior is celebrated for its deposits of copper, so the Azoic system is equally interesting from its ores of iron. Indeed, at some points on the lake, the iron in the form of a nearly pure oxide forms entire mountains; one on Carp river being 1,067 feet above the level of the lake. From the detailed explorations of Mr. Mersch, communicated to Messrs. Foster and Whitney, they had no doubt that the Missouri iron region belonged to the same system of upheaval, and occupied the same relation to the Silurian system. They also stated that the magnetic ores of Sweden, associated with gneiss, belonged to the same epoch. The same was true with regard to the ores of the Champlain region of New York. As to the thickness of the Azoic system, it was impossible to form a correct idea. It might be 20,000, or 50,000, or 100,000 feet. If we were to adopt the usual method of measuring across the basset edges of the strata, it would give us a thickness greater than that of the whole fossiliferous series, from the base of the

Silurian to the crowning member of the Tertiary. It was evident that these strata were everywhere plicated and folded, and that the observer passed over a repetition of beds, instead of a succession of beds; but that the strata, throughout the whole region, had been so shattered by earthquakes, and so metamorphosed by direct or transmitted heat, that it was impossible to identify them, except over limited areas.

Prof. Agassiz remarked, that he had, at the Cambridge meeting of the Association, urged the importance of a close examination of the older rocks of the Palæozoic series, with a view of arriving at a standard for determining the order of succession of the contained fossils. It had long been an unsettled question with European geologists, whether we could accurately fix upon the exact point, in the palæozoic rocks, in which animal life had commenced. Mr. Lyell was of opinion that we could not. Yet it is now established, by the labors of Messrs. Foster and Whitney, that we can accurately determine this point, and feel certain that we have ascertained the exact strata which contained the fossil remains of the first created animals. If the zoologist would view with interest the skull of the first created man, it is with equal interest that we see, in the Potsdam sandstones, the evidences of the first created animals.

ON THE SILURIAN SYSTEM OF CENTRAL BOHEMIA.

M. Barrande, in his observations on the Silurian System of Central Bohemia, recognizes an upper and a lower Silurian, corresponding to what has been made out, first in England, and since in Russia and America. Each of these divisions contains four subdivisions or groups, which he letters A, B, C, D, and E, F, G, H. The lower Silurian consists almost wholly of siliceous and argillaceous rocks, to the nearly total exclusion of limestones; the upper consists mainly of limestones. The limit between the two is marked by eruptions of trap of great extent, which alternate with graptolite schists, in which twenty species of graptolites have been detected. Trilobites, analogous to those of the Caradoc sandstones and Llandeilo flags, (corresponding to subdivision D,) abound in the lower division, while in the upper, great numbers of Cephalopods, Gasteropods, Brachiopods, and Acephala occur, families hardly represented in the lower Silurian of Bohemia. The groups A and B are without fossils, or *azoic*, and have together a thickness of 24 to 26,000 feet. A is composed of semi-crystallized and argillaceous schists, and B to a great extent of conglomerates, alternating with argillaceous schists; they pass almost insensibly into one another. C consists mainly of greenish argillaceous schists, and is not over 1300 feet thick. Its fossils are mostly trilobites, and they are peculiar in having the thorax very much developed, with the pygidium very small. The group D, called also the *quartzite* division, abounds in siliceous as well as argillaceous rocks, and is very rich in trilobites. Its vertical extent is 8 to 10,000 feet. The several subdivisions from C upward are each distinct in their fossils. Not a species of C occurs in D, and even the genera of trilobites are most distinct. The extinction of the fossil species of C is referred to ejections of porphyry and other igneous rocks.

M. Barrande points out the existence of what he calls *colonies* of the upper Silurian interpolated in the D group of the lower Silurian. They are beds, sometimes 100 yards thick, having the upper Silurian character in the fossils. M. Prevost observes that if the existence of such *colonies* can be admitted as proved, (which must require still more investigation,) it indicates a synchronism between two different marine formations, and shows that extended systems of cotemporaneous beds may be paleontologically distinct, while, at the same time, beds of successive ages may be identical in their fossils. — *Bull. Soc. Geol. de France.*

COMPARISON OF THE STRATA OF THE SILURIAN BASIN OF MIDDLE TENNESSEE WITH THOSE OF NEW YORK OF THE SAME AGE.

The results of the examinations of Prof. Hall, of New York, and Safford, of Tennessee, were presented by Prof. H., at the Albany meeting of the American Association.

Prof. Hall commenced by stating that our previous knowledge of this region had been derived mainly from the published reports of Prof. Troost, and from a map of Dr. Owen. From the fossils published by Dr. Troost, it would appear that the lower and upper Silurian, Devonian, and even carboniferous species occurred together in this basin. Prof. H. said that for several years past Prof. J. M. Safford had been making examinations in this part of the country, the general result of which he had presented in a geological map, showing not only the limits of this Silurian basin, but also the subdivisions which he proposed to make, and which were characterized by certain fossils. The fossils collected amounted to some 200 species, about one half of which were identical with those known in the rocks of New York. In general terms we might say that the rocks of nearly the whole of this basin correspond to the lower Silurian limestones of New York. In the lower portion of the series in this basin, Prof. Safford recognizes three divisions. From the lower of these divisions, he has brought eight species of fossils, and of these eight species five are of species characteristic of the birds-eye and Black River limestone in New York, and the other three appeared to be new or undescribed species. From the second division, fifty-eight species had been collected, of which twenty-eight were identical with species known in New York, and mainly those characteristic of the Trenton limestone, a few species only being those which occur in the birds-eye and Black River limestones. In the upper of these subdivisions sixteen species had been found, of which eleven were known as characteristic of New York strata, and nearly all of the Trenton limestone. Prof. Hall had collected a cephalopoda of peculiar structure, in the Black River limestone of New York, and had traced its occurrence in the same geological position as far as the Mississippi River, and it occurred also in the basin of Tennessee. In all the localities it was associated with fossils which were in the same geological position in New York. It seemed, therefore, scarcely possible to avoid the conclusion that this lower limestone of Tennessee was the equivalent of the Black River limestone of New York, and that perhaps, also, a portion of the birds-eye limestone was included with it. In the second and third divisions there were about forty species of fossils common to those rocks, and to the Trenton limestone of New York, making the conclusion unavoidable that the strata of these two portions of country were of the same age. In the same manner it was shown, that the Nashville group of limestones were probably identical with the Hudson River group. In this connection, Prof. Hall showed that the lower Silurian limestones, or those known as the Chazy, Black River and Trenton limestones, thinned out in a north-westerly direction, till they were less than 100 feet thick on the north shore of Lake Michigan, and the west shore of Green Bay; that in Wisconsin they were less than seventy-five feet thick, and at the Falls of St. Anthony, on the Mississippi River, they were less than fifty feet thick. In Tennessee, the same strata, as far as seen, were 200 feet thick, and the base had not been seen. In like manner, the Hudson River group gradually thins out in the west and north-west, its sandy portions disappearing in Canada West; and though eight hundred feet thick in New York, is less than two hundred on the north shore of Lake Michigan, and disappears entirely in Wisconsin. In Tennessee, the rocks corresponding in position are nearly all limestones, and have a thickness of about three hundred feet. The strata succeeding these lower Silurian limestones are known as the gray limestone. From this limestone, forty-two species of fossils had been collected, of which twenty-seven were known species, and common to the rocks of New York, as well as Tennessee. But what was very remarkable was the fact that of these twenty-seven species, several were of the Niagara group, or those known only in the rocks of that period, while others were known only in the lower Helderberg limestones; and others still were found only in the upper Helderberg limestones, or the Onondaga and corniferous limestones. Thus showing that rocks of the middle and upper Silurian periods, and of the Devonian period, were here united in one; or that the formation was altogether so uniform and homogeneous, that no subdivision could be made. That the Onondaga salt group of New York, having a thickness of 800 or 1,000 feet, has entirely disappeared, and that the Niagara and lower Helderberg limestones thus come in contact; and, again, from the absence of Oriskany sandstone, and Candigalli grit, the lower and upper Helderberg limestones are united; and thus the three limestones, so widely separated in New York, become, physically, one limestone in Tennessee. Prof. H. showed that each of these periods in New York were marked by the presence of more than three hundred species of fossils, and that very few of these passed from one group to the next, showing, conclusively, that they were distinct formations, and of distinct and succeeding creations. He remarked that this collection of fossils afforded some evidence of the influence of latitude upon the development of animal life, and that climatic influences had prevailed at that early period as well as in subsequent ones. Of the lower Silurian species, one half were new, or unknown in the rocks of New York, of the same age, from which four hundred species were already known. In comparing the proportion of new species from the northern and north-western localities, there were scarcely more than ten per cent. of new species, while, at the same distance to the south-west, the proportion was ten times as great. Whether or not this proportion would hold true on further examination, it could not now be determined, but since so many specimens had been collected, and over such wide areas, it was evident that there were most incontestable proofs of the occurrence of a larger number of species in localities at the south than in northern localities of the same extent. This difference was, therefore, to be accounted for either from climatic agencies, or from other circumstances more favorable to the development of species in the southern than in the northren localities.

REPORT ON THE GEOLOGY OF THE LAKE SUPERIOR LAND DISTRICT.

The first report of Messrs. Foster and Whitney, United States Geologists, for the Lake Superior Land District, has been published during the past year. It forms a volume of 224 pages, illustrated by numerous charts, maps and plates. From its pages we take the following notes : —

The Lake Superior Land District is bounded on the north by Lake Superior, east by St. Mary's river, south by Lakes Huron and Michigan, and west by the Montreal and Menomonee rivers, being situated between 45° and 49° north latitude and 83° 45′ and 90° 33′ west longitude. A striking feature in the topography of the region is the parallelism of the north-west shore of Lake Superior, the south shore, west of Keweenaw Point, and the narrow island of Isle Royal between, proving, as the authors state, that this part of the lake must be the course of a great synclinal valley, arising from two parallel axes of elevation on opposite sides of the lake. We might add, farther, that this course is *at right angles* to the great range of lakes that extends from Erie and Michigan north-west to the Northern ocean, which range is parallel to the Rocky Mountains and the north-west coast of America on one side, and to Hudson's Bay and the shores of Davis Straits on the other. The district contains an area of 16,237 square miles. The number of rivers comprised in it is 34, of which the largest is the Menomonee. Their aggregate length is 1,478 miles, and the area drained is 10,530 square miles. The course of the rivers is chiefly north-west, the outlets of eighteen being in Lake Superior. The remainder fall into Lake Michigan, Keweenaw Bay, or Lake Huron, or are tributaries of the larger rivers.

The mountains of the region consist of two granite belts in the north-west, the Huron Mountains to the southward, a trap range starting from the head of Keweenaw Point and running west and south-west into Wisconsin, and the Porcupine Mountains. The Huron Mountains in places attain an elevation of 1,200 feet above the lake. The highest elevation attained by the Porcupine Mountains is 1,380 feet.

Meteorological observations were instituted, by order of the government, at three military posts in the district, viz., Forts Wilkins, Brady and Mackinac. From these observations it appears that the mean annual temperature of Fort Brady is nearly two degrees lower than that of Fort Wilkins, although the latter post is nearly a degree further north. This difference arises from the insular position of Keweenaw Point, which is surrounded on three sides by water. The climate of Fort Brady during the whole season corresponds in a remarkable degree with that of St. Petersburg. The temperature of the region is very favorable to the growth of cereals. The annual ratio of fair days at Fort Brady is 168 ; of cloudy days, 77 ; rainy days, 71 ; snowy days, 47.

The temperature of the water of Lake Superior, during the summer, a fathom or two below the surface, is but a few degrees above the freezing point. In the western portion the water is much colder than in the eastern — the surface flow becoming warmer as it advances toward the outlet.

ON THE AGE OF THE CONNECTICUT RIVER SANDSTONES.

The following remarks on the age of the sandstones in the valley of the Connecticut and in New Jersey, were made by Mr. Redfield, of New York, at the Cincinnati meeting of the American Association : —

In the earlier periods of geological inquiry the Red Sandstone rocks of the Connecticut were supposed to be an equivalent of the Old Red Sandstone of England. Resting immediately on crystalline and gneissoid rocks, and apparently deficient in organic remains, there appeared to be no obvious grounds for a different conclusion. On subsequent investigation, Prof. Hitchcock was induced to class these rocks with the New Red Sandstones of the English geologists. At this period, some fishes and remains of plants had been discovered in the rocks ; but their characters were not then so well understood as to be considered decisive of the geological position. Mr. Redfield alluded to the views of Dr. Jackson, and to a paper read by Mr. Wells at different meetings of the Boston Society of Natural History. He was compelled, by the evidence of fossils in his own collection, to dissent wholly from the views of Dr. Jackson regarding the geological position of the sandstones of Nova Scotia, Maine, Connecticut River and New Jersey ; and was also constrained to dissent from the division of the series which Mr. Wells has attempted to establish. Mr. R. has examined the formation attentively in three States, and does not consider the grounds alleged to be of sufficient validity. The whole extent of this formation in Connecticut has been examined most carefully for a series of years by Dr. Percival, apart from its fossils, and an attentive examination of his Report on the Geology of Connecticut will show that, in the default of zoological evidence, no such separation can be established. The conclusion to which Mr. Redfield had himself been led by these fossil remains was, that the Red Sandstone rocks in which they occur are decidedly of Post-Permian date. They *may* belong to the Triassic group, but appear to have stronger affinities to fossils of the Liassic or Oolitic groups. He submitted to the Association some characteristic specimens.

Mr. Foster remarked, that, from the investigations of the Messrs. Rogers, and others, it was indisputable that the metamorphism of the rocks of the Appalachian chain took place at the close of the Carboniferous era ; but that the sandstone of the Connecticut valley had not partaken of that metamorphism. It was also highly probable that the sandstone was older than the coal deposits of Richmond, which were proved to belong to the Oolite. Therefore, whatever might be the ultimate position assigned to this sandstone, it was intermediate between these two epochs. It was found, too, as a general rule, that whenever a great change occurred in the physical conditions of the earth, those changes were indicated by the character of the deposits. Thus, the base of many of the great systems of rocks is occupied by conglomerates, succeeded by coarse sandstone grits ; and it was not until after the lapse of a considerable time, that the finer silts were thrown down. It was also found that these coarse grits and conglomerates were barren of types of organic life ; whereas the finer silts contained the most abundant traces. The fact, therefore, that the sandstone at the base of this series of rocks was unproductive in fossils, while the shales contained numerous traces of their existence, did not necessarily imply that the rocks belonged to two epochs of deposition.

As to the unconformability of the two portions, as described by Mr. Wells, he remarked, that this sandstone, throughout its range, exhibited numerous instances of the intrusion of trappean rocks. These took place at successive intervals, as was evidenced by the manner in which they were intercalated with the sandstones. These belts, like those of Lake Superior, were not the result of protrusion between the strata, but of overflows, like submarine volcanoes, and mingling with the sediments there being accumulated. There might, therefore, be an unconformability between the upper and lower portions of the series, without the necessity of presupposing a great lapse of time, unless that unconformability was found to prevail over an extended area.

ON THE LITHOLOGICAL CHARACTERS OF THE SANDSTONE AND TRAP OF LAKE SUPERIOR.

At the American Association, Cincinnati, Mr. J. W. Foster, U. S. Geologist, in a description of the rocks of the Lake Superior district, adverted to some curious lithological characters exhibited in the trap and sandstone formations of this region : —

" The changes which have taken place in the structure and lithological character of the sandstone and trap, are of an interesting character, and throw much light on the mode of formation of the trappean beds. The upper portions of the sheets of the bedded trap are often highly vesicular, resembling pumice. Fragments of amygdaloid, sometimes rounded, at others angular, are found enclosed in the pumice-like trap, as though they had become detached from, and afterwards reünited to, the mass while in a soft state. Numerous short and irregular fissures, extending to no great depth, are observed on the upper surface of the trap, and in which the sandstone has been deposited. At the junction of the two rocks, where the sandstone lies *above*, it is extremely difficult to determine where one begins and the other ends, and there is little appearance of metamorphism in the sedimentary rock; but, on the other hand, where the trap is the overlying rock, the line of junction is clear and well defined. The trap in this case is more compact, and the sandstone, for a distance of three or four feet, is converted into a jaspery mass. These phenomena have been observed at numerous places, both on Isle Royal and Keweenaw Point. The beds of sandstone are not shattered, nor does the igneous rock penetrate them in the form of dykes or ramifying veins. All the phenomena indicate that the igneous rocks were not protruded in the form of dykes between the strata, but that they flowed like lava sheets over the preëxisting surface, and that the sandstone was deposited on the surface of the igneous mass, in some cases, while the latter was still in an incandescent state."

INFERENCES DEDUCIBLE FROM THE RAIN-DROP IMPRESSIONS IN THE TRIASSIC AND CARBONIFEROUS ROCKS.

Sir Chas. Lyell, in a recent lecture on the impressions of rain and hail in the strata formed in triassic and carboniferous epochs, deduces the following inferences:—"These impressions, in rocks of such remote antiquity, confirm the ideas entertained of the humid climate of the carboniferous period, the forests of which, we know, were continuous over areas of hundreds of miles in diameter. The average dimensions of the drops indicate showers of ordinary force; and show that the atmosphere corresponded in density, as well as in the varying temperature of its different currents, with that which now invests the globe. The triassic hail-marks, moreover, imply that some regions of the atmosphere were intensely cold, and, coupled with the foot-prints, worm-tracks, ripple-marks, and the casts of cracks formed by the drying of mud, these impressions of rain clearly point to the existence of sea-beaches, where tides rose and fell, and, therefore, lead us to presume the joint influence of the moon and the sun. Hence we are led on to infer that, at this ancient era, the earth, with its attendant planet, was revolving, as now, round the sun, as the centre of our system, which, probably, belonged then, as now, to one of those countless clusters of stars with which space is filled."

ROCKS NOT FORMED BY INFUSORIA.

It is evident that infusorial animalculæ can make their appearance, develop, and multiply, only in those places where they find an abundance of the necessary nourishment in a form adapted to assimilation. Several species, and these very widely diffused Infusoria, are distinguished from other species by possessing certain inorganic constituents, namely, silica, which forms the shells, or cuirasses, as they may be termed, of *Naviculæ*, Bacillaria, &c., and peroxide of iron, which is a constituent of many Gallionellæ. The carbonate of lime of the chalk animalculæ is precisely similar to the shells of the common molluscous animals. Many persons have pleased themselves with ascribing the enormous depositions of silica, of lime, of peroxide of iron, in the siliceous fossil strata, in tripoli, in chalk, and in bog-ores, to the vital processes of primeval Infusoria; as if the formation of these enormous geological strata could be effected solely by the vital principle! But they have altogether overlooked the circumstance, that chalk, silica, and peroxide of iron, must first be present, as the necessary conditions of the life of these creatures before they could be developed; and that their constituents at the present moment are never absent from the sea, the lakes and the marshes, where the same forms of animalculæ occur in a living state. The water in which these primeval Infusoria lived contained the silica and the chalk in solution, and in a condition perfectly suitable for their deposition, in the form of marble, quartz, and other similar mineral masses; and this deposition would have taken place inevitably in the ordinary manner, if the water had not contained the putrefying and decaying remains of preceding races of animals, and in them the other conditions of the life of siliceous and calcareous Infusoria.

Without a combination of these circumstances — the presence of these substances constituting the conditions of their existence — none of these species of animalculæ would have propagated and increased to form these enormous masses. These infusorial animalculæ can only be considered accidental media of the form which the minute particles of these depositions exhibit; — accidental, inasmuch as, even without these creatures, depositions of the silica, the lime, the peroxide of iron, would have taken place. Sea-water contains the lime of the coral animals, of the innumerable mollusks existing in this medium, in the same form and condition as it is contained in the lakes and marshes, in which the chalk animalculæ develop themselves, or those mollusks the shells of which constitute the Muschelkalk formations. —*Liebig Letters*, 3*d edition.*

ON THE LAW OF DEPOSIT OF THE FLOOD TIDE.

At the American Association, Cincinnati, a paper was presented by Lieut. C. H. Davis, U. S. N., "On the Law of Deposit of the Flood Tide." This communication was intended to be supplementary to Lieut. Davis' former paper before the Association,* and in some degree explanatory. It was as follows :— "In my memoir on the geological action of the flood tide," says Lieut. Davis, "I stated that the deposits which are constantly accumulating upon every alluvial coast are increased, or have their growth, in the direction of the flood stream. In proof of this, numerous instances were cited of such growth, or accumulation, on the south coast of the State of Massachusetts; and this controlling effect of the flood current was further exemplified by the drift of the materials of wrecked vessels, which was found to be always in the same direction, that is, in the direction of the flood current. Since the memoir referred to was written, additional instances have been collected, equally well authenticated and important, and all tending to confirm the conclusion laid down in that paper. In my inquiry into the mechanical action

* See *Annual of Scientific Discovery*, 1850, vol. I.

of this law, I have been very much indebted to the able paper of Mr. J. Scott Russell, on waves, in the proceedings of the British Association. It may be said here generally that the motion of translation, or motion of the water particles in the positive wave of the first order of Mr. Russell's classification, is such as to make that wave 'a vehicle for the transmission of mechanical force.' This is the form of wave that follows upon the destruction of the waves of the sea upon an alluvial coast. The wave of the sea is of the second order; in passing from the second to the first order, the motion of the particles changes from the motion of oscillation to that of translation. The matter transported by the current of the flood tide is subjected to this wave action; the particles of water and the suspended matter being projected forward at the moment of disintegration with a mechanical power proportioned to the height of the wave. The substances beneath the breaking wave also receive a shock tending to force them further up the beach. It is under the control of this law that the vast material of the tertiary and drift periods, which constitute the flesh and muscles of the great continents, have been saved from wasteful diffusion in the depth of the ocean, and have been grouped around their original sources. It may be assumed to be one of the subordinate fundamental laws of the globe."

After the reading of Lieut. Davis' note, Prof. Bache stated that he had directed the officer engaged in the hydrography of Charleston harbor, to take up a considerable bulk of water at different periods of the ebb or flood tide, with the sand mixed in it, so as to determine the relative amount of deposit in equal quantities of water at different periods of the tide. The examination was not completed, but Lieut. Maffit had reported that the water, during the flood, contained a very much greater amount of sand than during the ebb. The sand of the bar, during the flood tide, is, as termed by sailors, "alive," a fact which confirms signally the proposition of Lieut. Davis.

ON THE GEOLOGICAL AGENCY OF THE WINDS.

The following is an abstract of a paper, read at the American Association, Albany, by Lieut. M. F. Maury: —

In the recent survey of the Dead Sea, by Lieut. Lynch and others, a level was run from the surface of the lake to the Mediterranean, which showed the surface of the Dead Sea to be about 1300 feet below the general sea level of the earth. In seeking to account for this great difference of water level, the geologist examines the neighboring region, and calls to his aid the forces of elevation and depression which are supposed to have resided in the neighborhood. He points to them as the agents which did the work. But is it necessary to suppose that they resided in the vicinity of this region? May they not have been, if not in this case, at least in the case of other inland basins, as far removed as the other hemisphere? This is a question which I do not pretend to answer definitively. But the inquiry as to the geological agency of the winds, in such cases, is a question which my investigations have suggested; and I therefore present it as one which, in accounting for the formation of this or that inland basin, is worthy, at least, of consideration. Is there any evidence that the annual amount of precipitation upon the water-shed of the Dead Sea, at some former period, was greater than the annual amount of evaporation? If yea, where did the vapor that supplied that precipitation come from, and what has cut off that supply? The mere depression of the lake-bed would not do it. If there were ever a river from the Dead Sea to the arms of the ocean about it, we may imagine that river to have abounded with falls, as the rivers do which drain the lakes into the Atlantic. And if we establish the fact that the Dead Sea did ever send a river to the ocean, we carry along with it the admission, that when that sea overflowed into that river, then the water that fell from the clouds over the Dead Sea basin was more than the winds could convert into vapor and carry away again. In the basin of the Dead Sea, in the basin of the Caspian, of the Sea of Aral, and in the other inland basins of Asia, we are entitled to infer that the precipitation and evaporation are at this time exactly equal; were it not so, the level of these seas would be rising or sinking. As far as we know, the level of these seas is as permanent as that of the ocean, and it is difficult to realize the existence of subterranean channels between it and the great ocean. Were there such a channel, the Dead Sea being lower, it would be the recipient of ocean waters; and we cannot conceive how it should be such a recipient without ultimately rising to the level of its feeder. It may perhaps be evident that the question suggested by my researches has no bearing upon the Dead Sea; that local elevations and subsidences alone were concerned in placing the level of its waters where it is. But is it probable that, throughout all the geological periods — during all the changes which have taken place in the distribution of land and water surface over the earth — the winds, which in the general channels of circulation pass over the Dead Sea, have alone been unchanged?

Where does the water which falls from the clouds upon the valley of the great North American Lakes come from? It goes into the sea, and out of the sea it must come again; else "the sea would be full." From what part of the sea, therefore, do the clouds get vapor to make rain of for the lake country?

The researches conducted at the National Observatory, with regard to the winds, have suggested the probability that the vapor which is condensed into rains for the lake valley, and the excess of which the St. Lawrence carries off to the Atlantic, is evaporated by the S. E. trade winds of the Pacific. Suppose this to be the case, and that the winds which bring this vapor arrive with it in the lake country at a mean dew point of 50°. This would make the S. W. winds the rain winds for the lakes, generally, as well as for the Mississippi valley. They are also, speaking generally, the rain winds of Europe; and, I have no doubt, of extra-tropical Asia, also. Now, suppose a certain mountain-range, thousands of miles to the S. W. of the lakes, but across the path of these winds, were to be suddenly elevated, and its crest pushed up into the regions of snow, having a mean temperature of 30° F. Now the winds, in passing that range, would be subjected to a dew point of 30°; and, not meeting with any more evaporating surface between such range and the lakes, they would have no longer any moisture to deposit at the supposed lake temperature of 50°. They could not yield the dew point to anything above 30°. Consequently the precipitation in the lake country would fall off; the winds which feed the lakes would cease to bring as much water as the lakes now give to the St. Lawrence — that river and the Niagara would drain them to the level of their bed. Evaporation would be increased by reason of the dryness of the atmosphere and the paucity of rain; and the lakes would sink to that level, at which, as in the case of the Caspian Sea, the precipitation and evaporation would become equal. Thus, our great lakes would remain inland seas at a permanent level. The salt brought from the soil by the washing of the rivers and rains, would cease to be taken off to the ocean as it now is; and, finally, the great lakes too, in the process of ages, would become first brackish and then briny. Now, suppose the water basins which hold the lakes to be over a thousand fathoms (6,000 feet) deep. We know they are not nearly so deep. But suppose they are 6,000 feet deep. The process of evaporation, after the St. Lawrence had gone dry, might go on until one or two thousand feet or more were lost from the surface; and we should then have another instance of the level of an inland water basin being far below the sea level, as in the case of the Dead Sea; or it might become a rainless district, when the lakes themselves would go dry.

Corallines are at work about the Gulf Stream; they have built up the Florida Reefs on one side, and the Bahama Banks on the other. Suppose they should build up across that pass and obstruct the Gulf Stream, and that in like manner they were to connect Cuba with Yucatan by damming up the Yucatan pass, so that the waters of the Atlantic should cease to flow into the Gulf. What should we have? The Marine Basin, which holds the waters of the Gulf, is in the deepest parts about a thousand fathoms. The officers of the U. S. ship Albany have run a line of deep-sea soundings, from west to east, across the Gulf. The greatest depth they obtained was 960 fathoms, (5,760 feet.) We should, therefore, have, by stopping up the channels between the Gulf and the Atlantic, not a sea level in the Gulf; but we should have a mean level between evaporation and precipitation. If the former were in excess, the level of the Gulf waters would sink down until the surface exposed to the air would be just sufficient to return to the atmosphere as vapor the amount of water discharged by the rivers, the Missippi and others, into the Gulf. As the waters were lowered, the extent of evaporating surface would grow less and less, until nature should establish the proper ratio between the ability of the air to take up and the capacity of the rain to let down. Thus we might have a sea whose level would be much further below the water-level of the ocean than is the Dead Sea.

There is still another process by which the drainage of these inland basins may, through the agency of the winds, have been cut off from the Great Salt Seas, and that is by the elevation of continents from the bottom of the sea in distant regions of the earth — and, consequently, the substitution of a dry land for a water surface, as the sources of vapor supply to the winds that blow over the place. From what part

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of the ocean, I again ask, comes the vapor which forms the rains that fall on that immense water-shed to which the lakes give drainage? My investigations have suggested the idea that they come from the trade-wind region of the South Pacific Ocean. Now suppose that a continent should rise up in that part of the ocean, wherever it may be, that supplies the clouds with the vapor that makes the rain for the lake water-shed — what would be the result? Why, surely, a change of climate in the lake country. An increase of evaporation, because a decrease of precipitation; and, consequently, a diminution of cloudy screens to protect the waters of the lakes from being sucked up by the rays of the sun; and, consequently, too, there would follow a low stage for water-courses, and a lowering of the lake-level.

In the case of Utah, we have an example of drainage that has been cut off, and an illustration of the process by which Nature equalizes the evaporation and precipitation. To do this, in this instance, she is salting up the basin which received the drainage of this inland water-shed. Here we have the appearance, I am told, of an old channel, by which the waters used to flow from this basin to the sea. Supposing there was such a time and such a water-course; the water returned through it to the ocean was the amount by which the precipitation used to exceed the evaporation over the whole extent of country drained through this now dry bed of a river. The winds have had something, probably, to do with this. They are the agents which used to bring more moisture to this water-shed than they took away; and they are the agents which now carry off from that valley more moisture than is brought to it, and which, therefore, are here making a salt-bed of places that used to be covered by water. In like manner there is evidence that the great American lakes formerly had a drainage with the Gulf of Mexico. Steamers have been actually known, in former years and in times of freshets, to pass from the Mississippi over into the lakes. At low water, the dry bed of a river can be traced between them. Now the Salt Lake of Utah is to the southward and westward of our northern lake basin. That is the quarter whence the rain winds have been supposed to come. May not the same cause which lessened the precipitation, or increased the evaporation in the Salt Lake water-shed, have done the same for the water-shed of the great American system of lakes? If the mountains to the west, the Sierra Nevada, stand higher now than they formerly did, and if the winds which fed the Salt Lake valley with precipitation had, as I suppose they have, to pass the summits of these mountains, it is easy to perceive why the winds should not convey as much vapor across them now as they did when the summit of the range was lower and not so cool. The Andes, in the trade wind region of South America, stand up so high that the wind, in order to cross them, has to part with all its moisture, and, consequently, there is on the other side a rainless region. Now, suppose a range of such mountains as these to be elevated across the track of the winds, which supply the lake country with rain, it is easy to perceive how the whole country, watered by the vapor which such winds bring, would be converted into a rainless region. I have used these hypothetical cases to illustrate a position which any philosopher who considers the geological agency of the winds may with propriety consult, when he is told of an inland basin, the water level of which, it is evident, was once higher than it now is; and that position is, that though the evidences of a higher water level be unmistakable and conclusive, it does not follow, therefore, that there has been a subsidence of the lake basin itself, or an upheaval of the water-shed drained by it.

Having, therefore, I hope, made clear the meaning of the question proposed, by showing the manner in which winds may become important geological agents, and having explained how the upheaving of a mountain range in one part of the world may, through the winds, affect climates, and produce geological phenomena in another, I return to the Dead Sea, and the great inland basins of Asia, and ask: How far is it possible for the elevation of the South American Continent, and the upheaval of its mountains, to have had any effect upon the water level of these seas? There are indications that they all once had a higher water level than they now have, and that formerly the amount of precipitation was greater than it now is. Then, what has become of the sources of vapor?

A chain of evidence, which it would be difficult to set aside, can be introduced, if required, to show that the vapor which supplies the extra-tropical regions of the North with rains, comes in all probability from the trade wind regions of the Southern Hemisphere. Now, if it be true that the trade winds from that part of the world take up there the water which is to be rained in the extra-tropical North, the path ascribed to the S. E. trades of Africa and America, after they descend and become the prevailing S. W. winds of the northern hemisphere, should pass over a region of less precipitation generally than they would do if, while performing the office of S. E. trades, they had blown over water instead of land.

The S. E. trade winds, with their load of vapor, whether great or small, take, after ascending in the equatorial calms, a north-easterly direction. They continue to flow in the upper regions of the air, in that direction, until they cross the Tropic of Cancer. The places of least rain, then, between this tropic and the pole, should be precisely those places which depend for their rains upon the vapor which the winds that blow over S. E. trade wind of Africa and America convey.

Now, if we can trace the path of these winds through the extra-tropical regions of the northern hemisphere, we shall be able to identify it by the foot-prints of the clouds; for the paths of the winds which depend for their moisture upon such sources of supply as the dry land of Central South America and Africa, cannot lie through a country that is watered well.

It is a remarkable coincidence, at least, that the countries in the extra-tropical regions of the north, that are situated to the N. E. of the S. E. trade winds of South Africa and America, — that the countries over which theory makes these winds to blow, include all the Great Deserts of Asia, and the districts of least precipitation in Europe. Let any one take a map of Mercator's projection, and on it draw lines from the Tropic of Cancer toward the north, to represent the probable route and direction which the trade winds of the two southern continents take, in their general channels of circulation over the northern continents. The country between these two lines is the country which, in the general system of atmospherical circulation, lies under the lee of S. E. trade wind of Africa and America. And to see where this country is, we have first to ascertain where those two points on the Equator are between which the S. E. trade winds cross, after having traversed the greatest extent of land surface in South America, and then from these points to project lines in the direction which these winds are supposed to take, after rising up in the equatorial calms. These two points will be, one near the mouth of the Amazon, the other not far from the Gallipagos Islands. The part of the Equator between them is the part crossed by the S. E. trades, after having traversed the greatest extent of land, from whose surface the supplies of moisture are most scanty. A line from the Gallipagos, through Florence, in Italy, and another from the mouth of the Amazon, through Aleppo, in Holy Land, would, after passing the Tropic of Cancer, mark upon the surface of the earth the route of these winds. This is that "lee country" which, if such be the system of atmospherical circulation, ought to be scantily supplied with rains. The hygrographic map of Europe, in Johnston's Physical Atlas, places the region of least precipitation between these two lines. It would seem that nature, as if to reclaim this "lee" land from the desert, had stationed by the wayside of these winds a succession of inland seas to serve them as a line of relays, for supplying with moisture this thirsty air. There is the Mediterranean Sea, the Caspian Sea, and the Sea of Aral, all of which are situated exactly in this direction, as though these sheets of water were designed, in the grand system of aqueous arrangements, to supply with fresh vapor winds that had already left enough behind them to make an Amazon and an Orinoco of.

The Andes were once covered by the sea; for their tops are now crowned with the remains of marine animals. When they and their continent were submerged — admitting that Europe in general outline was then as it now is — it cannot be supposed, if the circulation of vapor was then such as I suppose it now to be, that the climates of that part of the old world which is under the lee of those mountains, were then as scantily supplied with moisture as they now are. When the sea covered South America, the winds had nearly all the waters which now make the Amazon to bring away and to distribute among the countries situated along the route ascribed to them.

Is there any evidence that the basin which holds the Caspian Sea has been more copiously watered than it is now? There is evidence in favor of the probability that it has been, for portions of that sea have retired and left salt-beds behind. If ever the Caspian Sea exposed a larger surface for evaporation than it now does — if the precipitation in that valley ever exceeded the evaporation from it, as it does in all valleys drained into the open sea — then there must have been a change of hygrometrical conditions there. And, admitting the vapor springs for that valley to be situated in the direction supposed, the rising up of a continent from the bottom of the sea, or the upheaval of a range of mountains across their route in certain parts of America, Africa, or Spain, might have been sufficient to rob the air of the moisture which it was wont to carry away and precipitate upon this great inland basin. See how the Andes have made Atacama a desert, and of Western Peru a rainless country, simply by the rising of a mountain range between these regions and their vapor springs.

The great inland basin of Asia in which are the Aral and the Caspian Seas, is situated on the route which I make the thirsty winds from Africa and America to take, and so scant of vapor are these winds when they arrive in this basin, that they have no moisture to leave behind. Just as much as they pour down, they take up again and carry off. The level of the Caspian Sea is as permanent as that of the whole ocean. We know that the volume of water returned by the winds, the rains, and the dews, into the whole ocean, is exactly equal to the volume which those seas give back to the atmosphere ; for, as far as our knowledge extends, the level of each of these two seas is as permanent as that of the great ocean itself. It is estimated that three times as much water as the Mediterranean receives from its rivers is evaporated from it. This may be an over-estimate, but the fact is made obvious, by the current which the Atlantic sends in through the Straits of Gibraltar, that the evaporation from it is in excess of the precipitation ; and that the difference, whether it be much or little, is carried off to modify climate elsewhere. But supposing the Mediterranean to be barred up across the Straits of Gibraltar ; the demand for vapor from it would exceed the supplies of water to it, and it would begin to dry up. As it sinks down, the area exposed for evaporation would decrease, the supplies to the rivers would diminish, until finally there would be established between the evaporation and precipitation an equilibrium, as in the Dead and Caspian Seas; but for aught we know, the water level of the Mediterranean might, before this equilibrium were attained, have reached a stage far behind that of the Dead Sea level. The Lake Tadjura is now in the act of attaining such an equilibrium. There are connected with it the remains of a channel by which the water ran into the sea. Its surface is now 500 feet below the sea level. If not in the Dead Sea, do we not, in the valley of this lake, find out-cropping some reason for the question — What have the winds had to do with the phenomena before us ? The winds, in this sense, are geological agents of great power. It is not impossible but that they may afford us the means of comparing directly geological events which had taken place in our hemisphere with geological events in another. The tops of the Andes were once at the bottom of the sea. Which is the oldest formation, that of the Dead Sea, or the Andes ? If the former be the older, then the climate of the Dead Sea must have been hygrometrically very different from what it now is.

In regarding the winds as geological agents, we can no longer consider them as the type of instability. We rather behold them in the light of ancient and faithful chroniclers, which, upon being rightly consulted, will reveal to us truths which nature has written upon their wings in characters as legible and enduring as she ever engraved the history of geological events upon the tablet of the rock.

It is probable that the salt of the sea is washed into it by the rains and rivers from the land. The waters of Lake Titicaca, which receives the drainage of the great inland basin of the Andes, are only brackish, not salt. Hence we may infer that this lake has not been standing long enough to become brine, like the waters of the Dead Sea; consequently it belongs to a more recent period. On the other hand, it will also be interesting to hear that my friend, Captain Lynch, informs me, that in his exploration of the Dead Sea he saw what he took to be the dry bed of a river, that once flowed from it. And thus we have two more stout links, and strong, to add to the circumstantial evidence going to sustain the testimony of this strange and fickle witness, which I have called up from the sea to testify in this presence concerning the works of nature, and to tell us which is the older, the Andes watching the stars with their hoary heads, or the Dead Sea sleeping upon its cubic beds of crystal salt.

DEEP-SEA SOUNDINGS.

The system of deep-sea soundings, instituted some years since, by Lieut. Maury, and since carried out to some extent by our national vessels, has been prosecuted with success during the past year.* Capt. Platt, in the sloop of war "Albany," has run a line of deep-sea soundings across the Gulf of Mexico, from Tampico to the Straits of Florida. The basin which holds the waters of this gulf has thus been ascertained to be a mile deep, and the Gulf Stream in the Florida Pass about 3,000 feet deep. In like manner the "John Adams," Capt. Barron, has made a step in giving us the shape of the great Atlantic basin between the Capes of Virginia and the Island of Madeira, showing it to be at least five miles and a half deep. The method of measurement now pursued is the suggestion of Prof. Guyot, and consists of ordinary packing-twine attached to a thirty-two-pound shot, which is allowed to run out until the shot strikes bottom, when the uncoiling is of course suspended. The length of the twine is previously ascertained, and the depth attained is known by measurement of the quantity remaining upon the reel. Improvements have been made upon this system by waxing the twine and timing its rate of descent.

In order to promote the schemes of Lieut. Maury, the Navy Department has ordered the commanders of all national vessels to make deep-sea soundings whenever it is practicable, in whatever part of the ocean they may happen to be cruising. The following is a specimen of the soundings made by the "John Adams" in the North Atlantic, as reported to the department:—

"May 3, 1851. Latitude 33° 50′ North; longitude 52° 34′ West; temperature of the air 64°, water 65°. Had a fair "up and down" sound with (2,600) twenty-six hundred fathoms of line. Time of running out, 1 hour 23 minutes 10 seconds — one 32-pound shot on the line.

"May 9. Latitude 32° 06′, longitude 44° 47′ West; temperature of the air 66°, water 68°. Got bottom with (5,500) five thousand five hundred fathoms of line out. Time of running out, 2 hours 44 min.

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* See *Annual of Scientific Discovery*, for 1851, p. 264.

28 seconds. Drift of ship, 3 miles. Lost two 32-pound shot and 5,500 fathoms of line.

"May 10. Latitude 31° 01′ North; longitude 44° 31′ West; temperature of the air 68°, water 68°. Got bottom with (2,300) twenty-three hundred fathoms of line out. Time of running out, 1 hour 04 minutes 35 seconds."

CORAL REEFS OF FLORIDA.

At the American Association, Cincinnati, Prof. Agassiz presented the results of an exploration of the coral reefs of Florida, made under the auspices of the U. S. Coast Survey, with a view of investigating the character of the coast and the structure of its extensive range of corals.

In describing these reefs, Prof. Agassiz remarked, in the outset, that they differed entirely from the coral reefs of other seas, which have been so ably described by Mr. Darwin, in the British explorations under Capt. Fitzroy, and by Mr. Dana, in the United States Exploring Expedition, under command of Capt. Wilkes. In order to point out the peculiar characteristics of the reefs of Florida, it would be necessary to speak of the reefs of other regions, and particularly those of the Pacific. These are divided into three classes; viz., the Fringing Reef, the Barrier Reef, and Atolls or Lagoons — islands. The characters of each of these divisions fully justify such a classification. But in the case of the Florida reef, the coral formations extend in several parallel ridges between the main land of Florida and the Gulf Stream, in a westerly course; diverging more and more from the main land, until, near Cape Sable, they are forty miles distant; stretching like a broad arm into the Gulf of Mexico, and extending in a southerly direction into the rapid current of the Gulf Stream. The Pacific Ocean reefs, on the contrary, grow in the open sea, and differ essentially in character from those of Florida. The principal reef of living corals in Florida occurs between the main keys and the rapid sea current which runs between Cuba and the islands encircling the main land of Florida; but other coral deposits, of a peculiar nature, are found to exist around, upon, and between the keys of the main land. The combined action of the tides and currents produces eddies, in which fine sand, and even mud, is deposited around the reefs. These materials, Prof. Agassiz considers to be minute fragments, or an impalpable powder, held in suspension by the water, which is rendered milky white by their presence. At a short distance beyond, the water becomes clear.

The three classes of coral reefs, distinguishable elsewhere, are, first, the "fringing reefs;" secondly, the "barrier reefs," which form rising walls at some distance from the main land, between which and the land a broad and safe channel frequently exists; and, thirdly, the "lagoons," or islands, which present circular walls, sometimes continuous, and sometimes broken up. The lagoons often constitute accessible and safe harbors. These encircling reefs are formed in a similar manner to the barrier reefs, by the growth of coral from an unknown depth to the surface. The formation of the two latter classes of reefs has been ascribed to the subsidence of the bottom, combined with the upward growth of the corals. The range of living, reef-building corals has been ascertained to be limited between a depth of sixteen to twenty fathoms, and a few inches below low-water mark; for, unless constantly submerged, they die; but they are frequently found dead at enormous depths, forming walls of coral rocks very precipitous.

In Florida, we have no barrier reef, but a series of concentric reefs enclosing parallel channels, formed without the slightest indication of submergence or upheaval. There are the outer reef, the Florida keys, and the shore bluffs, with the main channel, south of the keys; the mud flats, between the keys and the main land, with a slight depth of water, often not more than two feet; and flat, low islands, on which there is an extensive growth of mangroves. The keys rise from ten to twelve, seldom thirteen, feet above the level of the ocean. Near the shore there are mud and coral sand accumulations, which are evidently the results of the decomposition of the solid parts of the corals themselves. Beyond the keys, the channel is from five to six, and seldom more, fathoms deep. Its boundaries are frequently indicated by small islands or shoals, some of which form very dangerous reefs, such as Carysfort reef. It is within this channel that the wreckers take up their abode, being safely sheltered from the strong gales which blow frequently outside, behind the walls of the outer reef and the bar islands, rising for a few feet above the level of the ocean. No coast, said Prof. A., has a more secure and safe navigation than this, if it be properly understood; every twenty miles there is the broadest and safest harbor to run into. But, at present, it is perhaps more dangerous to know of these harbors than to be ignorant of their existence; for the lights and signals along the shore are located without reference to using these places of refuge.

Adverting to the geological and zoological character of the general reef, the Professor remarked that it was important to ascertain whether, as reported by some, the reef consisted of dead corals only; or, as others maintained, was composed of living corals, still growing and extending; or whether, as it had been asserted by others, it consisted only of oolitic rocks, containing no indications of corals whatever. All these statements are found to be consistent with the qualification that the three classes occupy different localities. On the outer reef, from Cape Florida to Key West, in from ten to twelve fathoms up to the surface of the water, living corals are found, greatly differing, however, in constitution — the Madrepores (*Madrepora palmata*) especially rising to the very surface, while the commonly so called brain coral (*Meandrina*) occurs in the lower, and the *Astræa* in still lower levels. Specimens of the different species were exhibited. The *Madrepora palmata* form extensive fields of powerful stems, branching and expanding near the surface into large flats, resting upon strong bases, and presenting the appearance of leaves spread out. The Professor characterized these fields as a wonderful spectacle. This extensive growth does not occur, however, further than one or two fathoms below the surface. Lower down a number of other species are found.

When a growing reef has attained its maximum height, or reached the level of low water, a new process begins, consisting chiefly in the accumulation of loose materials upon its summit. Large coral bowlders are thrown up, and gradually ground into fragments, coral gravel and sand, and finally deposited in more or less regular beds, presenting all the complications of torrential stratification, which are finally cemented, by the infiltration of amorphous limestone, into compact coral rock. When the materials are combined in a coarse state of decomposition, they form a kind of coral breccia ; but when cemented after they have been reduced to small globular fragments, they constitute a sort of oolite, and even compact limestone, when the deposit is formed by precipitation. Thin layers of such compact limestone occur frequently as dividing seams in the larger masses of oolite ; and there is everywhere such a layer of compact limestone upon the surface of all coral rocks rising above the level of the sea ; a circumstance which seems to indicate that such layers are not formed under a permanent sheet of water, but must be the result of action of gales and the spray. This is the more probable since this superficial crust is nowhere horizontal, but follows all the irregularities of the soil.

If it were asked how corals which, during their growth, have withstood so effectually the violence of the sea, become such an easy prey to the waves after the reef has reached the surface of the water, it would require only to point at the innumerable boring shells and worms which establish themselves in the dying part of their stems, and at the brittleness arising from these perforations, to satisfy every careful observer that the peculiar mode of life of these boring animals is a provision of nature subservient of the secondary purpose of the corals, to furnish materials for the increase of the solid parts of our globe.

Along the outer reef of Florida, and in the main range of keys, many islands may be selected and described, in such an order as to form a natural series, from a living reef, without a dead fragment upon its edge, to an extensive island, apparently formed entirely of coral rock or of oolite, or even of compact limestone ; but, in reality, presenting only a cap of such dead materials, overlying a true reef, once living, and now buried under its own fragments. The circumstance that the main keys and the shore bluffs, which have been formed successively, rise to the same height above the level of the ocean, is an unquestionable evidence that the ground, over which the general reef of Florida extends, has undergone no change of level ; that it has neither been raised nor subsided. This evidence may be carried further, by comparing, also, the Everglades with their intervening ridges and hammocks, which are, in reality, inland keys and islands, similar to the main keys and Mangrove islands, formed in the same manner as those now surrounded by the sea, and which, by the uniformity of their level, furnish additional evidence that the whole region has been stationary ever since corals began to grow in those latitudes.

The question of most interest to the Coast Survey, in the examination of these coral formations, was that of the probability of another reef being formed at some future time beyond the present outer reef. Until some conclusion could be arrived at in regard to this question, it would be impossible to select, with confidence, any sites for lighthouses, buoys, beacons, &c. Prof. Agassiz, as the result of his examination, declared his full conviction was that *no other reef would ever be so formed.* He then stated that he believed there had taken place *no elevation in the region*, as most have supposed. He had examined the upland keys carefully, and he found that, in all, the coral formation did not extend *above water mark.* From the main land a flat had extended off into the sea, and, at the proper depths, these little animals had commenced the inner reef, which gradually rose to the surface. Upon this reef, in many places, fragments of coral, and sand in layers, had been driven by the action of winds and waves, so that these islands were several feet above the water; but, in no instance, does the living coral formation exist above the present sea limit. Hence there had been no elevation, but all the elevation had been caused in this manner. Between this reef and the main land the basin which had been formed by the reef gradually filled up and formed the shallow mud flats. Beyond this reef the sand had been washed up, and the flat had been raised, until the conditions necessary for the existence of the polypi were obtained, when the outer reef was commenced and raised to the water level, for the polypi cannot work above the water. This reef would undoubtedly be increased laterally, and sand and detritus be washed upon it, forming a series of keys like the inner reef, but no reef would be formed beyond, because this reef was reared on the extreme limit of the flat, and outside this reef *the shore was precipitous and deep into the channel of the Gulf Stream*, and hence the conditions for the formation of another reef *could never exist.* It was only necessary, then, to build lighthouses on this outer reef, and the coast was as safe as any coast, for there were abundant entrances within the outer reef where a vessel would ride in safety. The water was yet deep between the two reefs; but, as the lights are now placed, they rather allured the vessel on to the outer reef than warned them of danger, and, he thought, had been erected according to the suggestions of the wreckers.

The formation of the so-called "Everglades" is described as follows: —"This portion of the peninsula is only a vast coral bank, composed of a series of more or less parallel coral reefs, which have successively grown from the bottom of the sea up to the surface, and have been added to the main land by the gradual filling of the intervals which separate them, with deposits of coralline sand and debris, brought thither by the action of the tides and of the currents. On the solid reefs, the action of the waves accumulates masses of sand and mud the height of twelve feet above the sea level. This soil soon becomes fixed by the growth of mangrove trees and other plants. The intervals, being lower, form large fresh water swamps, filled with every kind of aquatic plant, through which the Seminole, like the white man, can penetrate only in a boat. The higher and drier reefs are the so-called hammocks, which rise like islands from the deep and green swamps that bear the name of everglades. This formation still goes on. The series of keys, as they are called, which border the southern and eastern coast, and terminate with the Tortugas Islands, far beyond the point of Florida, are only a new line of hammocks which will soon be united to the main land by everglades formed by the deposits of the sea."

ON THE SOLIDIFICATION OF THE ROCKS OF THE FLORIDA REEFS.

THE following is an abstract of a paper read at the American Association, Albany, by Prof. E. N. Horsford : —

It is required to ascertain by what processes, chemical or mechanical, or both, the surface and the submerged rocks have become hardened. By the surface rocks is intended that thin brown crust, composed of numerous layers, which is distinguished by great compactness, and which occurs on the abrupt ocean side, and more abundantly on the long slopes on the land side of the Keys. By the submerged rock is intended the rock of oolitic appearance, which has solidified under water, and which is of superior hardness to the surface rock. The surface rock, so called, has, in many places, no longer the outermost position, though it had at the time of its formation. It is indeed inter-stratified with friable light-colored limestone. The epithet indicates the circumstances of its formation, not its present position. We are familiar with the fact that a mixture of quicklime, water and sand, spread out upon walls and ceilings exposed to an atmosphere containing carbonic acid, in a few days becomes hard. Analyses have shown that two chemical phenomena are concerned in the solidification, viz., the absorption of carbonic acid from the air, forming carbonate of lime, (which salt, uniting in equivalent proportions with the hydrate, forms a compound of great stability,) and the union of the outer portions of the sand-grains with the lime forming a silicate. Investigation has shown that sand fulfils, mechanically, a more important office by increasing the extent of surface to which the compound of the hydrate and carbonate may attach itself. The latter office may also be performed, and equally well, by pulverized limestone. It is well known that calcareous springs deposit carbonate of lime in crystalline forms. The salt had been held in solution by carbonic acid contained in the water. Upon reaching the surface, under less pressure and the influence of a high temperature, its carbonic acid is given up, and with it a precipitate of carbonate of lime takes place.

The value of hydraulic cements is now conceived to depend chiefly upon the presence of silica and lime, the oxide of iron having little or nothing to do with solidification. The alumina, in the form of a silicate, yields its silica to the lime, which, for its transportation, requires water. This explains at once the necessity of its being retained under water periods of variable length, according to the proportions of the ingredients. Gypsum, from which water of crystallization has been expelled by heat, rapidly hardens upon being mixed with water. This is ascribed to the reünion of the sulphate of lime with the water.

Do either of the above processes furnish a suggestion as to the methods by which the rocks of the Florida reefs have been hardened?

The facts presented in furnished. specimens are as follows : — The rock formed under water exclusively is composed of grains of size less than that of a mustard seed, which, to the naked eye, appear quite globular and of uniform diameter. More carefully examined with a microscope, they are found to be far from regular in form or uniform in size, but present numerous depressions and prominences. Distributed throughout the intervening spaces is a fine deposit of carbonate of lime, which adheres with considerable tenacity to the surface upon which it rests.

The surface or crust rock, though not strictly homogeneous, is composed of particles so minute as not to be distinguished from each other. It is soluble in hydrochloric acid. It contains neither silica nor sulphuric acid. Quantitative analysis showed the mass to be for the most part composed of carbonate of lime, a little hydrate of lime, and a small quantity of organic matter. These ingredients permitted no action like that occurring in hydraulic cements, in which silica is required, or like that presented in the hardening of gypsum, in which sulphuric acid is necessary. To one of the two remaining processes, if to either, must it be ascribed — and as hydrate of lime is present, it cannot be exclusively assigned to a place with calcareous spring deposits. Now, how could hydrate of lime be provided from carbonate of lime? The completeness of the suit of collections provided for me by Prof. Agassiz has enabled me to answer this question in such manner as leaves, I think, little room for doubt. On the main land against the keys there are depressions which are filled with water, only at long and irregular intervals. This water, like that within and about the keys, abounds with animal life. As the water evaporates, these animals die, and fall upon and mingle with the coral mud at the bottom. As the beds become more and more completely dry, the layer of mud and animal matter hardens till it forms a mass resembling the surface or crust rock. Of this soft, growing rock, specimens were collected. Agitated with water it yielded a turbid fœtid solution. Tested, it betrayed the presence of hydro-sulphuric acid. After standing some hours, a delicate white film was deposited upon the containing vessel, at the surface of the water, which proved to be carbonate of lime.

Conceiving this soft rock to be in the condition in which the solidified crust was at first, the process of hardening seems of easy explanation. The animal matter mixed with the carbonate of lime, containing sulphur and nitrogen, besides carbon, hydrogen and oxygen, in the progress of decay, which warmth and a small quantity of water facilitated, gave, as an early product of decomposition, hydro-sulphuric acid. This, by oxidation, at the expense of the oxygen of the atmosphere, became water and sulphuric acid. The sulphuric acid coming in contact with carbonate of lime, a salt soluble in 10,000 parts of water resolved it into sulphate of lime, a salt soluble in 380 parts of water. The carbonic acid set free, uniting with an undecomposed atom of carbonate of lime, rendered it soluble. At a later period, the nitrogen, going over into the form of ammonia, decomposed the sulphate of lime, forming sulphate of ammonia and soluble hydrate of lime. This hydrate of lime, with an atom of carbonate of lime, united to form the compound in ordinary mortar. The carbonate of lime in solution from the added carbonic acid, as the water is withdrawn by evaporation, takes on the crystalline form, giving increased strength and solidity to the rock. That this explanation may serve, in however small measure, for the crust rock on the land slopes of Key West and all localities of a similar character, it is necessary that there be animal exuvia in coral mud or finely divided carbonate of lime. Both these occur. The water about the keys abounds in animal life.

With the influx of the tide the slopes become overspread with the water and what it contains in suspension. The retreating water, at ebb tide, leaves a thin layer of the animal matter, mixed always, when the water is agitated, with the fine calcareous powder. Before the return of flood tide, exposure to the atmosphere and warmth have secured the succession of chemical changes enumerated above, and a thin layer of rock is formed. A repetition of this process makes up the numerous excessively thin layers of which this rock is composed. On the ocean side, the deposit is formed from spray during winds which drive the froth of the sea, containing, with coral mud, the exuvia from the barrier of living corals upon the low bluffs of the keys.

To these chemical changes must be added the simple admixture of the animal and vegetable matter, which, like mucilage or glue, fills up the interstices, increases the extent of surface, and with it the cohesive attraction, and still further to the decomposition of the organic matter furnishing carbonic acid, which gives solidity to the pulverulent carbonate of lime. The exceeding fineness of the coral mud is due in part to the stone plants which flourish in the waters within the reef, and which admit of ready reduction to a powder of extreme fineness.

No alumina was found in any of the corals analyzed. The stone plant as well as the coral animal possesses the power of abstracting lime from sulphuric acid — the change doubtless being due to double decomposition with carbonate of ammonia excreted from the plant and animal, yielding carbonate of lime — quite insoluble — and sulphate of ammonia of the highest solubility. The building up of the calcareous skeleton becomes, therefore, of exceeding simplicity. The surrounding element yields at once to the exhaling carbonate of ammonia the framework of stone.

The conclusions to which the above research has conducted, are :

That the submerged or oolitic rock has been solidified by the infiltration of finely powdered (not dissolved) carbonate of lime, increasing the points of contact, and the introduction of a small quantity of animal mucilaginous matter, serving the same purpose as the carbonate of lime — that of increasing the cohesive attraction ; and

That the surface rock has been solidified by having, in addition to the above agencies, the aid of a series of chemical decompositions and recompositions resulting in the formation of a cement.

It is one of the grateful reflections arising from this inquiry, that nature has provided, in the very conditions of the growth of the coral, the means of securing, and, in the progress of ages, rendering habitable, the domain cut off from the sea by the emergence of coral reefs.

THE COMPLETED CORAL ISLAND.

The coral island, in its best condition, is but a miserable residence for man. There is poetry in every feature ; but the natives find this a poor substitute for the bread-fruit and yams of more favored lands.

The cocoanut and pandanus are, in general, the only products of the vegetable kingdom afforded for their sustenance, and fish and crabs from the reefs their only animal food. Scanty, too, is the supply; and infanticide is resorted to in self defence, where a few years would otherwise overstock the half a dozen square miles of which their little world consists. Yet there are more comforts than might be expected on a land of so limited extent — without rivers, without hills, in the midst of salt water, with the most elevated point but ten feet above high tide, and no part more than 300 yards from the ocean. Though the soil is light, and the surface often strewed with blocks of coral, there is a dense covering of vegetation to shade the native villages from a tropical sun. The cocoanut, the tree of a thousand uses, grows luxuriantly on the coral-made land after it has emerged from the ocean; and the scanty dresses of the natives, their drinking vessels and other utensils, mats, cordage, fishing-lines, and oil, besides food, drink, and building materials, are all supplied from it. The pandanus or screw-pine flourishes well, and is exactly fitted for such regions; as it enlarges and spreads its branches, one prop after another grows out from the trunk and plants itself in the ground, and by this means its base is widened and the growing tree supported. The fruit, a large ovoidal mass, made up of oblong dry seeds diverging from a centre, each near two cubic inches in size, affords a sweetish husky article of food, which, though little better than prepared cornstalks, admits of being stored away for use when other things fail. The extensive reefs abound in fish, which are easily captured, and the natives, with wooden hooks, often bring in larger kinds from the deep waters. From such resources a population of 10,000 persons is supported on the single island of Taputeouea, whose whole habitable area does not exceed six square miles. Water is to be found commonly in sufficient quantities for the use of the natives, although the land is so low and flat. They dig wells five to ten feet deep in any part of the dry islets, and generally obtain a constant supply. The only source of this water is the rains, which, percolating through the loose surface, settle upon the hardened coral rock that forms the basis of the island. As the soil is white, or nearly so, it receives heat but slowly, and there is consequently but little evaporation of the water that is once absorbed.

Notwithstanding the great number of coral islands in the Paumotu Archipelago, the botanist finds there only twenty-eight or twenty-nine native species of plants. In the Marshall group, where the vegetation is more varied, fifty-two native plants exist. The language of the natives indicates their poverty, as well as the limited productions and unvarying features of the land. All words like those for mountain, hill, river, and many of the implements of their ancestors, as well as the trees and other vegetation of the land from whence they are derived, are lost to them; and as words are but signs of ideas, they have fallen off in general intelligence. It would be an interesting inquiry for the philosopher, to what extent a race of men placed in such circumstances are capable of mental improvement. Perhaps the query might be best answered by another: How many of the various arts of civilized life could exist in a land where shells are the only cutting instruments — the plants in all but twenty-nine in number — but a single mineral — quadrupeds none, with the exception of foreign mice — fresh water barely enough for household purposes — no streams, nor mountains, nor hills? How much of the poetry and literature of Europe would be intelligible to persons whose ideas had expanded only to the limits of a coral island; who had never conceived of a surface of land above a half a mile in breadth — of a slope higher than a beach — of a change of seasons beyond a variation in the prevalence of rains? What elevation of morals should be expected upon a contracted islet, so readily over-peopled that threatened starvation drives to infanticide, and tends to cultivate the extremest selfishness? Assuredly there is not a more unfavorable place for moral or intellectual development in the wide world than a coral island, with all its beauty of grove and lake. — *Prof. Jas. D. Dana, Geology of the Exploring Expedition.*

HEIGHT OF MT. WASHINGTON, N. H.

In the report of the Board of Regents of the University of New York, for 1851, Mr. Joel W. Andrews furnishes the results of some careful barometrical measurements, made with a view of determining the height of Mt. Washington, N. H. From these it appears that the elevation from tide-water in the Hudson river, to the White Mountain House, in the town of Carroll, N. H., is 1622.296 feet.

From the White Mountain House to the summit of Mt. Washington, by way of Mt. Pleasant, the elevation is 4874.322 feet, which sum added to the former, would make the height of Mt. Washington to be 6496.618 feet above tide-water at Albany, as indicated by the barometer. It is, therefore, sufficiently ascertained by experiment, that Mt. Washington, in latitude 44° 15′ N., has a greater elevation than any other mountain summit between the Mississippi and the Atlantic, east and west, or between the Gulf of Mexico and the Gulf of St. Lawrence, north and south. It also appears that the summit of this mountain is within 1000 or 1500 feet of the line of perpetual snow.

ASCENT OF MT. ARARAT.

Mt. Ararat has been ascended for the first time during the past year by a party of Russian and French officers. The height of the mountain is 17,000 feet. M. Khanikoff, in a letter read before the British Association, states "that the ascent does not present upon the side attempted any great difficulties; — above all, with the ample means which we had at our disposal — consisting of cossacks, soldiers, peasants, beasts of burden, tents, provisions, and such like. For myself, I remained twenty-four hours on the top; having maintained an uninterrupted series of horary observations of the barometer, the thermometer, and the psychrometer, to determine the diurnal change in the pressure of the air, the temperature and the humidity, at so considerable a height. A portion of the party remained upon the summit five days, for the purpose of continuing observations." In relation to the effect of this vast height upon the constitution, M. Khanikoff observes: "This elevation does not make itself felt except on the organs of respiration — which are considerably oppressed by the rarity of the air; of which the mean pressure on the sea-coast corresponds with a height of mercury in the barometer of 760 millimetres, while on the summit of Ararat it was only 410 millimetres. This causes a certain inconvenience to be felt all over the body, and makes one feel that the circulation of the blood is not carried on as usual. As to the other symptoms indicated by several travellers — such as tightness of the skin, loss of blood by the lips, the gums, the ears, and even the eyes, consequent on a nervous excitement resembling delirium, — nothing of the kind was experienced by any of us. In fact, the inconveniences of our position, which certainly was not very comfortable, arose not from the height at which we were, but from the cold which prevails at that height — to be experienced everywhere around in winter — and from the snow on which we lay and in which our little tent was overwhelmed. During the greater part of the time the thermometer was between 9° and 27° Fah., which, with the violent wind that prevails constantly in these regions, forms a temperature not very agreeable." — *London Athenæum.*

OBSERVATIONS ON THE MAMMOTH CAVE.

The May number of Silliman's Journal contains an interesting account of the Mammoth Cave, in a letter addressed to Prof. Guyot by Prof. Benj. Silliman, Jr., who has recently made an exploration of its mysteries; and also, in connection with Mr. Mantell, made a collection of the animals found there. One atmospheric phenomenon attracted the attention of these gentlemen, and tasked their ingenuity for a satisfactory explanation; viz., the blast of cool air blowing outward from the cave, which renders it nearly impossible to enter with a lighted lamp. If the external air has a temperature of 90° Fahr., the blast amounts to a gale; but if the air without has a temperature of 59–60°, no current is observed, and the flame of a lamp held in a favorable position indicates none. It immediately occurred to me (said Prof. Silliman) that there must be two currents, one above of warmer air, passing inward, and one below of colder air, passing outward, and the reverse; but experiment soon satisfied me that this was not the case. Only one current could be discovered, and, on inquiry of our intelligent guide, I found that this phenomenon had attracted his attention, and that he was satisfied, from many observations, that only one current existed, and that this flared *out* when the external air was above 60°, and *inward* when this was below 60°.

The phenomenon is accounted for by Prof. Silliman as follows: — The mouth of the cave is the only communication between the external air and the vast labyrinth of galleries and avenues which stretch away for many miles in the solid limestone. The air in these underground excavations is pure and exhilarating, which may, in part, be accounted for by the nitre beds of incredible extent, as the nitrogen which is consumed in the formation of the nitrate of lime must have its proportion of free oxygen disengaged, thus enriching this subterraneous atmosphere with a larger portion of the exhilarating principle. The temperature of the cave is uniformly 59°, summer and winter, and this is probably very near to the annual mean of the external air. The expansion which accompanies an elevation of temperature in the outer air is immediately felt by the denser air of the cave, and it flows out in obedience to the law of motion in fluids, and the outward current continues without interruption as long as the outer air is possessed of a higher temperature than the cave.

The phenomena of life within the cave are comparatively few but interesting. There are several insects, the largest of which is a sort of cricket, with enormously long antennæ. There are several species of coleoptera, mostly burrowing in the nitre earth. There are some small species of water insects, supposed to be crustaceous. Of fish, there are two species, one of which, as is well known, is entirely eyeless; the other has external eyes, but is quite blind. The only mammal, except the bats, is a rat, which is very abundant. Prof. Silliman is of opinion that the excavations of the Mammoth Cave have been formed by water, and by no other cause.

NATURAL BRIDGE IN ALABAMA.

In the recent geological survey of Alabama, by Prof. Tuomey, a natural bridge was examined, which is described as rivalling the celebrated one in Virginia. The location is in Walker county, about a mile from the road. "It occurs," says Prof. Tuomey, "in that geological deposit termed the millstone grit — the lowest one in the coal measures — the only rock which, in Alabama, exhibits the truly wild and romantic grandeur of nature. Before reaching it, our imaginations had been considerably elevated by the descriptions given by our guide; but, notwithstanding, when the reality broke upon us in its full magnificence, we found that our expectations fell very far short of the truth. This grand structure of the Great Architect spans about one hundred and twenty feet, while its height is about seventy. A smaller bridge connects it with the bluff beyond. The symmetry of the main arch will make it almost indestructible, though, of course, its regularity has only been produced by the undermining and breaking down of the rock which, at some by-gone time, existed below it. The cleavage marks of the massive sandstone, of which it is formed, causes it, even in the more minute construction, to resemble an artificial bridge, as these lines make it appear as if built with regularly worked blocks. Beneath it are many pieces of broken and partially water-worn rock — materials, as it were, left by the builders; and these, together with the mighty escarpments round about, would impart a most grand aspect, even if that were not produced by the bridge itself."

TUSCARORA SOUR SPRING.

This spring is situated in the Indian Reserve, about nine miles south of Brantford, and three miles south of the bank of the Grand

River, in the County of Wentworth, Upper Canada. The country, for some distance round, is thickly wooded; but, in the immediate vicinity of the spring, is a small clearing, upon a rising ground, on one side of which is the spring, in an enclosure eight or ten rods square. In the centre of this is a hillock, eight or ten feet high, made up of the gnarled roots of a pine now partially decayed. The whole enclosure is covered with crumbling rotten wood, and resembles a tan-heap; upon digging down eighteen inches, the same material was found, apparently derived from the crumbling away of the enclosure. The whole soil, if it may be thus designated, is saturated with acid water, and the mould at the top of the hillock, as well as without the enclosure, is strongly acid.

The principal spring is at the east side of the stump, and has a round basin, about eight feet in diameter and about four to five feet deep; the bottom is soft mud, and there is no visible outlet; and, at the centre, a constant ebullition is going on from the evolution of small bubbles of gas, which is found on examination to be carburetted hydrogen. The water is slightly turbid and brownish-colored, apparently from the surrounding decayed wood, which, indeed, forms the sides of the basis. It is strongly acid and styptic to the taste, and at the same time decidedly sulphurous; a bright silver coin is readily blackened by the water, and the odor of sulphuretted hydrogen is perceived for some distance round the place. Within a few feet of this was another smaller basin, evolving gas more copiously than the other, and somewhat more sulphurous to the taste, although not more acid. In other parts of the enclosure there were three or four smaller cavities partly filled with water more or less acid, and evolving a small quantity of gas. The temperature of the larger spring was 56° Fah., that of the smaller one 56° near the surface, but, on burying it in the soft mud at the bottom, it rose to 60.5°. The specific gravity was found to be 1005.683.—*Hunt's Survey of Canada.*

GREAT CATARACT IN INDIA.

The river Shirhawti, between Bombay and Cape Comorin, falls into the Gulf of Arabia. The river is about one fourth of a mile in width, and, in the rainy season, some thirty feet in depth. This immense body of water rushes down a rocky slope three hundred feet, at an angle of 45°, at the bottom of which it makes a perpendicular plunge of eight hundred and fifty feet, into a black and dismal abyss, with a noise like the loudest thunder. The whole descent is, therefore, eleven hundred and fifty feet, or several times that of Niagara. The volume of water in the latter is somewhat larger than that of the former; but, in depth of descent, it will be seen there is no comparison between them. In the dry season the Shirhawti is a small stream, and the fall is divided into three cascades of surpassing beauty and grandeur. They are almost dissipated and dissolved into mist before reaching the bed of the river below.

GROTTO DEL CANE.

The Grotto del Cane, or dog grotto, has been so much cited for its stratum of carbonic acid gas covering the floor, that all geological travellers who visit Naples feel an interest in seeing it. Unfortunately, like some other grottos, its enchantment disappears on a near view. It is a little hole dug artificially into the foot of a hill facing Lake Agnano. The aperture is closed by a door, and the space within is barely sufficient for one person to stand erect. Into this narrow cell a poor little dog is very unwillingly dragged, and placed in a depression of the floor, where he is soon narcotized by the carbonic acid. The earth is warm to the hand, and the volume of gas given out is very constant. Such is the world-renowned Grotto del Cane, which, if it did not equal our anticipation, at least afforded us the opportunity of some merriment. — *Prof. Silliman's Notes on Europe.*

THE SALT LAKE OF UTAH.

LIEUT. GUNNISON, of the Topographical Engineers, who has been employed for some time past in the survey of the great basin in which the Salt Lake is situated, speaks of the lake as an object of the greatest curiosity. The water is about one third salt, yielding that amount on boiling. Its density is considerably greater than that of the Dead Sea. One can hardly get his whole body below the surface. In a sitting position, the head and shoulders will remain above water, such is the strength of the brine, and, on coming to the shore, the body is covered over with an incrustation of salt, in fine crystals. The most surprising thing about it is the fact, that during the summer season the lake throws on shore abundance of salt, while in the winter season it throws up glauber salt in large quantities. The reason of this is left to the scientific to judge, and, also, what becomes of the enormous amount of fresh water poured into it by three or four large rivers — Jordan, Bear, and Weber — as there is no visible outlet.

ON EARTHQUAKES.

MR. MALLET, at the British Association, presented some additional observations on the limits of earthquake waves.* The rate of transit was expected to be the least rapid in sand, and most in some elastic, homogeneous, crystalline rock. Accordingly, a mile was measured on the sands near Dublin, and a cask of powder buried at one extremity; — the interval between the firing of the powder and the indication of the shock at the other station, as registered by Wheatstone's chronograph, gave a rate of 965 feet per second as the average of ten good experiments. A shorter base was measured on the granite, and shocks produced by borings three and a half inches diameter, and eighteen feet deep, in which as much as twenty pounds of powder exploded. The experiment was repeated twenty or thirty times; and where the granite was most shattered the shock arrived at the rate of only 1,299 feet per second; under the most favorable circumstances, where the rock was most homogeneous, the impulse travelled at 1,661 feet per second. In many of the most celebrated earthquakes, clocks have been stopped,

* See *Annual of Scientific Discovery*, 1851, p. 273.

and thus indications afforded of the rate at which the shocks travelled. In the Lisbon earthquake of 1761, the shock travelled to Corunna at the rate of 1,994 feet, to Cork at the rate of 5,280 feet, and to Santa Cruz, in Barbary, at 3,261 feet per second. The great Cutch earthquake, in 1819, stopped the clocks in Calcutta, and showed a rate of 1,173 feet per second. The Nepaul earthquake of 1834 stopped numerous chronometers, and the rate of transit from the assumed centre to various places showed a rate varying from 1,000 to 3,000 feet per second. These rates were all lower than would be expected, considering rocks as homogeneous substances; and, perhaps, after all, the earthquake shocks might follow a law altogether different from that of sound waves. Mr. Mallet then called the attention to the catalogue of earthquakes, amounting to nearly 6,000, and exhibited diagrams in which the amount of earthquake disturbance, in all known times, was represented by curved lines; these showed a slight indication of paroxysmal periods, with intervals of a half century or more. A colored map was exhibited showing the distribution of earthquakes, the intensity of the color being proportioned to the frequency of these visitations. On this map the regions of Guinea, Abyssinia and Madagascar were uncolored, no recorded earthquakes having occurred in them. Greenland was uncolored, because the slight shocks felt there might have been occasioned simply by the movement of masses of ice on the coast. Especial attention was called to one spot in the Atlantic, near the line, and midway between Guinea and Brazil; vessels passing this tract almost always experienced shocks; the soundings were extremely variable, some being obtained at 400 fathoms, whilst at very small distances the depth was exceedingly great, as if the bottom was formed by a group of volcanic mountains. The connection between earthquake lines and volcanic lines was very apparent on this map; but some earthquake regions, like Central Siberia, and a tract extending from India to Bohemia, display very little volcanic energy. On a diagram section of the globe, the most distant points at which great earthquakes had been felt were connected by straight lines; these showed what very large portions of the map of the earth might have been affected, supposing the original impulses to have been communicated at any great depths.

NEW VOLCANIC ISLAND IN THE MEDITERRANEAN.

It will be remembered that an island, about 120 feet high and 2,000 feet in circumference, suddenly sprang up in 1831 between Sicily and La Pantellaria. It disappeared about a month after, and at a later period even the sounding lead could give no indication of its existence; but vessels passing over the place it had formerly occupied would sometimes feel a sort of shock, which showed that it was of volcanic origin. In March last, however, the French vessel *Eole*, which was taking soundings in the vicinity, discovered some traces of its existence. Observations made since this time have verified the truth of the preceding observation, and further discovered that the island, which has been christened "Isola Giulia," was only nine feet under water. It is presumed from this that it is gradually rising.

MUD VOLCANO NEAR THE SALT LAKE, UTAH.

A CORRESPONDENT of the Buffalo Commercial Advertiser gives the following description of a mud volcano in the vicinity of the Great Salt Lake: —

This volcano is in a plain of mud, and on the borders of the lake. It is composed of mud, and covers several acres. Steam and water are escaping from some half dozen apertures. The mud is raised up into cones, the highest not five feet from the general surface. They are terminated by tubes, some hardened and lined with crystals of sulphur and other substances. One of the cones throws steam and water 10 or 15 feet into the air. It escapes rapidly, and with a sound resembling the escape of steam from the pipe of a small steam-engine; and it ejects hot and cold water at short intervals. One caldron, some four feet across, boils up until it overflows, then sinks several feet, and again overflows. Nothing is seen but a mass of foam; the water is strongly impregnated with sal-ammoniac. There are other caldrons, from 10 to 20 feet in diameter, filled to within three or four feet with boiling mud, which is occasionally thrown out in every direction. About a mile further off is another collection of mud cones, and on the opposite side an island of volcanic rocks rises to the height of 50 feet; at the foot of it is salt in sheets, strongly impregnated with sal-ammoniac; that from the lake is pure, and is used by the Californians. In the vicinity of the volcano we saw several ledges covered with pumice, and we met with it in various other places on the plains.

EARTHQUAKES REPORTED IN 1851.

EARTHQUAKES, in countries seldom visited by them, are generally regarded as somewhat rare and isolated phenomena. The following table of the earthquakes reported during 1851, will show that these phenomena, at least during the past year, have been somewhat frequent, and in several cases attended with most frightful consequences. The record given does not probably embrace one half the cases actually occurring; many shocks, of greater or less intensity, in remote countries, not being reported. The earthquakes here given are arranged chronologically.

December 10th, 1850, at sea, 850 miles from the coast of Chili, S. A., lat. 38° S., long. 96° W.; the shocks were so sensibly felt on shipboard as to cause apprehensions of having grounded.

January 9th, 1851; several shocks at Malta and the neighboring islands.

January 26th, at Guerrera, Mexico. This earthquake was accompanied by a meteor of great size, which fell upon a neighboring mountain.

January 17th and 21st, and February 4th, 6th, and 14th, in the

Punjaub, the north-west province of India, — no injury of note occasioned.

February 7th, at Carthagena, New Grenada. This earthquake was of great severity, and, had it continued a few seconds longer, would have destroyed the entire city. As it was, much damage was effected.

February 20th, at San Martha, S. A.; somewhat severe.

February 25th, repeated shocks at Trebizond, Asia Minor, and the neighboring countries.

February 26th, at the Sandwich Islands.

April 2d, the great earthquake of Chili, S. A.

April 11th, at the Island of Rhodes, destroying the city of Macri. A volcano opened near the port of Lavirâl, on the same island.

April 17th, shocks of unwonted severity in various parts of Sweden and Norway.

May 17th, at the Island of Gaudaloupe.

May 15th, shocks experienced in California and New Mexico.

May 26th, at Copiapo, S. A.

July 1st, in Hungary and Southern Austria.

July 2d, severe shocks were felt in Missouri, especially in the vicinity of New Madrid. The earth opened in several places, sand and water being thrown up. This is the first time the earth has opened, or that a *blow* has occurred, since the "great earthquake" of 1812.

July 14th, in the kingdom of Naples. This earthquake was one of great severity, and was attended with great loss of life and property.

August 5th, in the Island of Martinique, accompanied with a terrible eruption of the long dormant volcano, Pelee.

October 17th and 20th, in Albania and Dalmatia. This earthquake caused whole villages to disappear, and a great extent of country to be submerged.

November 12th, shocks experienced in California.

Since the commencement of 1852, two earthquake shocks have been experienced in the month of January; one on the 10th, in Massachusetts, sensibly felt at New Bedford, and extending west as far as Connecticut River; the other on the 26th, in Mississippi.

The following is an account of the great earthquake of July 14th, occurring in the kingdom of Naples: —

This convulsion appears to have had its origin in the volcanic region of Mount Volture, about one hundred miles to the south-east of Naples. It is a detached and isolated eminence, 3000 feet in elevation; its slopes and summits are broken into numerous craters, of the vitality of which no record exists, but which bear evidence of eruptive violence at some remote period.

The city of Melfi, containing 10,000 inhabitants, near the above mountain, was totally destroyed, with a great loss of life. No previous warning was given to the inhabitants, but the whole city was prostrated at one shock. This shock was followed by six others, of less intensity, occurring at intervals, within thirty hours. A large number of small cities and villages experienced a like fate with Melfi. The estimated loss of life over the whole district was upwards of 2500.

PHENOMENA ATTENDING THE EARTHQUAKE IN CHILI, APRIL, 1851.

Lt. Gilliss, in charge of the U. S. Astronomical Expedition to Chili, furnishes to the National Intelligencer, Washington, the results of the observations made on the great earthquake which occurred April 2d, 1851, at Valparaiso. He says : — " The instrument for measuring the direction and comparative violence of earthquakes, brought with us, having failed to record any of those previously occurring, in December last I caused a pendulum nine feet ten inches long to be made, with its lead ball, and some fine silver wire suspending the pendulum from a tripod. A common needle is inserted in a cork at the bottom of the ball, which just touches a sheet of glazed paper marked with concentric circles and the points of the compass. The paper lies on a horizontal plate of glass resting on the earth, and is sprinkled with black sand, so that the motion of the pendulum leaves a white line exposed. It is to be regretted that the paper had not been secured to the earth, for during the shock there was a displacement bodily of about half an inch ; but we have a distinct ellipse, whose diameters are 3.5 in. and 2.4 in., and positive evidence that the motion of the disturbing force was in a line varying little from N. by E. to S. by W., or contrary to the supposed direction in which the earth-wave has moved in all preceding great disturbances. Having personally traced the effects of the shock along its eastern line as far south as Rancagora, and also a section across the axis of motion to Valparaiso, no doubt remains on my mind that there are local causes (as the geological formation) which influence both the direction and violence of the phenomenon to a very great extent. At Valparaiso the direction from which the shock came was near N. E. by N. ; though the opinion among the masses is that it came from the opposite quarter. There is no indication that the land has been elevated in any part of the bay. For several days before and after there were extraordinary fluctuations of the barometer, and overcast weather."

PRESENT CONDITION OF VESUVIUS.

The eruption of Vesuvius in February, 1850, and that of the year previous, entirely changed the summit features of this ancient mountain of fire. The former crater disappeared, being filled with scoria and ashes, while *two* craters now occupy the summit of the cone. The deepest and most active of these is that of February, 1850, which is situated on the side of the cone nearest to Pompeii. It is somewhat lower and has a much greater depth than its immediate neighbor, which is on the side of the bay of Naples. We had no means of measuring its depth accurately, but judging from the time required for the returning sound of a stone cast into its mouth, as well as from inspection and comparison, we assumed the depth of the new crater to be from 800 to 1000 feet. It is acutely funnel-shaped, at an angle of not less than 60°. It is impossible, because of the steam and vapors of sulphurous acid, to see its bottom, even if not prevented by the danger of the descent to a position where one might hope to catch a glimpse of its bottom. Its activity at present is confined to the emission of vapor, and even this seems at times, when viewed from the sea, to be wanting. On the summit, however, these vapors appear dense enough, and are sufficient to prevent the possibility of making the entire circuit of the crater. The observer is much struck, not only with the change of form in the summit, as shown by the drawings of Prof. Scacchi, but also with the sharpness of the lip of both craters, which is such that it is hardly possible for more than two persons to stand abreast upon it. During the late eruption, the lava found vent from the base of the cone, on a level with the sand plain which fills the ancient crater of Somma. It here poured out a torrent of scoriaceous red lava through a well defined canal. This is now entirely cold, and we collected from its sides abundant specimens of aphthitalite, which frosted over the rugged cavern like snow. Near this spot also are two fumeroles formed during the last eruption; the largest about 25 feet high, with an aperture of near ten feet, its outer walls black, rugged and forbidding. The flow of lava from the eruption of 1849 was in the direction of the ancient Pompeii, and it was copious enough to destroy a small village, with its vineyards, at the distance of several miles. — *Prof. B. Silliman; Notes on Europe. Silliman's Journal.*

ON THE RESULTS OF THE LATEST RESEARCHES EXPLANATORY OF CARBONIC ACID EXHALATIONS.

Bischoff found that carbonic acid was gradually separated from carbonate of lime by silicic acid with the coöperation of boiling water. This decomposition took place, whether the silicic acid was in a soluble or insoluble condition; for even finely pulverized quartz decomposed the carbonate of lime, the process in that case being rather slower. Carbonate of iron and the carbonate of magnesia behave in like manner; the latter is decomposed even more easily and in greater quantity than the carbonate of lime. The more facile decomposition of carbonate of magnesia is shown by the fact that even boiling water by itself separates the carbonic acid from it, this not being the case with the carbonate of iron. When, therefore, either limestone, dolomite, or sparry iron, occurs at a depth beneath the earth's surface where boiling water heat exists and water has access, carbonic acid will be driven off from these carbonated salts. The Soffoni in Tuscany, discharging boiling hot water from crevices in limestone, must come from a depth where boiling heat exists, and it is very probable that the accompanying carbonic acid arises from the above-mentioned causes. The same must be admitted for the carbonic acid discharged so abundantly in the neighborhood of ancient localities of volcanic action in various parts of central Europe. According to the laws of the increase of temperature towards the centre of the earth, we may calculate that boiling heat exists at a depth of about 8600 feet in these districts, and this depth is certainly within the limits of the clay slate formation of Germany, which is calculated to be at least a mile (German) thick. Calcareous beds (transition limestone) and quartzose rocks occur at this depth; waters penetrate thereto, and carbonic acid is separated from the limestone, as in the above-mentioned experiments. To account, therefore, for the origin of carbonic acid exhalations, we need no more assume that the focus must be where red heat exists, which presupposes a depth of at least five miles (German); for the clay slate or any other sedimentary formation may be the seat of the evolution of the gas, since only in the moderate depths of about half a mile (German) the materials required are present.

ON THE GEYSERS OF CALIFORNIA.

Prof. Forest Shepherd, in a communication published in Silliman's Journal, September, 1851, gives an account of some remarkable geysers by him discovered north-west of the Napa Valley, California. Mr. Shepherd, having noticed what he conceived to be a line of thermal action in the Napa Valley, especially near the foot of Mount St. Helena, determined to trace it, and find its seat or focus of greatest intensity. With this object in view, he travelled, in company with a select party, in a direction north-west of the Napa Valley, and, after encamping one or two nights in the rain, and wandering through almost impenetrable thickets, reached the summit of a high peak on the morning of the fourth day. The scene presented from this point is described as follows: — "On the north, almost immediately at our feet, there opened an immense chasm, apparently formed by the rending of the mountains in a direction from west to east. The sun's rays had already penetrated into the narrow valley, and so lighted up the deep defile, that, from a distance of four or five miles, we distinctly saw clouds and dense columns of steam rapidly rising from the banks of the little river Pluton. It was now the 8th of February; the mountain peaks in the distance were covered with snow, while the valley at our feet wore the verdant garb of summer. It was with difficulty we could persuade ourselves that we were not looking down upon some manufacturing city, until, by a tortuous descent, we arrived at the spot where at once the secrets of the inner world opened upon our astonished senses. In the space of a half a mile square we discovered from one to two hundred openings, through which the steam issued with violence, sending up columns of dense vapor to the height of one hundred and fifty to two hundred feet. The roar of the largest tubes could be heard for a mile or more, and the sharp hissing of the smaller ones is still ringing in my ears. Many of them would work spasmodically, precisely like high pressure engines, throwing out occasional jets of steam, or volumes of hot, scalding water, some twenty or thirty feet, endangering the lives of those who rashly ventured too near. In some places the steam and water come in contact so as to produce a constant '*jet d'eau*,' or spouting fountain, with a dense cloud above the spray; affording vivid prismatic hues in the sunshine. Numerous cones are formed by the accumulation of various mineral salts, and a deposit of sulphur crystals with earthy matter, which often harden into crusts of greater or less strength and thickness. Frequently the streams of boiling water would mount up to the top of the cones with violent ebullition. Some of the cones appear to be immense boiling caldrons, and you hear the lashing and foaming gyrations beneath your feet as you approach them.

It is then a moment of intense interest. Curiosity impels you forward — fear holds you back; and while you hesitate, the thin crust under your feet gives way, and you find yourself sinking into the fiery maelstrom below. The writer, on one occasion, heard the rushing of water under his feet. He struck down an axe, which, on the first blow, went through into the deep whirlpool the whole length of the helve. He withdrew it and cut an opening, which revealed a stream of angry water, boiling intensely, and of unknown breadth and depth. He continued to enlarge the opening until the stream was seen to be five or six feet in breadth, leading on indefinitely into the dark caverns beneath the mountains.

"At the base of the cones, in the bottom of the ravines, and in the bed and on the north bank of the river Pluton, springs almost innumerable break out, which are of various qualities and temperatures, from icy coldness up to the boiling point. You may here find sulphur water, precisely similar to the celebrated *White Sulphur* of Green Brier County, Va., except its icy coldness. Also red, blue, and even black sulphur water, both cold and hot. Also, pure limpid hot water, without any sulphur or chlorine salts, calcareous hot waters, magnesian, chalybeate, &c., in almost endless variety. Where the heated sulphuretted hydrogen gas is evolved, water appears to be suddenly formed, beautiful crystals of sulphur deposited, (not sublimed as by fire,) and more or less sulphuric acid generated. In some places the acid was found so strong as to turn black kid gloves almost immediately to a deep red. Where the heated gas escapes in the river Pluton, such is the amount of sulphur deposited, that the whole bed of the stream is made white for one or two miles below. Notwithstanding that the rocks and earth in many places are so hot as to burn your feet through the soles of your boots, there is yet no appearance of a volcano in this extraordinary spot. Were the action to cease, it would be difficult, after a few years, to persuade men that it ever existed. There is no appearance of lava. You find yourself not in a solfatara, nor one of the salses described by Humboldt. The rocks around you are rapidly dissolving under the powerful metamorphic action going on. Porphyry and jasper are transformed into a kind of potter's clay. Pseudotrappean and magnesian rocks are consumed much like wood in a slow fire, and go to form sulphate of magnesia and other products. Granite is rendered so soft that you may crush it between your fingers, and cut it as easily as bread unbaked. The feldspar appears to be converted partly into alum. In the mean time, the boulders and. angular fragments brought down the ravines and river by the floods are being cemented into a firm conglomerate, so that it is difficult to dislodge even a small pebble, the pebble itself sometimes breaking before the cementation yields.

"The thermal action on wood in this place is also highly interesting. In one mound I discovered the stump of a large tree, silicified; in another, a log changed to lignite or brown coal. Other fragments appeared midway between petrifaction and carbonization. In this connection, finding some drops of a very dense fluid, and also highly refractive, I was led to believe that pure carbon might, under such circumstances, crystallize and form the diamond. Unfortunately for me, however, I lost the precious drop in attempting to secure it.

"A green tree, cut down and obliquely inserted in one of the conical mounds, was so changed, in thirty-six hours, that its species would not have been recognized, except from the portion projecting outside, around which beautiful crystals of sulphur had already formed.

"From the thermal exhalations and the amount of sulphur deposited, it might be supposed that the progress of vegetation would be retarded. But such is not the fact. On the contrary, it is greatly facilitated. The *Quercus sempervirens*, or evergreen oak, flourishes in beauty within fifty feet of the boiling and angry geysers. Maples and alders, from one to two feet in diameter, grow within twenty or thirty feet of the hottest steam-pipes. This, however, may be accounted for by the cold surface water flowing down from the adjacent mountain. Multitudes of grizzly bears make their beds on the warm grounds. Panthers, deer, hares and squirrels, also take up their winter quarters in the very midst of the geyser mounds. Farther down the stream, on the terraced banks of the limpid Pluton, vegetation '*actually runs wild*,' and the winter months exhibit all the fancied freshness of primeval Eden. I have traced the influence of this thermal action from two to three hundred miles on the Pacific coast in California, but only in this place have I been permitted to witness its astonishing intensity. The metamorphic action going on is at this moment effecting important changes in the structure and conformation of the rocky strata. It is not stationary, but apparently moving slowly eastward in the Pluton valley.

ARTIFICIAL TOPAZ.*

M. DAUBREE has communicated to the Paris Academy of Sciences the results of some researches on the artificial formation of Topaz. Pure alumina, previously calcined by a bright red heat, is submitted to the action of a current of fluoride of silicon. After two exposures of this kind, the alumina increased in weight 70 per cent. The product contained fluorine, and, what was more, this fluorine is in such a state of combination as not to be acted upon by boiling concentrated sulphuric acid. By this characteristic alone, the substance produced offers a great resemblance to topaz, the four constituent elements of which it also contains. A quantitative analysis indicated its very near approach to, if not identity with, topaz. Its specific gravity, which is 3.47, is the same as that of natural topaz.

CLINOCHLORE; A NEW SPECIES.

MR. W. P. BLAKE, of the Yale Analytical Laboratory, has examined the beautiful green foliated mineral from Chester County, Pa., which has hitherto been supposed to be chlorite. On the examination by polarized light, Mr. Blake finds that the mineral is *biaxial*, with a high angle between the optic axes, being in one specimen 84° 30′, and in

* See *Annual of Scientific Discovery*, 1850, p. 212, 1851, p. 167.

another 85° 59′. He also found that the optic axes were not equally inclined to the "normal," showing the crystals to be clinometric.

Mr. Blake gives the results of a blowpipe examination, which show the presence of water, silicic acid, oxides of chromium and iron. He has given it the name *Clinochlore*, in allusion to the great obliquity of the optic and crystallographic axes, and its green color.—*Am. Jour. Sci.*, vol. xii.

RED SAPPHIRE.

Mr. W. P. Blake, in a communication to Silliman's Journal, Jan. 1852, states that he has recently discovered a new locality of red sapphire in the township of Vernon, Sussex Co., N. J., where it occurs in the well known white crystalline limestone of that region, and with the associated minerals appears to constitute a true vein of segregation. As the minerals have been but recently removed, there has not been time to bestow on many of them the examination they require, and therefore a brief notice only can be given at this time. The sapphire is remarkable for its irregular "ragged" form, which is best seen in those crystals which were obtained from the soil where atmospheric agencies had removed the calcareous investment, and left the sapphire with its thin and ragged excrescences entire. The color of the finest specimens is "ruby red;" others have various shades of purple: — they are translucent, no *transparent* specimens having been obtained.

The associated minerals are remarkable for their beauty and peculiarity. The following list embraces those which occur in greatest abundance: red spinel, rose spinel, chondrodite, hornblende, iron pyrites, phlogopite, graphite, hydrous-sesquioxide of iron, hydrous silicates of alumina. The following minerals occur sparingly: rutile, sphene, ilmenite, zircon, blue fluor, and emerylite.

GRANITE FIRE-CLAY.

A discovery, of great service to the consumers of fire-clay and fire-bricks, has been made at the village of Steep Brook, Fall River, Mass. It had been long known that a decomposed granite there was suitable for fire-resists, and as such possessed the highest qualities; but the supposed small extent of the bed prevented the sale of more than a few hundred tons. Those who had used the material and become acquainted with its properties, requiring further supplies, an extended survey and the necessary openings have been made, and the result is, the development of a large deposit of this valuable mineral. A chemical examination of this clay, by Dr. A. A. Hayes, of Boston, shows that "it is a mass left by the decomposition of a granite, probably of the normal kind, in which no mica exists, or if of ordinary granite, every trace of mica has disappeared. The chemical change has been such as to break up the granite, first into quartz, granules and sand, distributed as if in granite rock, nearly uniformly, throughout a paste of porcelain clay, resulting from the feldspar of the granite. Quartz and porcelain clay are, excepting a minute portion of iron sand, therefore, its constituents, and it is naturally a plastic mass, which, even when the grains of quartz are large, can be worked by the wheel or hand, or moulded with ease. Vessels can be formed of it so thin that the grains of quartz in their size limit the thickness only. This porcelain earth differs from all the varieties of pipe-clay, in containing its silicate of alumina in the form of scales, imbued with silicate of potash and soda in minute quantity, which causes solidification by heat, with only slight contraction of the mass. Pipe-clays, besides silicate of alumina, contain hydrate of alumina, and *never* solidify without great contraction, and do not afford solid masses, unless largely mixed with sand or previously baked clay. These essential differences are seen in the porcelain wares and common queen's ware. The clay washed out from the quartz of the granite fire-clay forms excellent porcelain paste or fine crucible ware. An average obtained from several hundred pounds of the clay afforded 52 parts quartz, 48 kaolin, in 100 parts. Another sample, 55 quartz, 45 kaolin. The quartz grains are singularly roughened by cavities and irregularities, so that the kaolin embraces them with great cementing power. The moist mass resembles solid granite; when dry, it becomes a crumbling earth, having specific gravity of 2.602. 100 parts of the mass dried in the air lost, after exposure to a violent heat, only 3.6-10 parts. No indications of fusion took place at the melting point of iron, and, in small samples, platina melted without fusing the clay. Its color becomes nearly white by heat, indicating that the iron sand does not burn.

A comparison with the best known and most highly esteemed fire-clays in the world is here given.

	Granite Clay.	Stourbridge.	Strasburg.
Silica,	63.00	63.70	66.70
Alumina,	29.00	20.70	18.20
Potash, &c.,	1.20		.60
Water,	6.00	10.00	12.00
Ox. Iron, &c.,	.52	4.50	1.50

It will be thus seen that the granite fire-clay contains, for its plastic material, a true apyrous or fire-resisting clay. The quartz with which it is mixed naturally, represents so much more silica, which is infusible in any furnace-fire; and, considering such a mixture as composed of 50 dry kaolin and 55 quartz, we have a composition of 83.50 silica, and 15.40 alumina, as the essential constituents of the fire-bricks. Excellent crucibles for blast furnaces, it is well known, are made from silecious sandstone, presenting nearly the same amount of silica in 100 parts. As these stones resist the corroding action of iron oxides and slags, it is a reasonable conclusion that the granite fire-clay will have greater power of endurance, when exposed in the same way. It may, when moist, be applied to hot surfaces, where it adheres, and for repairs and linings to heated parts it is well adapted.

ON THE MEERSCHAUM FORMATION OF ASIA MINOR.

The following is an abstract of remarks made before the American Association, Albany, by Dr. J. Lawrence Smith, late Geologist to the

Sultan of Turkey, on the geology and general character of the Meerschaum of Asia Minor: —

This substance is one that has been long known to the arts, without an accurate knowledge as to the manner in which it occurs in nature, from the fact that almost all which came into commerce was derived from a region in Asia Minor but little visited. The locality alluded to is at Eski Shehr, the ancient Doujlaccm, in western Asia Minor, about a hundred miles from the Sea of Marmora and as many from the Black Sea. The substance occurs in an extensive plain, which consists of a calcareous breccia, extending to a considerable depth, and, doubtless, belonging to the tertiary formation. The meerschaum exists in masses of different sizes, from that of a walnut to the size of a man's body, embedded in this breccia. The origin of the meerschaum Dr. Smith was inclined to attribute to the change produced upon carbonate of magnesia, by waters containing silex. It was doubtless explored at this very place by the ancient Greeks; the use, however, that they made of it is unknown to us. The companies who now explore are Turks, and those who labor are paid proportionally to what is extracted; and, as the value of this substance increases greatly in proportion to the size of the mass, the business is of a precarious nature, and, in many instances, causes great loss to the miners. At other times they procure pieces affording large marketable specimens, and their profits then are proportionally good. The mining for this substance is carried on with the same eagerness, and its yield is as precarious, as that of gold. The principal mines on the plain are *Remick lich*, 27 miles north of Eski Shehr, and the shafts there are from ninety to one hundred and twenty feet deep; *Karanch*, 13 miles east of Eski Shehr — this is an old Greek mine, and has shafts from sixty to ninety feet; *Nemleckerer*, 15 miles west of Eski Shehr, and one near Kutayah. The two first are worked at present. *Karanch*, recently recommenced, is yielding well. and the third is abandoned on account of the rapidity with which the water flows into it. In sinking a shaft in these places, meerschaum is found from the surface down, but that near the surface has not the requisite properties, being hard, chalky, and does not yield readily to the pressure of the nail, as good meerschaum does. All meerschaum that is obtained from the mines goes to Vienna for the purpose of making pipes, cigar tubes, &c., that are cut out of the substance, and carved with ornamental figures, the stone being soft, and yielding readily to the knife. Large specimens were exhibited, which were more like cork than stone; it floats on water, like the latter substance, — hence its name, the foam of the sea, — but absorbs water rapidly and sinks. When dry, it is extremely white, and compressible by the nail; when saturated with water it is softer than wax, and is readily crushed in the hand; it absorbs twice its weight of water. Chemically speaking, meerschaum is a hydrated silicate of magnesia.

CARBONATE OF MAGNESIA IN CALIFORNIA.

The editor of the Pacific News thus describes the existence of a large deposit of carbonate of magnesia in the California territory. "On Pitch (or Pitt) river, the principal affluent of the Sacramento, and about five days' journey from Goose Lake, there is a hill of pure carbonate of magnesia, one hundred feet high. Much of it is perfectly white, while some is more or less discolored with iron, as if a painter had been striving to give effect by a coloring of light and shade. Large masses are easily detached, which, rolling down into the river that washes its base, float off as light and buoyant as cork, until they become saturated with water. A thousand wagons could be loaded in a very short time, and there is enough to supply the whole world. For three days' travel below, the soil seems to be impregnated with it, and the banks of the river are formed of it."

DISCOVERY OF PITCHSTONE ON LAKE SUPERIOR.

Dr. C. T. Jackson read a description and analysis of pitch stone, obtained by him at Isle Royal, Lake Superior, as follows :—During the summer of 1847, while engaged in the U. S. Geological Survey of the mineral lands bordering upon Lake Superior, I discovered upon the shores of Isle Royal some rounded pebbles and boulders of jet black color, which appeared to be identical with pitchstone porphyry, like that of the Isle of Arran, in Scotland. One of these pebbles, which had been mislaid, I have found since I made my report to the government, and have submitted it to chemical analysis, which has proved my original opinion — that it is pitchstone — to be correct, and it has since been confirmed by Mr. Teschemacher. This mineral has not, so far as I know, been discovered before in the United States, and it may therefore be interesting to mineralogists and geologists to know of its occurrence on the shores of Isle Royal, in Lake Superior. I have not had an opportunity of searching for the mineral *in place*, and it is doubtful whether it occurs in the trap rocks which compose the principal part of that island, or derives its origin from porphyry, erratic boulders of which are so common in the drift and among the shore pebbles of Lake Superior. — *Proc. Bos. Nat. Hist. Society.*

ON THE METEORIC MASS DISCOVERED AT SCHWETZ.

M. G. Rose gives to the Berlin Academy the following account of a newly discovered meteoric mass : — In the spring of 1850, while removing a hill of sand, in the grading of a railway near Schwetz, on the Vistula, a mass of iron, about four pounds in weight, was found at a depth of four feet, at the limit where the upper sand covers the subjacent clay. The mass sent to Prof. Rose is somewhat prismatic in shape, about nine inches (Prussian) long, with the thickness of five and a half and four inches, a line around it lengthwise being 24 inches long, and transversely 17½ inches. The whole mass weighs about 43 pounds (livers). There is a fissure cutting it somewhat diagonally. The outer surface is rounded and covered with hydrated oxide of iron, and so also that of the fissure. A surface cut and polished and acted upon by an acid, exhibited fine Widmannstattian figures, much like those of the Texas iron. There is a mixture of some large and small grains of sulphuret of iron. M. Rose has detected in it nickel.

METEORIC HILL IN NEW MEXICO.

In the course of a discussion on meteorites before the American Association, Albany, Dr. Le Conte stated some interesting circumstances relative to the existence of a meteoric hill in New Mexico. While passing through the village of Tucson, in February last, he observed two large pieces of meteoric iron which were used by the blacksmiths of the town for the purposes of an anvil. He was unable to procure any specimens from these bodies, but was guided to a cañon between two mountain ridges, in the immediate vicinity, from which both pieces had been taken, where the masses of the meteorites were so abundant as to have given name to the cañon. He had not before heard any account of this remarkable circumstance, and had considered it an interesting subject for observation.

METALLIFEROUS DISCOVERIES AND WORKINGS IN 1851.

Gold, in considerable quantities, has been discovered during the past year in Australia, near to the town of Bathurst. Great numbers of persons have been attracted to the "diggins," which are similar in character to the California deposits. In the month of August the receipts per week from the various mines were thought to exceed £20,000. Lumps weighing several pounds had been found in several instances. From Sidney papers we learn that the existence of gold was first predicted by Rev. W. B. Clarke, who had long been engaged in investigating the geology of the country. His opinion was based upon his knowledge of the character and position of the rocks, and he early recommended exploration in the main Australian range along the meridian of 149°, where gold has been found. Rev. Mr. Clarke states the singular fact that just 90° west of the auriferous range in Australia, we find an auriferous band in the Urals; and just 90° west of the Urals occur the auriferous mountains of California.

Several new mining deposits of gold have been discovered upon the river Chaudiére, Canada. The quantity found thus far has in most cases proved insufficient to remunerate the operatives.

The editors of the New Orleans Bee state that they have seen a number of specimens of gold obtained in Arkansas, in the bed of the White River, some miles above Batesville. The largest lump was a mass of quartz, of a dirty white color, profusely penetrated with the precious metal, and in some places so completely mingled with it that the gold seemed like an integral part of the rock. The amount of gold in all the specimens exhibited could not have been less than five or six ounces. The existence of gold in Arkansas was predicted some time since by Mr. Snell, of New Orleans, from observations on the geological character of the formations.

A scientific expedition sent out from Denmark, in the spring of 1851, for the purpose of exploring the mineral resources of Greenland, have already met with some encouragement. Copper in considerable quantity has been found, with some traces of other metals. From the direction and character of the mountain ranges, deposits of the precious metals have been thought to exist in this country.

PRODUCTION AND CONSUMPTION OF GOLD.

A writer in the London Athenæum estimates the supply of gold, for the year 1851, at twenty millions sterling. This amount is made up of fifteen millions from California, four from Russia, and one from Australia. What may be the results for 1852 it is impossible to say. The supply of gold for the present must be considered as unlimited; and whether five or fifty millions are to be picked up in the course of a twelve-month, depends wholly on the number of heads, hands, and machines devoted to the business of gold-finding. It is quite certain that during the three years in which the California "diggins" have been in operation, a quantity of gold equal to somewhere about thirty millions sterling has been added to the former amount of that metal in existence in the markets of the world; and it is also certain that no corresponding or equivalent increase has taken place in the supplies of silver. The question then arises: where has this new thirty millions of gold gone to? The stock of gold in the Bank of England is not higher than at recent periods anterior to the California influx — the price of silver as measured in gold is not sensibly higher than it was — and the prices of commodities, far from being higher, are decidedly lower. The explanation of all this seems to be very simple. There has been immense absorption of gold into the currencies of America and of France; and in France, at least, there has been an enormous liberation of silver from the currency in consequence of the introduction of gold. In both America and France the standard is what is called "double;" that is to say, both gold and silver coins are legal tender according to a certain scale of proportion established by law between the two metals. In America a gold eagle is declared to be equal to so many silver dollars, and in France a gold Napoleon to so many silver francs. The consequence is this, — all debtors pay their debts in the cheapest metal. If gold bears an agio, silver of course is used, and gold coins are scarce. If the agio on gold disappears, and is transferred to silver, then gold coins are used and silver coins are melted into bullion. This is precisely what has taken place both in France and in America during the last two years to a very great extent. The increased supply of gold has first removed the agio from gold, and then silver has been rapidly abandoned as currency, and gold introduced. Some returns have been published from the French mint, which strikingly show the effect of the change in France. We learn from these that while the coinage of gold in France was less than half a million sterling for some years previous to 1848, it rose in that year to one and a half millions sterling, — in 1849 to two millions, — in 1850 to three and a half millions, — and in the first ten months of 1851 to no less than ten and a quarter millions. In America the facts, we imagine, would be still stronger. We are enabled, therefore, with this evidence before us, to account pretty satisfactorily for the twenty millions of gold already yielded by California.

SIR R. MURCHISON ON THE GOLD DEPOSITS OF CALIFORNIA.

Sir R. Murchison, at a recent meeting of the London Geological Society, expressed an opinion that the central culminating ridge of granite of the Sierra Nevada was entirely devoid of any deposits of gold ore. The chief and original matrix of the gold being unquestionably the quartz rock, which is in juxtaposition to the granite, and which rises higher on the sides of the chain than any of the slaty rocks with which it is associated, there could, he said, be no doubt that the immensely rich and vast accumulations of coarse drift, which were piled up like gigantic mole-hills on the slopes below the quartz, had all been derived by ancient convulsions and great former debacles from the auriferous veins in that rock. Whilst he admitted that the wealth of these vast heaps of ancient rubbish did, through the hacking down and trituration of the mountain side, afford a very copious supply of gold, which it would probably take many years to exhaust, he still retained his opinions, as expressed at various public meetings in the last two years, that the idea, now becoming prevalent in America, that the mining in the solid rock would be found more profitable than digging in the drift, would prove fallacious, and that, on this point, the gold *veins* of California would prove to be similar to those of all other countries, in being richer toward the surface than when followed down to great depth.

PRODUCTION OF THE RUSSIAN GOLD MINES.

We find in the *Triester Zeitung* a letter from St. Petersburg, which gives exactly, and apparently from the best sources, the yield of the gold mines in the Russian Empire. In the year 1823, the product was 105 *puds*, or $3,937,500, the *pud* being worth $37,500; in 1833, it had risen to 379, and in 1843, to 1,242 *puds*. Since then it has been as follows: —

1844,	1,277 *Puds.*	1848,	1,727 *Puds.*
1845,	1,304 "	1849,	1,634 "
1846,	1,629 "	1850,	1,510 "
1847,	1,741 "	1851,	not yet known.

With respect to the present year, (1851,) during the first six months, the mines in the Ural yielded 170 *puds*, or the same as in 1850. According to this, the gold crop of the empire will not exceed $57,000,000 for the year; a falling off of seven and a half millions from 1848. This is caused by a tax laid since then upon the yield of private mines. This tax varies from five to thirty-five per cent. upon the produce; and, as nine tenths of all the mines are carried on upon private account, the result is a very considerable diminution in their working. This tax is in addition to that for the support of the police and military force kept up in the gold region, which averages one quarter of the value of the gold extracted.

THE QUICKSILVER MINES OF CALIFORNIA.

The richest mine yet discovered is located in the Santa Clara Valley, about twelve miles from San Jose, which is worked by an individual company, who hold possession under the old Mexican title of "denouncement." At this mine a large number of furnaces are in operation. These furnaces resemble in appearance a long steam boiler, set in brick, with fires underneath. The ore does not require to be crushed except to a convenient size for the boilers. The mine is worked by Mexicans and Chilians, who carry the ore in raw hide sacks, upon their shoulders, from the bottom of the vein to the opening above, a distance of between three and four hundred feet. The mine is probably the richest in the world, and with the same facilities and machinery used elsewhere would yield most enormously, far beyond even what is now produced. At one time during the past season there were 8,000 *cargas*, or mule loads, of the ore, lying at the mouth of the mine, each *carga* being 300 pounds, or an aggregate of 2,400,000 pounds. At an average yield of fifty per cent., the product would be 1,200,000 pounds of pure quicksilver, which, at a market value of $1 per pound, would yield the enormous sum of $1,200,000. This finds its way to market in one direction and another, but its value is enhanced by the fact that California itself affords a good market, large quantities being used in separating fine particles of gold from the sand and dirt, and which cannot be procured by the ordinary process of washing.

In addition to the quicksilver mine to which we have particularly referred, there are three or four others in the same valley, though not worked to the same extent, yet are reported to be equally as rich in yield of ore. It is said, by a correspondent of an eastern paper, that the aborigines had known and resorted to these deposits of cinnabar for centuries, for the purpose of procuring coloring materials; and it was by following their trail that a knowledge of the existence of this valuable mineral was obtained.—*Pacific News.*

SCARCITY OF PLATINUM.

At a meeting of the Boston Society of Natural History, July, 1851, Mr. Teschemacher alluded to the fact that a very important article to chemists and manufacturers, platina, was becoming scarce, from the exhaustion of the localities from which it has hitherto been procured. It was a well known fact that most of the gold from California had more or less of this mineral in combination with it. Mr. Teschemacher had estimated that as much as 5,300 ounces of it must have been brought in this way to the Atlantic States. This would be a very important amount for scientific purposes. Its value in the market is now about $15 the ounce.

Platina has been found at only two places in South America; namely, at Choso, in New Grenada, and at Barbacoas, between 2° and 6° north latitude. Previous to its discovery in California,* this metal had never been found north of the Straits of Panama. It occurs in South America, associated with palladium and iridium, in diluvial soils.—*Editor.*

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* See *Annual of Scientific Discovery*, 1851, p. 298.

ON THE PRODUCTION OF COPPER.

Messrs. Foster and Whitney, in their report on the geology of Lake Superior, state, "that they consider the mining interest of this section of country to be yet in its infancy. When it is considered that nearly the entire copper region of Lake Superior is an unreclaimed wilderness, the miners' settlements appearing like mere dots on the surface, covered with a dense growth of trees, through which the explorer with difficulty forces a path; and that, except where the streams have worn their beds in the rock, or the hills terminate in bold and craggy ledges, the ground is covered with a thick carpet of mosses and lichens, effectually concealing every trace of veins, it is surprising that such an amount of mineral wealth has been revealed within so short a period. This region had occasionally been traversed by the trapper, and the white man had coasted along its rock-bound shores, at intervals, for nearly two hundred years; but, up to the year 1841, when Houghton made his reconnoissance, we have no evidence that a really productive vein had been observed. To him is to be ascribed the credit of having first pronounced on the value of this region for mining purposes, and delineated its geological outlines.

"As the country becomes opened, and the means of exploration become increased, new sources of mineral wealth will undoubtedly be revealed. There will be an increase in the products of these mines from year to year, until the national supply will exceed the national consumption. For certain purposes in the arts, the copper of Lake Superior stands unrivalled; in density and tenacity it surpasses all other ores of copper. The estimated product of the mines for the year 1849, was 1,200 tons, and for the year 1850, 2,000 tons. The average value of copper imported into the United States slightly exceeds $1,708,000. Assuming the price of pig copper to be 18 cents per pound, and sheathings to be 22 cents, the annual consumption would be less than 5,000 tons. The product of the Lake Superior mines, for the year 1851, will probably reach one half this sum, or 2,500 tons."

According to the estimates of M. Leplay, Secretary of the Commission of Mining Statistics in France, the whole amount of copper produced in the world is equal to 52,400 tons. This, however, does not include portions of the Asiatic continent, with regard to which we have no statistical knowledge, but of which the mineral produce is entirely consumed within its own borders. According to the same authority, this amount of copper is consumed in the following manner:

	Tons.		Tons.
Great Britain, . .	10,600	Other States of Europe, .	6,600
France, ...	9,200	America, (U. S., 5,000,) .	6,100
German Customs Union, .	5,400	Asiatic Continent, (India and Oceanica,) . .	8,300
Austrian Empire, . .	2,600	Japan, ...	1,200
Russian Empire, . .	2,000		
Sweden and Norway, .	400	Total, ...	52,400

LEAD MINES OF GALENA, ILLINOIS.

The Galena Gazette furnishes the following account of a vast ore-bed recently opened about two miles from Galena city. The locality is upon a side hill, where a shaft has been sunk forty feet in limestone, and about as far in "*mineral*." "The mineral now stands up in a perpendicular sheet, about thirty-eight feet in height, between walls of limestone rock, and varies from twenty inches in width to four feet, averaging about thirty-five inches the whole distance. The narrowest places in the crevice are filled with solid, clear, heavy mineral, looking like a mass of conglomerated cubes, measuring from one to six inches on the side. If the rock was cleared away, between which it is wedged, masses, tons in weight, would be instantly detached. Where the crevice opens wider, the cubes of mineral are smaller, and the masses lie detached, between which there is a yellow, ochreish earth and clay. One gets some conception of the vastness of the wealth of our mines in such displays as this. How far these masses of mineral extend, or what is the length or height of this perpendicular sheet, beyond what is visible to the eye, it is impossible to determine; it may not extend twenty feet, but the evidence is, when compared with similar leads that have been formerly wrought, that it will run some hundred or even thousand feet. In the latter case, its value is hardly appreciable. About 160,000 pounds have been taken out already, and the lead is considered to have been safely proved for 1,000,000 pounds. Perhaps the best idea we could give miners of the value of the land, and of the size of the sheet, is to say that the owners have drifted about eighteen or twenty feet only westward from where the lead was first struck, and from this space they have raised the 160,000 pounds aforesaid. A lead that yields a thousand pounds to a foot is considered a good one; this, so far, has yielded more than 8,000 to that distance."

METAMORPHIC CONDITION OF A PART OF THE LARGE VEIN OF FRANKLINITE, IN NEW JERSEY.

The following communication was made to the American Association, Albany, by Mr. A. C. Farrington.

During the summer of 1848, while engaged in exploring the metalliferous veins upon what is called Mine Hill, near the Franklin furnace, New Jersey, my attention was arrested by the difference in structural arrangement presented by the opposite sides of the large vein of Franklinite, at different places along its extent. While much the largest portion of the mass appeared to consist of imperfect octahedral crystals, compacted or cemented, other parts appeared like an aggregation of their lamina, its crystals resembling tabular spar. This latter portion was highly magnetic, and, in pulverizing, I found the hammer would take up large quantities of it. Knowing that other parts of the vein did not exhibit this property, I pursued my investigation for the purpose of ascertaining how much of the ore presented this magnetic property. The result was that it was found only where the tabular crystals prevailed, and they only where the vein was in contact with sienite, and in tracing across the vein in a right line, magnetic action was not perceptible for more than four feet. I repeated my experiments, and found four feet three inches was the maximum distance that the ore was found magnetic. I broke off fragments in a line across the vein, at the distance of three inches from each other, and, after pulverizing, weighed one hundred grains from each parcel, and applied a common magnet to them. The magnet would take up all or nearly all of the powder from such parts as came from the side of the vein nearest the igneous rock, and gradually diminished as they receded from it. I failed in establishing any regular series or ratio for the diminution of magnetic action, but inferred from the results that the iron of the Franklinite, in the parts of the vein in contact with sienite, was a protoxide, while the mass of the vein was a peroxide; and intermediate, for the distance examined, as before stated, there was a mechanical mixture of the two oxides. In presenting these facts, an important geological question arises: — Is the metamorphism of this metallic vein attributable to the agency of the intrusive rocks in contact with it; and, if so, should we not infer that the igneous intrusive rock is more recent than the vein of Franklinite?

COAL DEPOSITS OF IOWA AND OREGON.

From the forthcoming report of Dr. D. D. Owen, U. S. Geologist, on the geological survey of Iowa, Wisconsin and Minnesota, we derive the following facts in regard to the coal formation in Iowa: —

"Between Johnson and Iowa counties, an uplift of carboniferous sandstone is encountered, which is probably near the eastern limit of the Des Moines coal-field. The Iowa river meanders near the eastern margin of this coal-field, but the seams presented on the river are of inferior quality. It is upward of two hundred miles in the direction of the valley of the Des Moines across this great coal-field. Westwardly it extends from Des Moines river nearly across the State of Iowa, and includes a considerable portion of Missouri. The entire area of this coal-field, in Iowa alone, cannot be less than 20,000 square miles, in all, embracing a country nearly equal in extent to the State of Indiana. Although of so great an area, this western coal-field is comparatively shallow in Iowa, probably hardly exceeding fifty fathoms in thickness. It consists of three well-marked divisions — a lower calcareous, about one hundred feet thick; a middle argillaceous, from fifty to one hundred feet thick; and an upper silecious, from eighty to one hundred and twenty-five feet thick. The beds of coal at present discovered are confined to the middle division, and are hence, probably, not over one hundred feet in thickness."

The district of country embraced in the surveys, made under the superintendence of Dr. Owen, comprises about two hundred thousand square miles, lying both east and west of the Mississippi, and occupies an area six times as large as the State of New York. Ninety-one streams have been explored, one fourth of which were navigated from their mouths to their sources, in bark canoes.

Coal in Oregon.— Samples of bituminous coal, obtained near Puget's sound, Oregon, have been transmitted to the Navy Department. The samples were selected from a considerable quantity dug up within three feet of the surface, the vein having a dip west towards the near hills and mountains, thus indicating its existence in great quantities. This coal has been examined by Prof. W. R. Johnson, of Washington, who pronounces it to be one of the purest American coals which he has yet seen. It has a specific gravity of 1.315, and will require on board a steamer about $42\frac{1}{4}$ cubic feet of space to stow one gross ton. It contains in every 100 parts, 40.36 per cent. of volatile matter, 56.84 per cent. of fixed carbon, and 2.80 per cent. of earthy matter. After the luminous flame ceases, the coke burns with a bright glow, and leaves a light brick-red or deep salmon-colored ash. Under a well-constructed boiler, this coal ought to produce from $7\frac{1}{2}$ to $8\frac{1}{2}$ pounds of steam from 212° to one pound of coal burned. The importance of a discovery of this character cannot be over-estimated when it is remembered that we have heretofore failed to obtain coal from any part of our Pacific territories. The explorations of geologists have shown, conclusively, that there is no coal in California, and, until this discovery was made, none was known to exist in Oregon. There are inexhaustible deposits of this valuable mineral at Vancouver's Island, but that island belongs to the British government. Puget's Sound is the nearest point in Oregon to Vancouver's Island, and it is probable the coal obtained there is of a similar character to that derived from the island.

COAL IN CHINA.

The following notices of coal in China have been forwarded to us by Dr. D. J. Macgowan, of Ningpo. — *Editor.*

Coal deposits exist to a greater or less extent throughout the different mountain ranges which girt the great plain of China. On its northern boundary it is met with in numerous localities, on the Celestial mountains, on the Mongolian steppes, and various offsets of the Altai range, the most productive of which are in Shingking and Shánsí. There are several smaller deposits in Chihlí and Corea. Unskilful mining and the want of suitable means of transport enhance the cost of the mineral, and limit its consumption. Except for culinary and manufacturing purposes, it is little used; the inhabitants trusting to furs and skins for protection from the extreme rigor of their winters. The best coal brought to the capital is from Pingting, in Shansi. Chinese cosmogonists, drawing on mythology, gravely state, that in one of the Pingting mines the furnace still exists in which Niúkiva fused stones for repairing holes in the heavens.

Those deposits which have been mined for the longest period, with which we are best acquainted, and are the most productive, lie in the middle and southern parts of the empire.

That branch of the Himalayan range known as the Yun-ling has the carboniferous system superimposed on a granitic base through a great part of its extent, in numerous sections of which the coal measures exist, generally interstratified with beds of slaty clay and limestone. Those best known lie in the basin of the Kán in Kiángsí, reposing on old red sandstone and gray compact limestone, in close connection with deposits of iron ore. Those in the valleys of the Siáng, Tsz', and Yuen in Húnán, the western slope of the terminal ridges of the Yun-ling, and the southern aspect of the same range in Kwángtung, all present analogous geological relations. This vast carboniferous tract appears to be continuous in a measure with that of Assam and Burmah. The coal most in demand in central China is called "the Kwang coal." It is brought from various districts in Húnán. It is black, very compact, specific gravity 1.34, columnar structure, occasionally iridescent, and, from the large quantity of carbon it contains, is analogous, though inferior to the American anthracite : it burns intensely with a small blue flame, its ashy residuum being of a reddish color. That in use at Shánghái is of this description. It is brought from Súchau to Ningpo, where it costs $12 per ton, about one third more (the dealers say) than at Shánghái. Its consumption is very limited, being almost wholly confined to the manufacture of brass tobacco pipes. In a number of the provinces, coal, iron, and lime occur most advantageously for the manufacture of iron. The coal measures in other places are in close proximity to the disintegrated granite of which the celebrated porcelain is fabricated. The furnaces at Kingtehchin, the great seat of this branch of industry, are chiefly heated by coal from adjacent mines.

A variety of coal called the "wood coal" is much valued, and is in extensive use. This "wood coal" is generally reduced to powder, formed into cakes with mud, and employed in furnaces for culinary purposes, and in chafing-dishes for warming public offices. It is used to some extent by blacksmiths. Coal cakes are much used at Hángchau, in the liquor shops, in order to keep warm rice-whiskey on hand at all hours of the day ; and in the tea shops, where boiling water is in constant requisition. The furnaces are certainly primitive, consisting of a few bricks, making a close square or circular chamber, generally about four inches in diameter, with a small grate below, and inclosed above. When the cakes are perfectly ignited by a few chips, and the smoke ceases to rise, the top is covered over with mud, through which, before drying, an orifice is pierced, half an inch in diameter. The vessel containing whiskey is then placed over the hole, and is thus kept hot all day without further care, at a cost of a cent and a half. The same rude apparatus, with slight modifications, is in general use, wherever coal from its proximity is not expensive. Sometimes the brickwork is enclosed in boards, elaborately carved and varnished. Were grates or fireplaces constructed with suitable flues and chimneys, coal would be found a more useful article, be in greater demand, and the mines consequently be better worked. Even the miners find it more convenient and cheaper to burn the shrubs and grass of their sterile hills, than the coal they dig from their bowels.

The wood coal referred to exhibits, where it is laminated with the fibres of the bituminated vegetable, a distinct, bright, conchoidal fracture ; at all other points it presents a dull, coarse-grained, segregated texture. Specific gravity, 1.29. It burns with some smoke, and cakes ; emitting a small quantity of hydrogen gas, leaving light colored ashes. It possesses a much larger proportion of carbon than ordinary bituminous coal.

The total annual produce of the China coal mines is estimated by Dr. Macgowan at 820,000 tons, valued at about six millions of dollars. The paucity of the supply is owing, not to the poverty of the mines, but chiefly to the want of those facilities for mining which the steam-engine can alone supply. Mines, often, when they become most productive, are suddenly filled with water and rendered useless.

To appreciate rightly the value of the vast coal deposits extending from Corea to Siam, regard must be had to the increasing commerce of the Pacific, to the revolution which seems on the eve of taking place in the route of communication with western nations, and the prospective greatness of the Anglo-Saxon states springing into existence on its eastern shores. Of their capacity, aided with the appliances of foreign skill and capital, to supply all demands which the steam-engine may make upon them, both for manufactures and navigation, there can exist no doubt. Nor have these primeval forests been stored upon the continent alone ; they abound in more accessible situations, isolated, as it were, expressly for steam navigation, in the islands of Japan, Formosa, and Borneo. Before the application of steam and coal to navigation, a sceptical philosophy might have questioned the utility of deposits of this mineral in the torrid zone, and immediately under the equator ; but the design of the Omniscient Artificer of this beautiful sphere is now obvious, affording another evidence that He left nothing to fortuitous circumstances, and another lesson fraught with instruction for reflecting minds.

IMMENSE COAL BED.

Mr. J. Dill, of Ohio, in a recent communication to an Ohio journal, says : — " Reports of an immense structure of coal, in the vicinity of this place, have long been circulated in Central Ohio. I first heard of it in the winter of 1848–9 ; it was then reported to be about ninety feet thick. Further examinations ascertained the thickness of the uncovered part, in the face of a deep ravine, at 112 feet. A few days since a gentleman of high standing informed me, that an acquaintance of his, with some others, had stripped the upper surface of the bed and bored through the coal stratum to ascertain its thickness, and found it to be 138 feet."

Mr. J. W. Foster, U. S. Geologist, in a letter to the editors of Silliman's Journal, in reference to the above communication, says : — " Although this extent is at variance with all other previous knowledge of carboniferous deposits, yet I have no doubt that, in the main, it is true. I conversed with several intelligent persons who had seen the deposit, and all concurred in representing it as one of unparalleled thickness. It is exposed for several miles in the banks and along the bed of a small stream — one of the tributaries of the Hocking river. Like most of the coals of Ohio, it is highly bituminous, and is more or less impregnated with iron pyrites, which, for manufacturing purposes, impairs its value. The deposit, instead of being one bed, may be regarded as a repetition of beds; for, at intervals of a few feet, we meet with thin seams of shale, forming natural divisions. Altogether, it may be regarded as the most wonderful deposit yet brought to light."

ANALYSIS OF BITUMINOUS COAL-ASHES.

At the meeting of the American Association, New Haven, 1850, analyses of anthracite coal-ashes were presented,* by Mr. Bunce, of New Haven. At the Albany meeting, 1851, similar investigations of bituminous coal-ashes were communicated by Mr. Wyman, of the Yale Laboratory.

The coal from which the ash was obtained was procured at Pittsburg, Pa., and is the same as is generally used there. It was burned in a large furnace, where the heat was intense, and every precaution was taken to have it free from impurity. The fire was allowed to burn for a day, and then thoroughly raked out before any ash was taken. The mean of three determinations of ash, &c., in the coal, gave the following results: —

Bitumen,	32.32
Carbon,	64.34
Ash,	3.34
	100.00

Three determinations of amount of ash soluble in water and hydrochloric acid, gave these results: —

	First Determination.	Second.	Third.	Mean.
Soluble in water,	3.40	3.41	3.42	3.41
" hydrochloric acid,	8.53	8.36	8.46	8.45
" insoluble,	88.06	88.06	89.79	88.63
	99.99	99.83	101.67	100.49

The amount soluble agrees very nearly with the solubility of the anthracite ash, while that soluble in acid is only a little more than half as much.

A qualitative analysis detected the presence of silica, iron, alumina, lime, soda, potash, sulphuric acid, and chlorine. Separate qualitative analyses were made of both the portions soluble in water and soluble in hydrochloric acid. All the alkalies existing in the ash could not be dissolved out with water, and about a third of them was determined in the acid solution. The ash was washed with water until the water gave no tache. The alkalies existed, undoubtedly, in the state of silicates. But the slightest trace of phosphoric acid was detected in the bituminous ash. By comparing this ash with that of the anthracite, we find that this is much more rich in alkalies. In the anthracite they amount to about .4 per cent., while here they exceed one per cent. The lime is also about twice as much. No magnesia was detected. The absence of phosphoric acid in this ash lowers its value as manure, but the presence of so large a quantity of alkalies

* See *Annual of Scientific Discovery*, 1851, p. 305.

compensates in some measure for its absence. These results fully confirm the value of coal-ashes and their applicability as a manure.

ALBERT COAL, HILLSBORO', NEW BRUNSWICK.

In the Annual of Scientific Discovery, 1851, p. 307, the mineral deposit at Hillsboro', New Brunswick, was described as asphaltum. Further investigations, carried on by Drs. Jackson, Hayes, and others, show conclusively that this curious mineral product, although resembling asphaltum in its external features, is yet a true bituminous coal. The strata in which it occurs are inclined at an angle of from 70° to 80°, the coal seam being parallel to the strata. The depth of the shaft now worked is about fifty feet. The coal occurs columnar and loose, so that it cannot be worked in the usual way by undermining it, but is taken out by a series of horizontal grades. It requires no blasting, but may be easily detached with a pick. The mine affords evidence that the strata were once horizontal. Black and white gypsum are found in the adjoining rocks.

The strata adjoining the coal beds are a very fine-grained shale. They contain rounded masses, like pebbles, principally made up of scales of gaoid fishes and coprolites. Many of the most beautiful impressions of fishes and of plants, belonging to the coal formation, which we have ever noticed, have been taken from these shales, by Dr. C. T. Jackson. In the vicinity of this coal deposit, very numerous specimens of fossil trees, such as stigmaria, sigillaria, &c., of great size, have been found. — *Editor.*

ELECTRICTY OF BITUMINOUS COAL.

At a meeting of the Boston Natural History Society, February, 1852, Dr. C. T. Jackson stated that an attempt had been made to confound the highly bituminous coal of Hillsboro', New Brunswick, with asphaltum, on the ground that it possessed electric properties when rubbed with woollen or silk. It has been also asserted that asphaltum alone possessed this property, and that true coals did not. In order to test this hypothesis, Dr. Jackson had made numerous experiments. Several varieties of cannel coal, from Virginia and Kentucky, on being rubbed, readily attracted and repelled light substances, as paper, cotton, &c. The electric properties of these coals were in no way diminished by roughening their surfaces, or increased by polishing. Digested for a considerable length of time in pure benzole, and in alcohol and ether, they were found to be wanting in any soluble bituminous or resinous matter. Their electric properties, therefore, do not depend upon the presence of bitumen in the state of asphaltum.

On trying Scotch cannel coal, it was found to be non-electric, as were also several varieties of Nova Scotia and Ohio bituminous coals, and the Pennsylvania anthracites. The electric coals from Virginia and Kentucky break with a broad conchoidal fracture, are very tough, and possess a laminated structure, which corresponds to the stratification of their beds. Their lustre is dull on the broken surface, like the cannel coal of Scotland, burning with a large yellow flame, and without softening.

ON THE TRACES OF VEGETATION IN COAL.

At the Boston Natural History Society, August, Mr. Teschemacher stated the results of his study respecting the traces of vegetation in coal. This communication, given below, is one of the most important contributions to our knowledge of the character and composition of coal ever laid before the public.

Mr. Teschemacher said :—"My observations have been entirely confined to the traces of vegetation in the coal itself, omitting those in the shales accompanying the coal. A previous study of these latter was, however, indispensable. I believe, however, that the investigation of the former branch, hitherto almost untouched, will lead to by far the most interesting results. One of the most striking points in this investigation was the appearance, on cleavage, of forms entirely simulating those of well known vegetables of the coal period, yet without a trace of the vegetable, being in fact homogeneous coal. Such are these specimens of peacock-eye coal, resembling the roots of Stigmaria, these perfect resemblances of the leaves of Neuropteris and Cyclopteris, even to the course of the veins. Such, also, are those masses of vessels which have hitherto been thought to be scratches caused by sliding, but of which I have several specimens on which a small portion of the plant remains ; and one on which there is a portion of a cylindrical form of cones of these vessels, symmetrically arranged, surrounded by a clearly organic bark or rind. Something of this nature may be seen in a transverse slice of a recent Equisetum. These appearances are not unfrequent, and each in its class is constant ; their outlines are also perfect. Such conditions admit alone of the supposition that during the consolidation of the coal the mass was in a liquid state, and that each particle of the liquid mass sustained an equal pressure in every part, so that there could be no motion whatever amongst these particles by which the outline of form could be destroyed, and, consequently, that all disturbing action took place posterior to its consolidation. The finely polished surfaces are also unquestionably the surfaces of the vegetable. Of the same striking nature are the fissures so frequently found on the surfaces of the vegetable imprints, but seldom on the general mass. At first, I considered them, as others have done, as mere effects of shrinkage ; but, after close examination of some thousand specimens, observing them only on vegetable surfaces, sometimes containing carbonized vegetable matter, differing from all around, on other specimens, curved in peculiar ways, so as to shut out the action of any general dynamic law, it occurred to me that the determination of these fissures must have been caused by rupture of the weak annular vessels crossing the leaves, like those traversing the leaves of almost all the palm tribe.

"Now this opinion involves the decision of the mooted question, of the existence of the palm tribe in the fossil flora of the coal period. My own idea is, from this as well as from other appearances, that the palm tribe formed a large portion of the coal, and was a large source of the hydro-carbons of that period. I think that my specimens completely prove the existence of fungi in great quantities in the coal period, and that other appearances, extremely puzzling to me at present, will turn out to be the remains of large plants of this peculiar growth. Gœppert has stated, in some of his recent works, that the remains of filices are seldom or never found in the coal itself; there are, however, fine impressions of the veins of the Cyclopteris, and perhaps of Neuropteris, on the coal itself; and they are so clear and distinct as to forbid any idea of motion in the mass, until the whole had taken a solid form. Specimens of Sigillaria and Lepidodendra are by no means uncommon in anthracite. All the surfaces have the well known beautiful polish.

"I am quite persuaded that much light will be shed on the subject of the coal formation by the pursuit of this nearly untrodden path; but to arrive at just conclusions requires a considerable knowledge of dynamical causes, and also of physiological botany, particularly of the vegetation of tropical countries. In the course of my own studies, I have had rather to depend on specimens of recent palms, ferns, &c., which I could dissect myself, than on anything to be found bearing much on this subject in publications; and I am convinced that the personal examination and comparison in this and in every other subject of natural history is the only way that leads to discovery or truth."

In a communication to Silliman's Journal, Sept. 1851, Mr. Teschemacher makes some additional remarks on this subject. In 1846, the Natural History Society at Haarlem, Holland, adjudged a prize to Dr. Gœppert, for a dissertation on the prize question proposed by them: "Whether the beds of coal were composed of plants which grew on the spots where these coal beds now exist, or whether the vegetation grew in other places, and was floated or brought there by other means." A copy of this dissertation, with the plates, is now in the library of the Boston Society of Natural History, and from its examination it appears that Dr. Gœppert, for the purpose of elucidating the subject, has been pursuing the same course with the coal from various beds in Germany, as Mr. Teschemacher has with the coal of Pennsylvania since 1843. And although the main question has received the same solution from both, namely, that the plants grew where the beds of coal now exist, and were solidified amongst other conditions under that of absolute rest, yet some differences in regard to minor points exist between the two experimenters. In relation to these Mr. Teschemacher says: — "Without the inspection of regular series of specimens, presenting various details, it is impossible to arrive at satisfactory conclusions on many points of this occult subject, and it has several times occurred that a single specimen has thrown unexpected light, not obtained by the inspection of fifty others of nearly the same appearance. My specimens of Sigillaria, Lepidodendra, and Sagenaria, are numerous, and there are various appearances, representing the internal structure of some of these gigantic vegetables, which, if they can be recognized as such, would cause considerable astonishment. When this subject shall be taken up and studied by scientific men, whose minds are well prepared, and who are possessed of sufficient leisure, I am sure that most interesting facts and consequences will be developed by their observations."

DISCOVERY OF FOSSIL FISH IN THE COAL FORMATION OF NEW BRUNSWICK.

Dr. C. T. Jackson, during the past year, has discovered a large number of well preserved specimens of fossil fish in the coal formation of Albert county, N. B. In a letter to the editors of Silliman's Journal he says: — "You may feel interested in knowing that I have made out some of the genera, and found new species of fossil fishes, and that the Paleoniscus occurs abundantly associated with aquatic plants; also that Lepidodendron, near if not exactly identical with the *L. gracile*, Br., is found, with the fishes and with scattered fish-scales in the same piece of the shale. Broad flat leaves, like those of palms, occur also in the fish-shales of the coal mine, and a curious blistered leaf is extremely abundant in all parts of the fish strata. These I at last traced to a stem. They appear to be new species, and remind me of our aquatic floating plant, the bladder-wort of our ponds.

"The occurrence of immense quantities of well preserved coprolites of fishes confirms the idea of Agassiz, that the heterocercal-tailed fishes swam close to the bottom; for, otherwise, the form of such materials could not be preserved; for they were entire in the mud which ultimately enveloped them. There are herbivorous fishes associated with those that ate them, and the excrements of some tell the tale that some of the fishes were carnivorous. Some of the coprolites I have seen connected with the anus of the fish, appearing as if extruded by compression of the fish. Some of the fish appear to have been dead and partially putrid when they were enclosed in the strata; others evidently struggled hard against adverse fortune, erected their fins strongly to guard themselves from some imagined swallower; while others wiggled and squirmed in vain to free themselves from the tenacious mud which embalmed them in their last struggle. In fact, these fishes are literally embalmed, and not petrified, the bitumen which so richly charges the marly or soft clay slate or shale preserving in the most delicate manner every scale, fin, and the minutest markings; the scales retain their silvery hue, slightly tinted yellowish brown by the bituminous matter."

At the Boston Natural History Society, June, Dr. Jackson stated that at the South Joggings coal mine he had had an opportunity of comparing the Stigmaria with the roots of Sigillaria, and had found them unlike each other. The Stigmaria also is found in the sandstone, not in the under clay.

Dr. Jackson described the interesting appearance of the shores of the bay at this locality, through a distance of five miles, presenting a complete geological section of the strata. These are inclined at an angle of 20°, and show the trunks of trees imbedded in them at various depths. He himself saw a flattened stem of Sigillaria, 20 feet long, and he was assured by the miners that it extended at least 40 feet further into the rock. As there is no sign of decomposition, it would seem that the sand must have been rapidly deposited upon them; and as the trunks of the fossil trees are always at right angles to the strata, the latter must have been lifted since they grew. The formation consists of alternate marine shales and beds of coal. The coal seam which is worked is four feet in thickness, and, on going into the mines with a lamp, one passes directly beneath the roots of fossil trees.

FOSSIL FISH IN THE COAL ROCKS OF OHIO.

Mr. J. W. Foster, in a communication to Silliman's Journal, Sept., states: — "While at Zanesville, recently, I discovered a locality in the carboniferous series, rich in the remains of fishes. Associated with them were several species of molluscs and corals, and even the delicate fronds of the Neuropteris. I have never before observed a locality where the forms of animal and vegetable life were so confusedly mingled. I have also succeeded in procuring beautifully preserved teeth from the limestone of Cambridge, belonging to this series — the existence of which I had known for several years. Within the last few years it has been proved that the occurrence of the remains of fishes in many of the western groups of rocks is by no means rare. In the Clinton group, at the base of the Upper Silurian, as developed in the Lake Superior district, we have detected markings similar to those in the same group in New York, made by some vertebrated animal, probably a fish. Mr. Joseph Sullivant has observed the remains of fishes, consisting of teeth, scales and fins, in numerous instances, in the cliff limestone of Columbus, (Upper Silurian,) and Prof. Agassiz, in a recent visit to the quarries, was enabled to collect numerous specimens, and we may hope, ere long, to receive exact information as to the character of these ancient species.

ON THE DISTRIBUTION OF CRINOIDEA IN THE WESTERN STATES.

The following is an abstract of a communication made to the American Association, Cincinnati, by Dr. Yandell, of Louisville, Ky., on the "Distribution of Crinoidea in the Western States."

For several years past, said Dr. Yandell, I have been engaged, conjointly with Dr. Shumard, in collecting the Crinoids of the Western States, with reference to the continuation of the work undertaken on that subject by the late lamented. Dr. Troost. We have already collected about thirty genera and more than two hundred species, showing that our country is richer than any other part of the world in the remains of these curious tenants of the deep.

They are found in the oldest rocks which retain any vestiges of organic beings. Dr. Shumard has discovered them in the sandstones of Wisconsin and Minnesota, which correspond to the Potsdam sandstone of New York. At first they are few in number, and occur in fragments; but in the later formations they become abundant in the equivalents of the Niagara group, and attain their full development in the carboniferous system. They are of limited range, a species often being found in only a single locality, and rarely extending over an area of many miles. Not one is clearly common to this country and Europe, though one or two are claimed by both continents. Not one is common to two geological systems. Those of the Lower Silurian differ, not only in species, but for the most part in genera also, from those which occur in the Upper Silurian system, and these again from those found in the Devonian, while the genera and species of the carboniferous era were different from those of the earlier ages.

ON THE PALEONTOLOGY OF THE LOWEST SANDSTONES OF THE NORTH-WESTERN UNITED STATES.

At the meeting of the American Association, Cincinnati, May, 1851, Dr. D. D. Owen, of the U. S. North-west Geological Survey, presented a paper "On the Paleontology of the lowest Sandstones of Wisconsin, Iowa, and Minnesota," of which the following is an abstract: —

The occurrence of highly fossiliferous strata, much lower in the geological formations than had been previously observed in the west, is one of the most interesting facts connected with the paleontology of the Upper Mississippi and its tributaries in Wisconsin and Minnesota.

This discovery, which throws an entirely new light upon the zoological character of the oldest fossiliferous beds of the west, was made in 1847, during the first year of the survey of that country. Leaving out of view the as yet problematical Taconic system, only two species of lingulas had been discovered, up to that time, in this country, in strata of the age of Potsdam sandstone, with perhaps an associated Orbicula, and some obscure bodies, referred to a sub-genus of fucoides, and noticed in the reports under the name of *Scolethus.* These were considered the oldest fossils then discovered in the United States; so that Mr. Hall, in his preface to the Paleontology of New York, after remarking on this fact, says: — "We find ourselves forced, therefore, to commence our comparisons with European formations, from the Trenton limestone."

In August, 1847, while descending the St. Croix, I observed multitudes of *Lingulas* and *Orbiculas* disseminated in strata abutting against the south-west side of the trap range that crosses that stream at its falls. In tracing out the geological position of these beds, during the succeeding months of the same year, they were found to be only a portion of highly fossiliferous beds, lying toward the base of the lowest sedimentary strata, that rest and abut upon the igneous rocks of that country; all of which occupied a geological position beneath the Lower Magnesian limestone, containing *Ophileta* and other fossils of the Calciferous sandstone of New York.

At the same time, it was observed that *Lingulas* and *Orbiculas* were by no means the only genera characterizing these rocks, but were accompanied by other brachiopoda, and several forms of crustacea, some of which could be traced down six hundred to seven hundred feet below the bottom of the Lower Magnesian limestone, and even beneath lingula beds, containing apparently *Lingula prima* and *Lingula antiqua*, that characterize the lowest fossiliferous beds of the Potsdam sandstone of New York. In October, of the same year, I found beneath this lingula grit a species of obolus, very much like those obtained from the lowest sandstones of Russia; and in similar beds, ten miles below Mountain Island, I discovered a remarkable trilobite, provided with spines, which project backwards from the pygidium. The combined labors of the succeeding year (where minute stratigraphical and paleontological sections were undertaken) developed beneath the Lower Magnesian limestone at least six different trilobite beds, separated by from 10 to 150 feet of intervening strata.

The Menominie trilobite grit, situated about forty or fifty feet above the lowest trilobite bed, is characterized by a minute species of trilobite, chiefly remarkable on account of a spinous appendage, which has its origin at an angle in the middle of the posterior part of the glabella, and projects upward and backward in the median line of the body. The glabella in this species has only one distinct transverse furrow, immediately in rear of the origin of this spinous process. To convey an idea of the abundance of this species in the grits of the Menominie river, it may be stated that, on a specimen measuring three inches square, more than a hundred individuals can be counted.

In 1849, Dr. Shumard found in green sandstones above the level of the Mississippi, near the head of Lake Pepin, and also on the Wisconsin river, the remains of Crinoidea. This encrinital bed lies some forty feet below the St. Croix trilobite bed. Specimens of both Orthis and Spirifer occur at a lower level, between these crinoidal beds and the Mineska trilobite grits. A fuller description of these various species of trilobites, which belong, probably, to more than one genus, is in course of preparation for the final report on the geology of the Northwest. The object of this notice is merely to show, in connection with the specimens exhibited, that crustacea do actually occur in Wisconsin, Iowa, and Minnesota, even as low down in the unaltered sedimentary strata as any organic relics have yet been traced; and that the oldest sandstones of that country contain also *Spirifer*, *Orthis*, *Obolus*, and remains of Crinoidea, besides *Lingulas* and *Orbiculas*.

FOSSILS OF THE SILURIAN EPOCH.

At a meeting of the Boston Natural History Society, January, 1852, Professor Rogers stated that Mr. Salter had recently demonstrated in London the fallacy of Hugh Miller's argument for the deterioration of species, based on the supposed existence of fishes, in some of the older rocks, of a higher organization than those of a more recent period. One of the specimens from which the argument was drawn, was shown to be a piece of a trilobite, and another a zoöphyte. Prof. Rogers remarked that the only evidence remaining of vertebrata in the Silurian system, was a single occurrence of foot-prints in the sandstone of the St. Lawrence Valley. With regard to the nodules, like coprolites, occurring in the Barlow limestone, Professor Rogers suggested that the same source which could supply phosphate of lime to coprolites, might supply it in the form of concretions to the geological formation itself; so that the occurrence of such nodules merely was not positive proof of the existence of fishes at that time.

ON THE EXISTENCE OF TRACKS AND TRAILS ON THE ROCKS OF THE LOWER SILURIAN.

The following description of some supposed reptilian foot-prints from the oldest rocks of the Lower Silurian series, is taken from the appendix of Sir Charles Lyell's address before the Royal Geological Society of England. He says: —

"We are indebted to Mr. Logan, now at the head of the Government Survey in Canada, for having carefully determined the position of the rocks containing them. The locality is the village of Beauharnois, on the south side of the St. Lawrence, twenty miles above Montreal. The rock, a fine-grained whitish sandstone, quarried for building, belongs to the group called the Potsdam sandstone of the New York system, and lies at the base of the whole fossiliferous series of North America. Assuming the Chelonian origin of these foot-prints, they constitute the earliest indication of reptile life yet known; and are not only anterior to the most ancient memorials of fish hitherto detected, but agree in date with the first known signs of well defined organic bodies, such as Lingulæ, met with in the same rock. Prof. Owen has examined a slab of sandstone, on the upper surface of which the foot-prints are impressed, together with a plaster cast of the remainder of the continuous trail, in all 12½ feet long, brought to London by Mr. Logan." The following description of these impressions is given by Mr. Owen: — "The impressions are more numerous in regular succession than any that have been previously discovered; so that the evidence of their having been made by successive steps, afforded by this succession of corresponding prints at regular intervals, is the strongest we possess. They are in pairs, and the pairs extend in two parallel lineal series, with a groove midway between the two series. The outer impression of each pair is the largest, and it is a little behind the inner one. Both are short and broad, with feeble indications of divisions at their fore part. They succeed each other at intervals much shorter than that between the right and the left pair. The median groove is well defined, and slopes down more steeply at its sides than towards the bottom, at some parts of the track. I conclude, from these characters, that the animal which left the track was a quadruped, with the hind feet larger and wider apart than the fore feet; with both hind and fore feet very short, or impeded by some other part of the animal's structure from making any but short steps; that the fore and hind limbs were near each other, but that the limbs of the right and those of the left side were wide apart; consequently, that the animal had a short but broad trunk, supported on limbs either short or capable only of short steps; and that its feet were rounded and stumpy, without long claws. As to the median impression, that may be due either to a thick heavy tail, or to the under surface of the trunk dragged along the ground. The shape of the body and the nature of the limbs, indicated by the above described characters of the steps, accord best with those of the land or fresh-water tortoises; and the median groove might have been scooped out by the hard surface of a prominent plastron. The disproportion in the size of the fore and hind feet is such as we find in some existing terrapins — e. g., the *Emys geographica*."

At the meeting of the American Association, Albany, Mr. T. S. Hunt, of the Canadian Geological Survey, stated, that during the past summer, similar tracks have been discovered, in large numbers, in different beds, and at distances several miles apart. There is a great diversity in their size, but they agree in their general characters. The beds containing them are lying at a very small angle, and are overlaid by undoubted calciferous sandstone, while to this formation succeeds the Trenton limestone with its characteristic fossils.

ON SOME REPTILIAN FOOT-MARKS OF THE INFRA-CARBONACEOUS RED SHALE OF PENNSYLVANIA.

Prof. H. D. Rogers exhibited to the geological section of the American Association, Albany, specimens of impressions on the infra-carbonaceous red sandstone of the anthracite region of Pennsylvania, and submitted a description of their forms. These marks are of at least three species. They are all of them five-toed, and in double rows, with an opposite symmetry, as if made by right and left feet, while they likewise display the alternation of fore foot and hind foot. In other words, they are evidently quadrupedal. One species, the largest discovered, presents a diameter for each foot-print of about two inches, shows the fore and hind feet to be nearly equal in dimensions, displays a length of stride of about nine inches, and a breadth between the right and left treads of nearly four inches, and it shows the hind feet very little in the rear of the fore feet. This disposition of the footsteps, and other features described, were deemed, by Prof. Rogers, to ally the animal which made them rather to the saurian reptiles than to the batracians or chelonians ; but he wished to speak doubtingly of a point so difficult of decision in the present state of our information. Another series of smaller impressions displays also the quadrupedal indications, there being the same alternation of fore and hind, and of right and left feet; but the intervals between the fore and hind feet are about equi-distant. In this species, the width between the right and left feet is more than half the length of each stride. Associated with these footmarks are all the evidences of a subaerial exposure of the surfaces on which they are impressed, as sun cracks, rain-spotting, and the signs of the tricklings of a wet, sandy beach. All these associations confirm the inference, from the form of the foot-prints themselves, that the animals imprinting them belonged to air-breathing, and not to aquatic races.

Professor Agassiz was disposed to combat the views advanced, that these were the foot-prints of some tribe of reptilian animals, and he ventured to conjecture that they might more probably have been made by articulated animals. He indicated how certain families of fishes imprint the wet sand over which they swim, leaving marks somewhat resembling reptilian footsteps. His arguments were, however, dissented from by other members. The quadrupedal arrangement of the Pennsylvania foot-prints was again adduced by Professor Rogers, in evidence that these, at least, could not have been left by worms, nor even by fishes.

ON THE REPTILIAN FOOT-PRINTS OF EASTERN PENNSYLVANIA.

In former numbers of the Annual of Scientific Discovery,* some account has been given of reptilian foot-prints in the rocks adjacent to the coal measures of Eastern Pennsylvania, discovered by Mr. Isaac C. Lea, in 1849. As the exact position of these remains in the geological series has been called in question, we copy, from the proceedings of the Philadelphia Academy, the following remarks of Mr. Lea on this subject: —

"The geological position of this reptilian quadruped is of great interest, from the fact that no such animal remains have heretofore been discovered so low in the series. Those discovered by Dr. King, in Westmoreland county, and described by Mr. Lyell, in Silliman's Journal, July, 1846, are in the western coal-field, only 800 feet below the surface of the coal formation. (No. 13 of Prof. Rogers, the State Geologist.) The position of the Pottsville 'foot-marks' is about 8500 feet below the upper part of the coal formation there, which is 6750 feet thick, according to Professor Rogers, and they are in the '*red shale*,' (his No. 11,) the intermediate silecious conglomerate (No. 12) being stated by him to be 1031 feet thick at Pottsville. These measurements would bring these foot-marks about 700 feet *below the upper surface of the old red sandstone.* A mass of coal-plants exists immediately on the northern face of the heavy conglomerate, here tilted ten degrees over the vertical, and forming the crest and 'back-bone' of Sharp Mountain. This conglomerate mass is about 150 feet thick at the western side of the road, below Pottsville. On the same road side, about 1735 feet from these coal-plants, is the face of the rock, tilted slightly over the vertical, and facing the north. It is proper to state, that the limestone of the old red sandstone exists here, about two feet thick, and underlies these 'foot-marks' sixty-five feet."

The foot-marks in question are six in number, and very distinct. They assimilate remarkably to those of the recent *Alligator Mississippiensis*, and are somewhat analogous to the *Cheirotherium.* The name proposed for them by Mr. Lea is *Sauropus primævus.*

NEW ENGLISH FOSSILS.

Mr. Bowerbank, at the British Association, exhibited some few specimens of the remains of a once gigantic bird, found in the London clay, near Sheppy. He also exhibited drawings and restorations of several species of Pterodactyles from the chalk formation, showing that the great species of the chalk (*P. Cuvieri*) must have had a spread of wing equal to 16 feet 6 inches; whilst a second large species (*P. compressirostris*) was estimated at 15 feet. The largest species previously well known, the *P. macronyx* of Buckland, from the lias, was only computed at 7½ inches from tip to tip of its expanded wings.

At a meeting of the London Geological Society, Dec., Dr. Mantell exhibited a fossil lizard, about six inches long, which had been sent him to examine and describe by Mr. Duff, who discovered it near Elgin.

* See *Annual of Scientific Discovery*, 1849, p. 281, et 1850, p. 314.

In the same strata Capt. Brickenden found a track of 20 footsteps of a chelonian or turtle; and in the lower beds of the Devonian, in Forfarshire, fossil eggs of frogs and aquatic salamanders have been discovered, specimens of which were placed before the society. The great interest of these discoveries is the fact that previously no vestiges of any reptiles whatever had been found in the old red formation. Dr. Mantell has named the reptile *Telerpeton Elginense*, to indicate its remote antiquity and the place from whence it was obtained.

NEW FOSSILS FROM THE DRIFT OF NORTHERN AMERICA.

Some additional fossils have, within a very recent period, been discovered in the drift deposits of the northern portions of this country. On the 29th of Jan., 1852, the laborers on the Great Western Railroad, on Burlington Heights, Canada West, found part of the head and the tusk of an elephant beneath the strata of gravel. The tusk measured six feet nine inches in length, and thirteen inches in circumference.

FOSSIL EGGS OF SNAKES.

Prof. Blum communicates to the Quarterly Journal of the Geological Society, England, an account of some curious bodies found in the fresh-water limestone of Beiber, near Offenbach, Germany, and which he supposes to be fossil eggs of snakes. In size they are 8—10‴ long and 5—6‴ thick. The ends taper off in so nearly a uniform manner, that one end scarcely appears broader than the other. They are altogether more cylindrical than the eggs of birds. Some specimens are here and there somewhat compressed, which is easily accounted for by the soft condition of the shell in a recent state. Externally, the surface is for the most part rough, like a wrinkled skin. These bodies consist, generally, of calcspar, a thinnish rind of which supports the outer surface, while the inside is more or less hollow, and covered with little calcspar crystals. In one specimen, some of the calcareous matrix, in which the eggs are found, has penetrated into the inside. In another, it constitutes the whole substance of the fossil. These fossils are found in a brackish-water limestone, easily distinguished, by its soft loamy nature, from the strata above or below, and occur singly or in groups. They are associated with the shells, Paludina, and one or two species of Helix. By some, these fossils have been supposed to be concretions, but from their characters and contents, and from the conditions under which they exist, all idea of their inorganic concretionary origin must fall to the ground. Concretionary bodies are formed from within outwards, but in these exactly the opposite has taken place; lime in solution has permeated the parchment shell of the egg, and has been gradually deposited on the inside, and thus preserved the form of the egg after the organic substance itself had disappeared. I consider these fossils, therefore, to be eggs of snakes, perhaps of a coluber, deposited originally in calcareous mud, where an increase of calcareous matter not only prevented the hatching, but furthered the petrifaction of the eggs.

ON THE BONES AND EGGS OF A GIGANTIC BIRD IN MADAGASCAR.

M. SAINT HILAIRE has recently communicated evidence to the French Academy of the existence, at Madagascar, geologically recent, of a gigantic bird, entirely new to the scientific world. The discovery of the evidence was made in 1850, by M. Abadie, captain of a merchantman. During a stay at Madagascar, he one day observed, in the hands of a native, a gigantic egg, which had been perforated at one of its extremities, and used for domestic purposes. The accounts which he received concerning it soon led to the discovery of a second egg, of nearly the same size, which was found, perfectly entire, in the bed of a torrent, among the debris of a landslip which had taken place a short time previously. Not long afterwards was discovered in alluvia, of recent formation, a third egg, and some bones, no less gigantic, which were rightly considered as fossil, or rather, according to an expression now generally adopted, as sub-fossil. These were all sent to Paris; but one of the eggs was unluckily broken. The others arrived in safety, and M. Saint Hilaire has presented them to the Academy. These eggs differ from each other in form: one has its two ends very unequal; the other approaches nearly to the form of an ellipsoid.

The dimensions of the latter are: — Largest diameter, 13½ inches; smallest diameter, 8½ do.; largest circumference, 33½ do.; smallest circumference, 28¾ do. The thickness of the shell is about the eighth of an inch. This great Madagascar egg would contain about seventeen English pints, and its gross volume is six times that of an ostrich egg, and equal to 148 ordinary hens' eggs. To carry out the comparison still further, one of the eggs of the Madagascar bird would be equal in bulk to 50,000 eggs of the humming-bird.

The first question to be decided was — Are these the eggs of a bird or of a reptile? The structure of the shells, which is strictly analogous to that of the eggs belonging to large birds with rudimentary wings, would have sufficed to determine the question; but it has been completely set at rest by the nature of the bones which were sent with them. One of them is the inferior extremity of the great metatarsal bone of the left side; the three-jointed apophyses exist, two of them being nearly perfect. Even a person unskilled in comparative anatomy cannot fail to see that these are the remains of a bird.

M. Saint Hilaire assigns to this bird the generic name of *Æpyornis*, and to the species, *maximus*. It cannot be classed with the *Ornithichnites* on the one hand, or with the Ostrich and allied genera on the other, but it is the type of a new genus in the group of the Rudipens, or Brevipens. Its height, according to the most careful calculations made by comparative anatomists, must have been about twelve English feet, or about two feet higher than the largest of the extinct birds (*dinornis*) of New Zealand. According to the natives of the Sakalamas tribe, of Madagascar, this immense creature, although extremely rare, still exists. In other parts of the island, however, no traces of belief in its present being can be found. But there is a very ancient and universally received tradition amongst the natives, relative to a bird of colossal size, which used to slay a bull, and feed on the flesh. To this bird they assign the gigantic eggs lately found in their island. That this tradition is wholly a fable, is evident from the character of the bones found, which clearly show that the bird in question had neither talons, nor wings adapted for flying, but must have fed peaceably on vegetable substances.

M. Saint Hilaire considers it quite probable that the *Æpyornis* has had an existence within the historic period, and that it has even been referred to by two French travellers at different times, viz., by M. Flacourt in 1758, and by another at a later period. These accounts have heretofore been regarded as wholly fabulous. It is not, however, improbable, that the Eastern story of the Roc may have had its origin in a knowledge of the existence of the bird of Madagascar. It could not, as before observed, have possessed any of the ferocious characters ascribed to this fabled bird.

ON THE EPOCH OF THE MASTODONS.

At the Boston Society of Natural History, June, the President, Dr. Warren, brought before the society the subject of the epoch of the Mastodons, with the view of eliciting, he said, the opinions of members on the subject. He thought that great importance was due to the condition in which the remains of the food of these animals had been found in its bearing on this subject. Relics of the food of Mastodons had been found, in several instances, in such relation to them, as to leave no doubt of its real character. It was unfossilized, and in fragments of one or two inches in length, parts of it in coiled masses, as if shaped by the intestines. The vegetable structure could be distinctly made out under the microscope. The President, likewise, alluded to a tradition of the Indians, quoted by Mr. Jefferson, which he thought might have reference to the Mastodon. From these circumstances, he was inclined to the belief that Mastodons may have existed within the human epoch, possibly within 1000 or 2000 years.

Dr. Gould remarked that the remains of these animals had been usually found in bogs of peat, a substance particularly well calculated to preserve objects buried in them from decomposition. Most of the fragments of wood, also, which had been found with Mastodons, were resinous, and, from their very nature, capable of resisting, for a long time, the tendency to decay. Mr. Lyell, from his study of the formations at Niagara, has been led to the opinion that at least 20,000 years must have elapsed since the epoch of the Mastodons. They are found in formations below all the works of man, even the earth works of Ohio. Dr. Gould thought that if these animals had been known to the Indians, some trace of them would have been found in their various utensils, or in their pictures; but no such trace existed.

Dr. Cabot thought it not impossible that Jefferson's tradition might refer to the Mastodon. That such gigantic animals might be slain by the Indians, was evident from the fact that the Caffirs of the present day are able, with their primitive weapons, to kill elephants, almost as large. Such an event as the expulsion of the last of the race would be likely to be commemorated, and handed down from one generation to another. Bones of Mastodons were found at Big Bone Lick, in company with those of the buffalo. As for the circumstance of no pictures of Mastodons having been found on Indian robes or tents, he was inclined to attach little importance to it, as such memorials were very perishable. He alluded to the frequent occurrence, among the ruined cities of Yucatan, of monstrous heads, each furnished with a proboscis, sometimes pendant and sometimes turned up, which it was not impossible might have been intended to represent the heads of Mastodons.

In a discussion which took place at the American Association, Cincinnati, on the question whether the American Mastodon existed before or after the drift period, Major Owen said that he could bring forward one fact, from personal observation, which might throw some light on the subject. At the Blue Lick Springs he had obtained some remains of the Mastodon, found near the tusk, nine feet long, which had been sent to Peale's Museum, in Philadelphia. He had searched diligently in the black bog earth, in which the animals had evidently been swamped, while crowding to the brine springs, (from which, up to the present day, salt can be made,) but had found no shells to characterize the epoch. Fourteen miles, however, from that place, while searching for gigantic mammalian remains in yellow clay, (from the abrupt bank of which, after heavy rains, bones were frequently seen to project,) he found no bones, but found an ambonychia, imbedded fifteen or twenty feet below the surface. This, on examination, seemed to be identical with the *ambonychia amygdalina*, described by Prof. Hall, in his "Paleontology of New York." It had consequently been derived from the adjoining limestone or Silurian formation, either by agencies which had detached it from the limestone and carried it to the clay, or by having the loam of the drift, or a yet later period, wash down into the mammalian remains, bringing with it the debris and fossils of the surrounding Silurian rocks. From the same locality he obtained, a few weeks afterwards, a grinder of the *Eliphas primogenius*, or mammoth.

In other localities, where no such disturbance had taken place, the imbedded shells, accompanying similar remains, had been pronounced by Lyell, on his late visit to the United States, as showing the loam bluffs of the West and South to be *contemporaneous with the drift;* whereas, in Canada and New York, some lacustrine and swamp deposits of marl and bog earth, including the bones of extinct quadrupeds, were decidedly *post-glacial.*

MASTODON ANGUSTIDENS.

At a recent meeting of the Boston Natural History Society, Dr. Warren, the President, exhibited a cast of a Mastodon's tooth, an allusion to which he had happened to meet with some years since. It had been dug up from the banks of a stream about twelve miles distant from Baltimore, under the direction of Dr. Ducatel, State Surveyor. After having possessed it a considerable time, Dr. D. showed it to Mr. Charlesworth, who judged it to have belonged to *Mastodon Longirostris.* Sir Charles Lyell having seen it, was disposed to believe it to be a tooth of *M. Angustidens*, and in this opinion concurred Drs. Hays and Harlan of Philadelphia. The President said that, being in Baltimore, he sought for this tooth, and ascertained it had disappeared some time before, in a manner wholly unknown. Some time after, being in the Museum of the Academy of Natural Science, Philadelphia, looking over a fine collection of Mastodon teeth, in company with Dr. Hays, this gentleman discovered a tooth which had all the characters of the lost Baltimore specimen. Dr. Wilson, who had given it to the Academy, on being inquired of, said that it was purchased by his brother in London, as a supposed American fossil. On examination it appeared to have none of the characters of the tooth of the American *Mastodon giganteus*, but evidently belonged to the narrow-toothed group, either *Angustidens*, *Longirostris* or *Humboldtius*. Furthermore, whatever was its species, it was a Miocene fossil, and, of course, was derived from a deposit that had never presented any relic of *M. giganteus*, in this country. Being an insulated fossil, since none belonging to the same species or group had ever been seen among thousands of Mastodon specimens met with in North America, it was of course an object of great interest, and he had been led to investigate its history with all possible exactness. All the evidence he could obtain concurred in supporting the opinion that it was the tooth actually possessed by Dr. Ducatel, and which was brought to light in the manner he had described. On a recent visit to Europe, the President said he had taken with him a cast of the tooth, colored, under the direction of Dr. Wilson, exactly as when discovered, and exhibited it to Sir Charles Lyell and Mr. Charlesworth, who were fortunately in London. Both of these gentlemen distinctly recognized it as the tooth they had formerly seen in America. On exhibiting it to Professor Owen he thought the fact of its being an insulated fossil ought not to be considered an objection to its being a native of America, since every newly discovered species would be liable to the same difficulty. He considered it as decidedly belonging to the narrow-toothed group, and thought it probable that other portions of a skeleton might hereafter be found in the southern parts of the United States. The President said he had taken every opportunity to call the attention of Paleontologists in this country and in Europe to this specimen, in the hope of obtaining such facts and opinions as would dissipate the doubt which existed in regard to it, and either restore it to the Old World, or establish it as a native inhabitant of the New

FOSSILS FROM THE POST-PLIOCENE OF MASSACHUSETTS.

Mr. Stimpson has given to the Boston Society of Natural History a list of fourteen different varieties of shells obtained from the post-pliocene deposits of Point Shirley, near Boston. These fossils occur in the upper part of a stratum of blue clay and pebbles, which crops out from under the coarse drift, at the cliffs on both sides of the hill. On the east side the stratum is at an elevation of fifty or sixty feet above high-water mark; on the west side it is but two or three feet above the same level. At some little distance from this site, a stratum of clay, probably the same, containing shells, was met with in digging a well, at a depth of fifty feet below high-water mark, showing the great inequalities of the ancient sea bottom. With regard to the species found at Point Shirley, Mr. Stimpson remarked that those most common in this deposit are inhabitants of deep water, and of northern origin. With one exception they may all be obtained in a living state by dredging within a mile of the locality where they are now found fossil.

The state in which they occur would seem to furnish evidence in favor of Lyell's theory of the drift being deposited from the melting of icebergs, by which the materials had been transported. The shells are almost invariably broken, but not worn, their angle of fracture remaining sharp.

Mr. Desor said that it had been thought that the coarse drift near Boston was glacial in its origin. The fact that shells had been found in it had been offered as an objection. This had been explained by the supposition that a glacier had entered the sea at the point where the shells had been found in the drift. The existence of a layer of clay containing shells beneath the coarse drift at Point Shirley, would seem to indicate a quiet deposition at variance with the glacial theory.

BOTANY.

HISTORY AND NOMENCLATURE OF SOME CULTIVATED VEGETABLES.

At the American Association, Cincinnati, a paper was presented from Dr. T. W. Harris, of Cambridge, "On the Nomenclature and History of certain cultivated Vegetables;" the object of which was to show, that the cultivated vegetables of this country, which have been generally ascribed to an Eastern origin, are by no means European, but purely American, and only introduced in Europe since the settlement of the northern part of this country. The following abstract embraces the result of Dr. Harris' investigations: —

The errors that have grown and spread, and multiplied with the lapse of time, in this neglected field of research, says Dr. Harris, require to be cleared away. Decandolle remarked that the species of the genus *Cucurbita* ought to be worked out anew. The names of the pumpkin and squash are no longer used precisely in their original sense. In general, they are the fruits of the plants belonging to the miscalled genus *Cucurbita*, as now restricted by Meisner and Endlicher. The illustrious Linnæus, following in the steps of his botanical predecessors, for whose errors he is not to be held accountable, gave the names of *Cucurbita pepo* and *Cucurbita melopepo* to those kinds of pumpkins and squashes that had been longest and best known. He added to the list one more old species, the *verrucosa*, and a new one, the *ovifera*, said to have been brought by Lerche from Astrachan. Several more species are now enumerated in scientific works, some separated from the *pepo* of Linnæus (*C. maxima* and *C. moschata*), and others more recently detected and characterized. Most of the pumpkins and the squashes that are cultivated in the United States as articles of food, have been referred to the Linnæan species. Ever since the time of Caspar Bauhin, whose "Pinax" seems to have served as the basis of botanical nomenclature, it has been taken for granted that pumpkins and squashes were the *pepones* and *melopepones* of the Greeks and Romans. If this be admitted, it must follow that pumpkins and squashes were not only well known to the ancients, but that they were natives of the eastern continent, to which, indeed, the most common kinds are actually assigned by modern botanists. Dr. Harris, however, shows that the *pepones* and *melopepones* of the Greeks and Romans were not pumpkins and squashes; that the latter were unknown to the ancients; that they did not begin to be known in Europe until *after the discovery of America;* and that they are natives of America. He traces out, in this paper, a detailed account of the ancient vegetables; proves that the musk-melon is still known and cultivated in Greece, and that the modern Greeks call it *peponi*, a word derived from the ancient name of the fruit; that the monuments of Egypt, though containing representations of many other plants, have none that can be referred to the peculiar products of which this paper treats; and that writers on Materia Medica enumerate four kinds of cold and demulcent seeds, namely, those of the citrul, cucumber, gourd and melon; but make no mention of those of pumpkins and squashes, which are included in the list by modern physicians.

The common nomenclature of the cucurbitaceous plants, in the languages of Europe, has become very much confused, many of the names now embracing species, and even genera, to which they did not originally belong. The European gourd, or calabash, originally a native of southern Asia, took its names mostly from the Latin *cucurbita.* It was known to the Anglo-Saxons, and was by them called *cyrfoet.* Though long cultivated by the Romans, by whom, perhaps, it may have been carried to Britain, it was not generally introduced in Western Europe till the time of Charlemagne, who greatly encouraged its cultivation. Tragus, who wrote in the early part of the sixteenth century, gave the first good figure and intelligible description of it. The French call it *courge;* the English, *gourd;* the Germans and Swedes, *kürbis;* the Dutch, *kauwoerde;* the Spanish, *calabaza*, and the Portuguese, *cabaça;* all which names are derived from *cucurbita.* The old names, *abóbora* and *abóbara*, by which it was known in Portugal, and the Danish *græskar*, are of uncertain origin. *Zucche* and *zucca*, the Italian names for the gourd, are probably derived from the Greek *sikua. Citrouelle* was the old French name for the water-melon, which is equivalent to the English *citrul*, and to the pharmaceutical *citrullus.* All these names were afterwards applied to gourds, pumpkins, and squashes.

The old botanists, by whom these fruits were first described, were chiefly Brunfelsius, Tragus, Fuchsius, Cordus, Matthiolus, Turner, Dodonæus, Lobelius, and Dalechamp — all of whom, except Lobelius, died before the year 1600. It is worthy of note, that John Eliot, the apostle of the Indians, in his translation of the Bible into the language of the Massachusetts Indians, which was first printed in 1663, and was the first Bible printed in America, could find no other words for *cucumbers* and *melons*, occurring in Numbers xi. 5, than *askootasquash* and *monaskootasquash*, hereby indicating that these fruits were unknown to the Indians by name. It seems, however, that the Indians had a name for gourd; for Eliot renders this word *quonooask*, in Jonah iv. 6, 7, 9, and 10. Several of the French missionaries in Canada have mentioned the *citrouelles* cultivated by the Indians. A number of extracts from early voyagers were cited by Dr. Harris, in this connection, which prove that the vegetables alluded to were in common use among the aborigines through the whole extent of country from Florida to Canada, and probably far to the west; and hence they could not have been derived from Europeans, even if they were not originally indigenous to the soil.

ON THE PRODUCTIVENESS OF THE WHEAT PLANT.

Some curious experiments on the productiveness of the wheat plant have been instituted at Buckingham, England, by a gentleman by the name of Stowe. On the 13th of July, 1850, a single grain of wheat was sown in the garden; the plant came up in ten days, and grew luxuriantly till the 13th of September; it was then taken up and divided into slips, and replanted. The plants lived and flourished till the 13th of November, when they were again raised, divided and replanted, and suffered to remain till the 16th of April of the present year. The weather then becoming unfavorably wet, they were all taken up again and divided into not less than 114 plants; these, being planted, were permitted to stand till the month of August, when they were productive of the amazing number of 520 ears of wheat, many of them of full size, containing more than 50 grains of corn. Whether the result of this trial will strengthen the opinion of those who contend for the thin sowing of wheat in ordinary field cultivation, must be left to the judgment of more practical agriculturists; but of the amazing productiveness of the wheat plant, under such treatment, any one may easily satisfy himself by repeating the experiment.

VITALITY OF SEEDS.

Prof. Henslow, at the British Association, stated, that during the last year he had planted several seeds sent to the committee appointed to report on this subject, and out of those he had planted two had grown. They both belonged to the order Leguminosæ, and one was produced from seed seventeen, and the other from seed twenty years old. On the whole, it appeared that the seeds of Leguminosæ retained their vitality longest. Tournefort had recorded an instance of beans growing after having been kept a hundred years, and Wildenow had observed a sensitive plant to grow from seed that had been kept sixty years. The instances of plants growing from seeds found in mummies were all erroneous. So also was the case, related by Dr. Lindley, of a raspberry bush growing from seed found in the inside of a man buried in an ancient barrow.

Mr. Babington related a case in which M. Fries, of Upsala, succeeded in growing a species of Hieracium from seeds which had been in his herbarium upwards of fifty years. Desmoulins recorded an instance of the opening of some ancient tombs in which seed was found, and on being planted they produced species of Scabiosa and Heliotropium. Recently some seeds from Egypt were sown in Cambridge, which were thought to have germinated; but on examining them they were covered with a pitchy substance, which had evidently been applied subsequent to their germination, and thus they had preserved the appearance of growth through a long period of time. Dr. Cleghorn stated that after the burning or clearing of a forest in India, invariably there sprung up a new set of plants which were not known in the spot before.

TOBACCO AND ITS RESULTS.

Mr. Robert Ellis, in editing the official catalogue of the Great Exhibition, makes the following remarks concerning tobacco : — " The total quantity of tobacco retained for English consumption in 1848, amounted to nearly 17,000,000 lbs. North America alone produces upwards of 200,000,000 lbs. The combustion of this mass of vegetable matter would yield about 340,000,000 lbs. of carbonic acid gas ; so that the yearly increase of carbonic acid gas from tobacco smoke alone cannot be less than 1,000,000 lbs., a large contribution to the annual demand for this gas made upon the atmosphere for the vegetation of the world."

VALUE OF FLAX TO GREAT BRITAIN.

It is estimated that there is yearly consumed in the linen and other manufactures of Great Britain, 100,000 tons of flax. Of this quantity 75,000 tons are imported, the remaining 25,000 tons being the produce of the British isles. The total value of all the articles of British manufacture, in which the flax fibre imported is employed, exceeds £5,000,000 annually.

Flax-seed for sowing and crushing is imported annually into Great Britain, to the amount of £1,820,000, taking the quantity imported 650,000 quarters, at 7s. per quarter ; 70,000 tons of oil-cake, for feeding of cattle, having a value of £600,000, are also imported yearly.

VEGETABLE PHYSIOLOGY.

MM. Cloës and Gratiolet, in some experiments upon aquatic plants, as species Potamogeton, Confervas, and the like, obtain the following results : *Influence of light.* — The disengagement of oxygen from the green part of plants is very rapid in full solar light, insensible in diffuse light, and null in darkness ; and in the last condition *no* carbonic acid is disengaged, contrary to an old opinion, but now for some years correctly understood. With glass of different colors, the effect was greatest with colorless glass, and diminished in the order, red, green, blue. *Influence of temperature.* — The decomposition of carbonic acid by aquatic plants, exposed to light under a temperature of + 4° C., does not commence until the temperature is raised to 15° C., and has its maximum at 30° C.; and if the plants are in a temperature of 30° C., then, on its reduction, action continues even to 10° C. This result corresponds with Chevreul's on the circulation and ascension of the sap of plants. *Influence of the composition of the surrounding waters.* — In river water, deprived of air by ebullition, and containing only carbonic acid in the same proportions as the waters of the Seine, the water being frequently renewed, the decomposition is at first active, but afterwards diminishes, and ceases after four or five days ; and by this time the green color of the plant has become paler. At first the gas produced is mixed with some nitrogen, the quantity of which goes on diminishing ; so that when decomposition ceases, the air disengaged is almost wholly pure oxygen. The total volume of the nitrogen disengaged is much more considerable than the volume of the plant; and, on submitting this plant to elementary analysis, it is found that, for equal weights, it contains much less nitrogen than a portion of the same plant not subjected to the experiment. The facts show that, in the act of growth, in submerged plants, nitrogen proceeds from the decomposition of the elements themselves of the plants; that consequently a re-supply is necessary, and, consequently, nitrogen, free or combined, is essential to the life of the plant. In the experiments instituted by Cloës and Gratiolet, a ten thousandth of ammoniacal salts dissolved in water always proves injurious. The decomposition of carbonic acid diminished and ceased after some hours; whence the conclusion that the plant assimilates directly nitrogen in solution in water. They have also found that whatever may be the position of the leaves of Potamogeton in water, carbonate of lime is decomposed by the superior surface of the leaves, and never by the inferior. They have also ascertained that the oxygen produced by the decomposition of the carbonic acid has a definite course; that it descends invariably from the leaves towards the roots. Thus, when the stem is placed horizontally in water, the emission of gas always takes place nearest the root of the plant. — *Institut.*

INFLUENCE OF THE POISON OF THE RATTLESNAKE ON PLANTS.

The following facts were communicated to the American Association, Albany, by Mr. J. H. Salisbury. In June, 1851, a large female rattlesnake, which had been caged in the New York State Cabinet of Natural History, died. On dissection, its stomach and intestinal canal were found entirely empty, as much so as if they had been scoured out with soap suds. The sack in which the poison is emptied was laid open, and the virulent matter (of which there was but little) carefully removed and placed in a porcelain capsule. About five minutes after its removal, four young shoots of the lilac, a small horse chestnut of one year's growth, a corn plant, a sunflower plant, and a wild cucumber vine, were vaccinated with it. The vaccination was performed by the dipping the point of the penknife into the virulent matter, and then inserting it into the plant, just beneath the inner bark. No visible effects, in either case, of the influence of the poison were perceptible, till about sixty hours after it had been inserted. Soon after this, the leaves above the wound, in each case, began to wilt. The bark in the vicinity of the incision exhibited scarcely a perceptible change; in fact, it would have been difficult to have found the points, if they had not been marked, where the poison was inserted. Ninety-six hours after the operation, nearly all the leaf-blades in each of the plants, above the wounded part, were wilted and quite dead. On the fifth day the petioles and bark, above the incisions, began to lose their freshness, and on the sixth day they were considerably withered. On the seventh day they were about as they were on the sixth. On the tenth day they began to show slight signs of recovery. On the fifteenth day, new but sickly-appearing leaves began to show themselves on the lilacs, and the other plants began to present slight signs of recovery in the same way. Neither of the plants were entirely destroyed. It was interesting to mark the progressive influence of the poison. The first indication of derangement of the healthy functions of the plants was observed in the leaves. These began to wilt and die at their edges and apices, and this death gradually and uniformly advanced on all sides towards the mid-rib and petiole till the whole or nearly the entire leaf was destroyed. It is an interesting fact in physiology, that the plants first exhibited signs of death in the leaves situated on the side in which the incisions were made. The facts naturally deducible from these experiments, are : — That the effects of the poison of the rattlesnake upon plants and animals, when introduced into their circulation by a wound, are similar. That it requires a much longer time to affect a plant than an animal. [It should be stated, in order to show that animals were readily affected by the poison of the snake, that, a short time previous to its death, a rat bitten by it died in about two hours.] That the effects were invariably exhibited on the part above the wound, and in no case affected the leaves below it. [This was probably owing to the small quantity of the poison introduced in each instance.] That it invariably affected first the leaves on the side of the plant in which the incision was made. That its influence was invariably first rendered visible on the edges and apices of the leaf-blades.

ABSORPTION OF INORGANIC POISONS BY PLANTS.

Chevallier has communicated several observations respecting the absorption of mineral substances by plants. Pepper-wort (*Lepodium sativum*) was planted in earth, and watered with an aqueous solution of tartar emetic, blue vitriol, and sugar of lead ; antimony, copper and lead were found respectively in the stalks of the plants, but only copper or lead in the seeds. He found lead in plants grown in a white lead manufactory, and he likewise confirmed the observation that chloride of sodium is absorbed by plants. The action of arsenious acid upon plants has been investigated by Chatin. He states that this acid is, to a certain extent, absorbed by plants, and that, if they are not destroyed by the influence of the poison, it is at a later period again ejected by the roots. He has examined the conditions which favor either the action of the poison or its secretion. We mention here only that the action of the poison on the various kinds of plants exhibited a remarkable difference — phanorogamia dying earlier than the cryptogamia, and the dicotyledons sooner than the monocotyledons. Fithol has confirmed the statements of Chatin ; and he has moreover minutely investigated the unequal distribution of the arsenic absorbed throughout the various parts of the plants. He finds that arsenic acid, employed in the same proportion, and in an equal state of dilution, has a more poisonous action on plants than is exhibited by arsenious acid. — *Liebig's Report.*

ON THE FREEZING OF VEGETABLES AND PLANTS.

From an interesting paper submitted to the American Association, Albany, on the above subject, by Prof. J. Leconte, we make the following extracts : —

The author commences by citing the opinion of John Hunter, before the Royal Society, in 1775, that animals must be deprived of life before they can be frozen ; and that plants must be deprived of the principle of vegetation before they can be frozen. But these generalities have been since contradicted, for Sir John Franklin, and others, have noticed that fishes and reptiles have been found in a frozen state, and have afterwards been restored to life. If this generalization is inapplicable to animals, it might naturally be expected that plants, in which the functions of vitality are still more obscurely manifested, should be endowed with the power of resisting cold in a greater degree. Yet writers on vegetable physiology seem to be very generally decided that " the complete solidification of the fluids of a plant must necessarily and inevitably result in its death." In corroboration of the opinions above stated, the author cites Decandolle, Prof. Henslow, &c. Modern vegetable physiologists have been so impressed with the fundamental idea of Hunter, that they have rather sought for causes which might prevent the juices of plants from freezing, then endeavored to overthrow the principle which they thought established.

Prof. Leconte stated that, until quite recently, he had participated in this fundamental opinion, and that when he commenced his investigation, all his prepossessions were in favor of the theory already established. But from the examinations made during the winter of 1850–51, he had become satisfied that plants might be frozen without the slightest injury. During that winter he had noticed roses, pines, and other plants, which had become frozen so that they snapped off like pipe-stems, yet they were uninjured by this intense freezing. After making a series of experiments on plants, such as the elder, with considerable pith, and which it might be supposed extreme cold would affect readily, he was forced to the conclusion that freezing has little or no effect on them. Instances were cited where trees have been known, as in Hudson's Bay, Canada, and Maine, to have been frozen so that the physical qualities of the wood appeared to be altered, yet still the trees lived and throve with unabated vigor on the return of warm weather. The observations of Erman, Von Humboldt, and others, have abundantly proved, that in Siberia the ground is frozen to a great depth, so that even the fibres of the roots and the roots themselves must be a solid icicle. Indeed, the larches in Siberia not only have their roots resting on a frozen substratum all the year round, but are themselves frozen for nearly eight months in the year. Nor are these facts confined to the larch forests of Siberia. Large portions of both Europe and North America, lying north of the isothermal line of 32° Fahr., support extensive forests of birch, spruce, larch, Scotch fir, &c., where the ground ice is perpetual.

It may be objected to this that trees are known to split with the cold. To this it may be remarked, that young trees are hardly ever known to split; while the aged and unyielding trunks of aged trees are those that suffer most in this way. Some facts are cited to show that the splitting and rending of trees by freezing is occasioned by the unequal contraction of the layers of wood caused by a sudden application of cold; for observation leads to the belief that the congelation of the sap alone does not produce this effect.

In conclusion, it must be admitted that the analogy between plants and animals is very perfect. There are genera of both, in which all the fluids may be frozen without perceptible injury, while both appear to be able to withstand a high degree of cold in a dormant state.

PROBABLE EFFECTS OF VEGETATION ON CLIMATE.

In the Secretary's report of the proceedings of the Bombay Geographical Society, for 1850, some interesting facts are given in regard to the influence of vegetation on the amount and distribution of moisture, and the consequent effect on climate.

It was early remarked by Humboldt, that men in every climate, by felling the trees that cover the tops and sides of mountains, prepare at once two calamities for future generations — the want of fuel and a scarcity of water. Trees, by the nature of their perspiration, and the radiation from their leaves in a sky without clouds, surround themselves with an atmosphere constantly cold and misty. They affect the copiousness of springs, not, as was long believed, by a peculiar attraction for the vapors diffused through the air, but because, by sheltering the soil from the direct action of the sun, they diminish the evaporation of the water produced by rain. When forests are destroyed with an imprudent precipitation, as they are everywhere in America, the springs entirely dry up, or become less abundant. The beds of the rivers, remaining dry during a part of the year, are converted into torrents whenever great rains fall on the heights. The sward and the moss disappearing with the brushwood from the sides of the mountains, the waters falling in rain are no longer impeded in their course; and, instead of slowly augmenting the level of the rivers by progressive filtration, they furrow, during heavy showers, the sides of the hills, bear down the loosened soil, and form those sudden inundations that devastate the country. Hence it results, that the destruction of forests, the want of permanent springs, and the existence of torrents, are three phenomena closely connected together. In India, their effects are very appreciable. At Dapoolie, the climate is much more hot and dry than formerly; streams now dry up in December which used to flow until April or May. This is attributed to the destruction of forests which formerly covered the neighboring hills, now barren and desolate. In southern Coucan, within the space of fifteen years, the climate has been greatly deteriorated by the diminution of vegetation and consequently of rain. The people of Pinang have memorialized government against the destruction of their forests, feeling sure that the result by its continuance will be the ruin of the climate. The dreadful droughts which now so frequently visit the Cape de Verd Islands are avowedly due to the removal of their forests; and in the high lands of Greece, where trees have been cut down, springs have disappeared. In India, a few years since, a proprietor, in laying down some ground, well watered by an excellent spring, for a coffee garden, at Genmore, despite the advice of the natives, cleared the adjacent ground, when the supply of water vanished. Cases are also cited, where the clearing of jungles was followed in every case by an almost immediate diminution of water; when the jungle was allowed to grow again, the water returned, the springs were opened and flowed as formerly. The St. Helena Almanac, for 1848, gives particulars of the increase of the fall of rain for the last few years, attributable to the increase of wood; within the present century the fall has nearly doubled. The plantations seem to have performed another service to the island. Formerly, heavy floods, caused by sudden torrents of rain, were almost periodical, and frequently very destructive; for the last nine years they have been unknown. On the mountains of Ferro, one of the Canary Islands, there are trees, each of which is constantly surrounded by a cloud; their power of drawing down moisture is well known to the people. The natives call them *gawl*, the Spaniards *santo*, from their utility. The drops trickle down the stem in one unceasing stream, and are collected in reservoirs constructed for their reception. The whole of this beautiful process depends upon the simple laws of temperature, condensation and evaporation. Trees shade the soil from the sun. They give off vapor during the day, and so mitigate heat, while they obstruct the direct rays from above;— they radiate heat out during the night, and occasion the precipitation of dew at night — many plants being endowed with this faculty to such an extent as to collect water in large quantities from the air.

In a discussion which occurred in the British Association, on the influence of forests on climate, Capt. Strachey said he could not agree with those who thought that forests had much influence on climate. It was a notion that they encouraged rain; but it was more probable that rain was the cause of forests. He alluded to districts in India, in which the forest vegetation was just in proportion to the fall of rain; being small and diminutive where there was little rain, and abundant and gigantic where there was much rain. In temperate climates forests might produce an effect, but certainly not in the tropics. With regard to the economical question, there could be no doubt that it was foolish to destroy what was valuable, but we had not the power to arrest the present destruction of the forests in India. Mr. Bunbury enumerated several instances where forests did not exist, and yet there was much rain, and others, where forests existed, and there was little rain. Humboldt was our great authority on this subject, and he had recorded his opinions of the influence of forests on climate. In many districts where forests were cleared and single individuals left, these latter soon died from the want of the influence of their neighbors. Dr. Lankester pointed out that, according to the laws of vegetation, plants must be supplied with water in a liquid or vaporous form for their growth, and that all the facts which had been mentioned, and which at first sight appeared opposed to each other, might be explained. That forests did not always grow in rainy districts, arose probably from the waters accumulating and forming morasses in which forest trees would not grow. In districts where there was not much rain, there might be much moisture in the atmosphere; rain in general supplied only a very small quantity of the water required by plants. Vegetable physiology afforded no explanation of the effects on climate, attributed by some observers to forests.

THE OPIUM TRADE.

From an essay published by Dr. Nathan Allen, on the history, extent, and effects of the opium trade, as carried on in India and China, we compile the following information in regard to this demoralizing traffic: — Opium, as is well known, is the production of the plant *Papaver somniferum*, called in English the Poppy. This plant was originally a native of Persia, but is now found growing as an ornamental plant in gardens throughout the civilized world. It is most extensively cultivated in India, where it is estimated that more than 100,000 acres of the rich plains of that country are occupied for this purpose, giving employment to many thousands of men, women and children. Its cultivation throughout is very simple. The seed is sown in November, and the juice is collected during a period of about six weeks in February and March. The falling of the flowers from the plant is the signal for making incisions, which is done in the cool of the evening, with hooked knives, in a circular manner, around the capsules. From these incisions a white, milky juice exudes, which is concreted into a dark-brown mass by the heat of the next day's sun; and this being scraped off every evening as the plant continues to exude, it constitutes opium in its crude state. India, it is said, produces forty thousand chests of opium annually, each chest varying in weight from 125 to 140 pounds. Two of the principal localities for the cultivation of this drug, in Bengal, are subject to the East India Company, and the manufacture and traffic in it is a strict monopoly of the government. In the others, there is a most oppressive system of espionage established over the natives, to an extent which throws the control of the traffic into the hands of the same Company. On that which is raised in Malwa, a province lying in the western part of India, beyond the East India Company's control, and which, in order to reach Bombay, the principal market, has to pass through certain territories of the Company, a transit duty of 400 rupees is levied. The income from this tax, in 1846, was £1,000,000, which, with the revenue received the same year at Calcutta from the article, makes the sum total of income to the Company from it £3,000,000.

The idea of sending opium from Bengal to China originated in 1767. From this time to 1794, the trade in it met with but poor success. In the latter year the English succeeded in stationing one of their ships laden with opium at Whampoa, where, for more than a year, she lay unmolested, selling out her cargo. In 1821, owing to the difficulties attending the sale at these places, the opium merchants withdrew all their vessels from Whampoa and Macao, and stationed them under the shelter of Lintin Island, in the bay, at the entrance of Canton river, which henceforth became the seat of extensive trade. From these vessels it was taken in Chinese junks and smugglers' boats, and retailed at various ports along the shore. In 1847, it is said about fifty vessels were engaged exclusively in this trade, besides a greater or less number which were only partially freighted with the drug. It is stated that two and a half millions of dollars' worth of opium is annually imported into Foo-chow, from whence it finds its way into the interior. In that city alone there were, in 1848, one hundred houses devoted to the smoking of the drug, while as many retailed the poison in small quantities.

As respects the progress and present extent of the trade, it is said that from 1794 to 1820, the amount exported to China varied from 3,000 to 7,000 chests per year. In 1837, it amounted to between 39,000 and 40,000 chests, valued at $25,000,000. From 1838 to 1842 the trade was almost entirely interrupted by the war, which grew out of the attempts on the part of the Chinese government to suppress it. At the conclusion of the war, the trade was resumed with renewed vigor. For the year 1848, the amount imported into China from Bombay was 19,111 chests, and from Calcutta 36,000 chests, which, at an average of $550 per chest, would amount to $32,000,000 expended for this single article of trade. Then the Chinese pay an advance on the sum of several millions more, which goes into the hands of the merchants as the fruits of their investment and labors in the trade. All this sum has to be paid in specie, or Chinese sycee, which is the purest of silver.

The principal use made of opium by the Chinese is in the form of smoking; a practice to which they become most passionately addicted. The wealthier orders do their smoking in their own dwellings, but for the poorer classes there are thousands of shops fitted, in many of the Chinese cities, with accommodations expressly for smoking. Many of these shops are represented to be the most miserable and wretched places imaginable. Rev. Mr. Squire says of them; — "Never, perhaps, was there a nearer approach to hell upon earth than within the precincts of these vile hovels, where gaming is likewise carried on to a great extent." It is stated that there are one thousand of these opium shops in the city of Amoy. All classes in the community are addicted to the practice. The effects of this drug upon the consumer are thus described by a distinguished Chinese scholar: —"It exhausts the animal spirits, impedes the regular performance of business, wastes the flesh and blood, dissipates every kind of property, renders the person ill-favored, promotes obscenity, discloses secrets, violates the laws, attacks the vitals, and destroys life." This statement is confirmed by other natives, and also by foreign residents; and it is asserted that, as a general rule, a person does not live more than ten years after becoming addicted to the use of this drug. The Chinese government have made strong efforts to cut off or restrict the traffic in this drug. Public attention was directed to its injurious effects in 1799, and in 1809 an edict was issued requiring all ships discharging their cargoes at Whampoa, to give bonds that they had no opium on board. Still more stringent laws were adopted in 1820. In 1834, an edict was issued, declaring that the injury done by the influx of opium, and by the increase of those who inhaled it, was nearly equal to a general conflagration, and denouncing upon the seller and smoker of the poison the bastinado, the wooden collar imprisonment, banishment, confiscation of property, and even death by public decapitation or strangulation. But, notwithstanding all this, the trade kept increasing, until at length an imperial commissioner was appointed, clothed with the highest authority and powers, to proceed to Canton and endeavor to effect an utter annihilation of the trade. In carrying out this determination, he seized and destroyed some 20,280 chests of opium, and compelled the merchants to sign a bond that they would forever cease trading in the article. This bold and decided measure on the part of the commissioner led to the war with England, which is commonly known as the opium war, the result of which is well known to all our readers. One result of the war was the ceding of the island of Hong Kong to the English. In this island, after passing into the hands of the victors, the trade in opium was legalized, and twenty shops for its sale immediately licensed, within gun-shot of the Chinese empire, where such an offence is punishable with death. Thus the war, instead of putting an end or check to the system, through the cupidity of the English resulted in affording greater facilities than ever for its prosecution. The Chinese dare not impose the penalties affixed to a violation of their laws restricting the trade, which have never been abrogated or repealed, for fear that, if they should do so, it might be made the groundwork for another war, which would result in their being despoiled of still larger portions of their territory and possessions.

It is stated, upon the highest authority, that the British government in India could not be sustained without the immense revenue derived from this trade. This revenue, for the last six years, it is said, has amounted to nearly $80,000,000. It is also estimated that the immense sum of $400,000,000 of specie has been drained from China to pay for this single article alone, within the last half century. That this pernicious contraband traffic is upheld mainly by the British government, through its agent, the East India Company, all are aware ; and the stain of its conduct towards the Chinese, in *forcing* this "flowing poison" upon them, is held up to the detestation of the civilized world. Money, not morality, has been its governing principle ; and to increase its own resources and power, it has legalized and upheld this traffic, which is destroying, morally, socially, and politically, the whole Chinese nation, and which threatens to blot it out from among the nations of the earth. Well does the author of the pamphlet before us ask, "What must be the verdict of future generations, as they peruse the history of these wrongs and outrages? Will not the page of history, which now records £20,000,000 as consecrated on the altar of humanity to emancipate 800,000 slaves, lose all its splendor and become positively odious, when it shall be known that this very money was obtained from the proceeds of a contraband traffic on the shores of a weak and defenceless heathen empire, at the sacrifice, too, of millions upon millions of lives?"

SUBSTITUTES FOR QUININE.

The present high price of quinine, and the threatened extinction of the supply of cinchona, have led to the publication, in the French journals, of various propositions for substitutes. Among these, *arsenic* deservedly enjoys most favor, especially since the publication of Boudin's papers upon its employments, his report being confirmed by many practitioners, though demurred to by others. Valuable a medicine as it is, however, we fear that, as a general rule, it is very inferior to quinine as a febrifuge in certainty and rapidity of action, and the less liability to relapse, said to be consequent upon its employment, is anything but proved. A medicine recently introduced by Dr. Band, under the name of *hydro-ferrocyanate of potassa and urea*, has excited considerable attention. The Academy appointed a commission to investigate its claims, and 30 cases of ague were treated by it, who had had recourse to various means without success. Of these, 26 were cured, confirming M. Band's favorable statement, founded on 200 cases that had been treated by himself and others.

M. Ossian Henry has assisted M. Band in the production of this substance on a large scale, but its exact composition has not been made known. From a complex organic product like this, the transition is great to so simple a one as *common salt;* and yet, according to M. Piony, given in doses of from four to eight drachms *per diem*, it effects very rapidly what no other *succedaneum* of quinine that he has tried does, a diminution of the size of the spleen. Recommended to the Academy, M. Piony promptly cured six out of eight cases in which he employed it.

Another practitioner of high repute, M. Gendron, has published an account of the great effacy of an indigenous solanaceous plant, the *alkekenge*, found among vines and shady places in France, Spain, and Italy. Of forty cases it failed only in five or six. It seems almost trenching on the ludicrous to repeat that two practitioners, residing, one at Naples and the other in Sardinia, are quoted in the "Révue Médicale" as recommending, as based upon sufficient experience, *spider's web*, forty grains being given in divided doses. Dr. Ruspini states, also, that economy would result from the substitution of a neutral sulphate for the present bibasic salt; for he and other practitioners have found such neutral sulphate or per-sulphate as useful as the bibasic in a half or quarter the dose — a fact easily understood in consequence of its great solubility. Computing, with Chevallier, the annual consumption of yellow cinchona in France at 140,000 kilogrammes, valued at 3,360,000 francs, the substitution of the neutral salt would reduce the quantity to 55,580 kilogrammes, and the price to 1,333,920 francs. Although quinine still holds its vantage ground, the importance of these investigations, as to the discovery of possible substitutes and the greater economizing of present supplies, are impressed upon us by the unfavorable report of M. Weddel, after five years' investigation of the sources of supply, and the high price which places the article beyond the reach of the poorer classes, and the rapidly increasing adulteration it is subjected to.

THE POTATO DISEASE.

Among the various causes assigned by different observers as to the origin of the potato disease, that of insects has been extremely common, both in this country and in Europe; but apparently without reason. The following is the opinion of Dr. T. W. Harris, the eminent entomologist of Harvard University, as given in a published letter, answering inquiries in relation to this subject.

After adverting to various species of insects which have been charged by various persons as the authors of the potato disease, viz., the *larvæ of Criocceris trilineata*, the *Coccinella*, black-bugs and others, Dr. Harris says: I could enumerate, at least, half a dozen more kinds of insects that are occasionally or always to be found, in their season, on the potato vines, — insects varying in size from the minute black Haltica and small bugs, to the big potato-worm, or *Sphinx quinquemacuta*, — all of them destructive according to the extent of their powers, but innocent of the great offence, which might be charged to them with as much propriety as to other insects, of causing the potato disease. I will only advert to one more, namely, the *Baridius trinotatus*, an insect for whose history we are indebted to a lady, Miss Morris, of Germantown. In the larva state it lives in the stems of the potato, where it is finally transformed to a little gray beetle, having three black dots on its shoulders. This insect, though common enough in the Middle States, I have never seen in New England, in the course of 30 years of observation, and am confident that it must be rarely found here, if at all. Miss Morris, when she first discovered its habits, thought she had detected the real culprit, but has become convinced that the potato-rot is not caused by it, though the ravages of this insect are admitted to be very considerable. A year or two after the potato rot appeared in England, a Mr. Smee thought he had discovered the cause of it, in the attacks of certain plant-lice, or *aphides*, and he wrote a work on the subject, and dedicated it to Prince Albert. British naturalists, however, did not sustain him in his views.

As the potato-rot had spread over Europe, and prevailed there to an alarming extent, *before* it reached America, and as the disease found here occurs with precisely the same symptoms and results as in Europe, it must, wherever and whenever it appears, have *one common specific cause.* If occasioned by insects, then the insects causing it must be of the same *kind or species* in all regions where the disease has extended. It would be entirely unphilosophical, and contrary to all analogy and all experience, to attribute the disease to one kind of insect in one country, and to an *entirely different kind of insect* in another country,— to aphides in England, to "black-bugs" in America, to *lady birds* in Massachusetts, and to the *Baridius trinotatus* in Pennsylvania. It is a well-established fact that the insects of America and of Europe *are not identical*, excepting only in those few cases where some one species of one country has been introduced, by the intervention of man, into the other country. It has never been shown, and I think will never be proved, that *any one species of insect*, of sufficiently destructive powers to prove extensively injurious to the potato crop, is to be found alike on the potatoes of Europe and of America; and, until such proof is produced, I shall continue to maintain the opinion that I have ever held, that insects have no concern or connection with the potato disease.

VICTORIA REGIA, OR THE SOUTH AMERICAN WATER-LILY.

This magnificent plant was discovered in one of the rivers of British Guiana, in 1837. Various attempts to introduce it into Europe were made by Sir Robert Schomburg, but all to no purpose, until the year 1849, when some seeds, sent to Sir J. W. Hooker, at the Royal Gardens, at Kew, England, gave germs of active vitality. They were immediately sent to Chatsworth, where, under the care of Sir Joseph Paxton, the plants grew and flowered. The germs were planted in a large tank, prepared especially for the purpose, in loam and fine sand. The water was kept, by means of hot-water pipes, at a temperature of 75° to 90° F., and, in order to place the plant, as far as possible, under the same conditions in which it exists naturally, a small water-wheel was placed in the pond to produce gentle undulations, as in the Guiana rivers. The leaves of the plant measure from five to six and a half feet in diameter, the petioles being from eight to twelve feet in length. The development of a leaf, on first rising to the surface of the water, presents a most curious sight, not easily described. Rolled into a body of a brownish color, and covered with thorny spines, it might readily be taken for some large species of sea-urchin. The under side of the leaves, as well as the long stems by which the flowers and leaves seem anchored in the water, are thickly covered with thorns, about three quarters of an inch long. The colors of the lily are white and pink, the outer rows of petals being white, and the inner a rich pink. The entire flower is from nine inches to a foot in diameter; it is of short duration, opening only on two successive evenings; but there is a constant display of flowers throughout the season. The petals always open early in the evening, and partially close about midnight. During the daytime, therefore, the Victoria Regia is seldom seen in its fullest splendor, unless when removed from the parent stem.

If the development of the leaves presents such a singular appearance, the successive movements or changes in the flower are not less extraordinary, and are far more beautiful. The crimson bud, which, for several days, has been seen rising, at last reaches the surface of the water, and throws off its external investment in the evening, soon after which the flower petals suddenly unfold, the expanded blossom, like a mammoth magnolia, floating upon the surface of the water, decked in virgin white, and exhaling a powerful and peculiar fragrance, which has been compared to the mingled odors of the pineapple and the melon. On the morning of the second day, another change is observed, and the outer petals of the flower are found turned backward, or reflexed, leaving a central portion, of a conical shape, surrounded by a range of petals, white on the outside, but red within. A slight tint of pink is discernible through the interstices of these petals, which increases as the day advances. In the evening, about five o'clock, the flower is seen to be again in active motion, preparatory to another production. The white petals which were reflexed in the early part of the day, now resume their original upright position, as if to escort their gay-colored companions surrounding the central cone to the limpid surface below. After this, the immaculate white of the first bloom changes to gay and brilliant pink and rose colors. Finally, a third change ensues, marked by the spreading of the petals further backwards, so as to afford the enclosed fructifying organs liberty to expand. These are soon seen to rise, giving to the disk of the flower a peach-blossom hue, the stamens and pistils assuming, at the same time, a figure not unlike a crown. On the third day the flower is nearly closed. All the petals seem suffused with a purplish pink; the coloring matter, which was originally only seen in the centre, having apparently penetrated the delicate tissues of the entire flower.

During the past year, the Victoria Regia has been introduced into the United States, by Mr. Cope, President of the Pennsylvania Horticultural Society. This gentleman has succeeded in bringing the plant to a greater perfection, as regards the size of the flowers and leaves, than has been attained to in England. He has also succeeded in raising the lily under glass, without the aid of stove-heat.

ZOOLOGY.

REGISTRY OF PERIODICAL PHENOMENA.

The following observations on the registry of periodical phenomena have been issued in a circular by the Smithsonian Institution : —

The Smithsonian Institution, being desirous of obtaining information with regard to the periodical phenomena of animal and vegetable life in North America, respectfully invite all persons, who may have it in their power, to record their observations, and to transmit them to the Institution. The points to which particular attention should be directed, are, the first appearance of leaves and of flowers in plants ; the dates of appearance and disappearance of migratory of hybernating animals, as Mammalia, Birds, Reptiles, Fishes, Insects, &c. ; the times of nesting of birds, of moulting and littering of mammalia, of utterance of characteristic cries among reptiles and insects, and anything else which may be deemed noteworthy. The Smithsonian Institution is also desirous of obtaining detailed lists of *all* the animals and plants of any locality throughout this continent. These, when practicable, should consist of the scientific names, as well as those in common use ; but when the former are unknown, the latter may alone be employed. It is in contemplation to use the information thus gathered, in the construction of a series of tables, showing the geographical distribution of the animal and vegetable kingdoms in North America.

ON THE INFUSORIA OF DUST SHOWERS AND BLOOD RAINS.

The infusorial character of the dust occasionally transported by winds is one of the most wonderful of Ehrenberg's discoveries. His investigations have been reported from time to time since 1844, but a recent publication contains the details of all his researches, with full illustrations. The plates contain not only the figures of all the forms observed in each case, but a sketch of a portion of the dust as it lay under the microscope, exhibiting to the eye the relative prevalence of different forms, and the colors they presented. Ehrenberg favors the view of the atmospheric origin of these showers, and speaks of their relation to the fall of meteorites. Chaldini, in his work on meteorites, observes that the stones which fell between 1790 and 1819 amounted to not less than 600 weight; while for the single dust-shower of Lyons, in 1846, the material that fell was full 7200 weight. The Cape de Verd shower of 1834 had a breadth, according to Darwin, of more than 1600 miles, and extended from 800 to 1000 miles from the African coast. This gives an area of 960,000 to 1,648,000 square miles. The surface of Italy and Sicily is about 100,000 square miles; a single dust-shower covering both these countries, like that of 1803, or of Lyons in 1846, would deposit 112,800 weight of dust in a single day. With such facts before us, Ehrenberg asks, how many thousand millions of hundred weight of microscopic organisms have fallen since the period of our earliest record of such events? He adds, "I can no longer doubt, that there are relations, according to which living organisms may develop themselves in the atmosphere;" and he speaks of this as a self-development, and not a production from introduced ova. He supposes it probable that the atmospheric dust-cloud region is of vast extent, and is above a height of 14,000 feet. These facts may seem inexplicable on any other hypothesis; yet much more investigation will be required before an opinion, so contrary to received principles, can be generally adopted.

The number of dust showers which Ehrenberg records is in all 340; 81 before the Christian era, 249 after. The first instance he adduces, is the plague of blood inflicted upon the Egyptians, as related in the Mosaic history, which continued throughout all the land of Egypt for three days and three nights. The second occurred about 1181, B. C., in the time of Æneas and Dido, as related by Virgil, Æneid, iv. 454, "*Horrendum dictu, latices nigrescere sacros visaque in obscœnum se vertere vina cruorem.*" Many other instances of subsequent date are also recorded, the information respecting which is not of as doubtful a character as with those referred to before the Christian era.

Ehrenberg remarks that these showers appear to prevail most within a zone extending from the part of the Atlantic off the west coast of Middle and North Africa, along in the direction of the Mediterranean Sea, reaching a short distance north of this sea, and continued into Asia between the Caspian Sea and the Persian Gulf. They seldom reach north as far as Russia and Sweden. This zone, in the North Torrid Zone, has a breadth of 1800 miles. The reddish color of the dust, as well as the organic forms, show that the dust is not of African origin. Moreover the storm-winds and Sirocco are found to afford the same species of organisms. The whole number of species of organisms observed is 320. A simultaneous occurrence of dust-showers and falls of meteoric stones has been observed in probably eighteen instances before the Christian era. During the Christian era, fourteen coincidences have been observed, making thirty-two in all. — *Compiled from Silliman's Journal.*

STRUCTURE AND GROWTH OF ZOOPHYTES.

A SINGULAR degree of obscurity has been thrown around the growth of coral zoophytes and coral formations, through the various speculations which have been offered in place of facts; and, to the present day, the subject is seldom mentioned without the qualifying adjective *mysterious*, expressed or understood. Some writers, scouting the idea that reefs of rocks can be due in any way to "animalcules," talk of electrical forces, the first and last appeal of ignorance. Others call in the fishes of the seas, suggesting that they are the masons, and work with their teeth in the accumulation of the calcareous material. Very many of those who discourse quite learnedly on zoophytes and reefs, imagine that the polyps are mechanical workers, heaping up these piles of rock by their united labors; and science still retains such terms as polypary, polypidom, as if each coral were the constructed hive or house of a swarm of polyps, like the honeycomb of the bee, or the hillock of a colony of ants.

It is not more surprising, nor a matter of more difficult comprehension, that the polyp should form coral, than that the quadruped should form its bones, or the mollusc its shell. The processes are similar, and so the result: in each case it is a simple animal secretion, a formation of stony matter from the aliment which the animal receives, produced by certain parts of the animal fitted for this secreting process. This power of secretion is the first and most common of those that belong to living tissues; and, though differing in different organs according to their end or function, it is all one process, both in nature or cause, whether in the animalcule or in man. Coral is never, therefore, an agglutination of grains made by the handiwork of the many-armed polyps; for it is no more an act of labor than bone-making in ourselves. And, again, it is not a collection of cells into which the coral animals may withdraw for concealment, any more than the skeleton of a dog is its house or cell; for every part of the coral of a polyp in most reef-making species is enclosed *within* the polyp, where it was formed by the secreting process. It is important that this point should be thoroughly understood, and fully appreciated.

The reproduction of coral by buds is a process so similar to the production of buds in vegetation, that a remembrance of the latter will aid much in conceiving of it. The bud generally commences as a slight prominence on the side of the parent; the prominence enlarges, and soon a circle of tentacles grows out, with a mouth at the centre; enlargement goes on, till the young finally equals the parent in size. Thus, by budding, a compound group is commenced; and it is evident that if the parent and the new polyp go on budding again, and so on, the compound group may continue to enlarge. This is the fact in nature. The polyps, one and all, continue propagating by buds, until in some instances thousands, or hundreds of thousands, have proceeded from a single one, and the colony has spread to a large size. Such is the Madrepora and Astræa. There are modifications of this process, analogous to those in vegetation, but we need not dwell upon them in this place.

It is obvious that the connection of the polyps in such a compound group must be of the most intimate kind. The several polyps have separate mouths and tentacles, and separate stomachs; but beyond this there is no individual property. They coalesce, or are one, by intervening tissues, and there is a free circulation of fluids through the many pores or lacunes. The zoophyte is like a living sheet of animal matter, fed and nourished by numerous mouths and as many stomachs. In some species the coalescence is confined to the lower half of the polyps, or to a still less part; and in this case the animals project above the general living surface. Polyps thus clustered, spreading at summit a star of tentacles, constitute the flowering zoophytes of coral reefs. Those coral animals which do not bud are to all external appearance true actiniæ. The existence of coral in the living coral zoophyte is nowhere apparent, and would not be suspected if not previously known; for, as before stated, it is wholly internal, and the visible exterior is the fleshy skin of the polyp.— *Prof. Jas. D. Dana, Geology of the U. S. Exploring Expedition.*

FORMS OF ACTINOID ZOOPHYTES.

Zoophytes imitate nearly every variety of vegetation. Trees of coral are well known; and although not emulating in size the oaks of our forests, — for they do not exceed six or eight feet in height, — they are gracefully branched, and the whole surface blooms with coral polyps in place of leaves and flowers. Shrubbery, tufts of rushes, beds of pinks, and feathery mosses, are most exactly imitated. Many species spread out in broad leaves or folia, and resemble some large-leaved plant just unfolding: when alive, the surface of each leaf is covered with polyp flowers. The cactus, the lichen clinging to the rock, and the fungus in all its varieties, have their numerous representatives. Besides these forms imitating vegetation, there are gracefully modelled vases, some of which are three or four feet in diameter, made up of a network of branches and branchlets and sprigs of flowers. There are also solid coral hemispheres, like domes among the vases and shrubbery, occasionally ten, or even twenty feet in diameter, whose symmetrical surface is gorgeously decked with polyp-stars of purple and emerald green. All the many shapes proceed in each instance from a single germ, which grows and buds under a few simple laws of development, and thus gives origin either to the branch, the broad leaf, the column, or the hemisphere.

But the more massy forms would not exist, and others would be of diminutive size, were it not for a peculiar mode of growth which characterizes most coral zoophytes. Life and death are here in concurrent or parallel progress, a condition favored by the existence of coral secretions. In some instances, a simple polyp, while growing at top and constantly lengthening itself upward, is dying at its lower extremity, leaving the base of the coral bare, and destitute of any living tissues. The polyp thus continues rising in height, and death progresses below at the same rate, till at last the live polyp may be at the extremity of a coral stem many times its own length. In species which bud and form large groups, the same operation takes place. In some instances the summit polyp or polyps bud and grow, while, at a certain distance below the summit, the work of death is going on, and polyps are gradually disappearing. There is thus a certain interval of life, the length of which interval is different for different species. The death of the polyps about the base of a coral tree would expose it seemingly to immediate wear from the waters around it, and especially as the texture is usually porous. But nature is not without an expedient to prevent a catastrophe that would be destructive to a large part of growing zoophytes, and would prevent the indefinite increase just explained. The dead surface becomes the resting-place of numberless small incrusting species of corals, besides Nullipores, Serpulas, and some mollusks. In many instances the lichen-like Nullipore grows at the same rate with the rate of death in the zoophyte, and keeps itself up to the very limit of the living part. The dead trunk of the forest becomes covered with lichens and fungi, or, in tropical climes, with other foliage and various foreign flowers: so, among the coral productions of the sea, there are forms of life which replace the dying polyp. The process of wear is thus entirely prevented.

The older polyps, before death, often increase their coral secretions within, filling the pores occupied by the tissues, and rendering the corallum more solid; and this is another means by which the trees of coral growth, though of slender form, are increased in strength and endurance.

The facility with which polyps repair a wound, aids in carrying forward the results above described. The breaking of a branch is no serious injury to a zoophyte. There is often some degree of sensibility apparent throughout a clump, even when of considerable size, and the shock, therefore, may occasion the polyps to close. But in an hour, or perhaps much less time, their tentacles will have again expanded; and such as were torn by the fracture will be in the process of complete restoration to their former size and powers. The fragment broken off, dropping in a favorable place, would become the germ of another coral plant, its base cementing by means of coral secretions to the rock on which it might rest; or, if still in contact with any part of the parent tree, it would be reünited and continue to grow as before. The coral zoophyte may be levelled by transported masses swept over by the waves; yet, like the trodden sod, it sprouts again, and continues to grow and flourish as before. The sod, however, has roots which are still unhurt; while the zoophyte, which may be dead at base, has a root — a source or centre of life — in every polyp that blossoms over its surface. Each animal might live and grow if separated from the rest, and would ultimately produce a mature zoophyte.— *J. D. Dana, Geology of the U. S. Exploring Expedition.*

ON THE HOLOTHURIDÆ OF THE NEW ENGLAND COAST.

Mr. Ayres, of the Boston Natural History Society, who has recently been engaged in the careful study of the Holothuridæ of the New England coast, has given the following as the result of his investigations, as communicated to the society: —

Thirteen species have been described, included in eight genera. Of these, three genera and eight species are believed to be new. The following list gives, with the name of each species, the depths through which it has thus far been observed to range: *Synapta tenuis*, Ayres, — littoral to six fathoms; *Chirodota arenata*, Gould — shoal water: *Sclerodactyla briareus*, Le Sueur — littoral to four fathoms; *Thyoni-*

dium elongatum, Ayres — thirty fathoms to forty; *T. musculosum*, Ayres — twenty fathoms; *T. glabrum*, Ayres — thirty fathoms to forty; *Stereoderma unisemita*, Stimpson — eighteen fathoms to forty; *Botryodactyla grandis*, Ayres — seventeen fathoms to fifty; *B. affinis*, Ayres — one fathom to fifty; *Cuvieria Fabricu*, Duben and Koren — six fathoms to twenty; *Psolus lævigatus*, Ayres — sixteen fathoms to twenty-five; *P. granulatus*, Ayres — thirty fathoms; *P. phantapus*, Lin. — sixteen fathoms to twenty.

A glance at this catalogue is sufficient to show that, with a single exception, no European species is included in it. One type of the genus *Psolus* resembles so much the Linnæan *phantapus*, that, until the point can be settled by direct comparison of specimens, it is not deemed advisable to impose a new specific name. Still, even here, we shall probably find that they are only allied forms. Of the other species, but one can be said to exhibit much resemblance to European types. In this respect a marked contrast exists between the Holothuridæ and other divisions of the Radiata. It will be noticed, also, that most of the species here designated inhabit deep water, and that of some the range is quite extensive. The depths, however, as given above, cannot at all be considered absolute; the numbers only represent the limits of our knowledge at the present time. Every additional opportunity for observation brings to light habits and localities previously unknown, and we have entire reason to believe that species hitherto obtained only in deep water, will yet be found in other circumstances within the range of the tide. The species which still remain undescribed will also illustrate the same point.— *Proceedings Boston Natural History Society.*

CUMING'S CELEBRATED COLLECTION OF SHELLS.

It is not, perhaps, generally known, that one of the most splendid collections of shells in the world is, at this moment, in the possession of a private individual in London, — Mr. Hugh Cuming. It consists of upwards of 19,000 species, or well marked varieties, from all parts of the world. Of many of the species and varieties there are several specimens; making in all about 60,000 shells, perfect in form, color, texture, &c. Professor Owen states that no public collection in Europe possesses one half the number of species of shells that are now in the Cumingian collection; and that, probably, one third the number would be the correct statement as regards the national museums in Paris and Vienna.

This collection has been made by Mr. Cuming in almost every part of the known world. "Not restricting," says Professor Owen, "his pursuits to the stores and shops of the curiosity-mongers of our seaports, or depending on casual opportunities of obtaining rarities by purchase, he has devoted more than thirty of the best years of his life in arduous and hazardous personal exertions — dredging, diving, wading, wandering — under the equator, and through the temperate zones, both north and south, in the Atlantic, in the Pacific, in the Indian Ocean, and the islands of the rich Archipelago — in the labor of collecting from their native seas, shores, lakes, rivers, and forests, the marine, fluviatile, and terrestrial mollusks; 60,000 of whose shelly skeletons, external and internal, are accumulated in orderly series in the cabinets with which the floors of his house now groan."

EFFECT OF PRESSURE OF THE SEA ON FISHES.

Dr. Williams has shown that a gold fish, when the water in which it was placed was subjected to a pressure of four atmospheres, became paralyzed. He also states the following conclusions, as deduced from his own experiments: — 1. That round fishes, having an air-bladder, cannot, without injury, be exposed to a pressure of more than three atmospheres. 2. That the use of the air-bladder is not so much to regulate the specific gravity of the animal, as to resist the varying force of the fluid column, and thus to protect the viscera and abdominal blood-vessels against excess of pressure. 3. (Though in this case the results are less striking,) flat fish exhibit a limited capacity only for sustaining pressure. From these observations, Dr. Williams infers that the condition of pressure regulates the distribution of fishes in depth.

EXTINCTION OF SPECIES OF SHELLS IN OHIO.

At the American Association, Cincinnati, Dr. Kirkland, of Cleveland, Ohio, stated some interesting facts, in relation to the extinction of species of fresh-water shells within a comparatively recent period.

It has been alleged that geologists are sometimes compelled to draw a little on their imaginations, in order to supply time for the accomplishment of all the revolutions that seem to have taken place in the structure of the earth. Within the memory of individuals now living, the recent vegetable and animal kingdoms of Ohio have undergone changes almost sufficient to mark a geological period. Numerous species, once abundant, are now very rare, or have become extinct. Other species have, in some instances, supplied their places. No class has suffered more extensive and fatal changes than our mollusca. Forty-one years since, when I was first acquainted with this State, every durable pond, lake and river, abounded with fluviatile bivalves. Ohio, at that day, probably contained a greater number of species than could be found on all the globe, North America excepted. With the clearing and cultivation of our lands many disappeared; the depredations of swine, during low stages of water, have destroyed immense numbers; the wash of cities, manufactories, and barn-yards, is still more fatal to them; and, in several instances, epidemics have extirpated immense numbers. After the construction of our canals, many of the rarer species rapidly increased for a few years, and our conchologists flattered themselves that these thoroughfares would preserve their favorites; but experience has shown that the accumulation of filth in the canals is fatal to most of the species. A few, especially *Anodontas* and *Alasmodontas*, continue to thrive and increase, while the finer species of *Uniones* have perished. Ten years since, the *Unio truncatus* and *cornutus* were common in the canal near Cleveland. At this time a living specimen can hardly be found.

During the present season we have seen workmen excavating portions of mud, that contain great numbers of dead shells of these and other scarce species. Perhaps, in another age, similar operations may expose to view similar remains, which may puzzle the geologist to tell at what period they existed.

ON THE SEXES AND HABITS OF SOME OF THE ACEPHALOUS BIVALVE MOLLUSCA.

The following is an abstract of a communication presented at the meeting of the American Association, Cincinnati, by Dr. J. P. Kirtland :—

The fluviatile bivalves of North America are principally embraced by the genera *Unio*, *Anodonta*, and *Alasmodonta*, and are appropriately arranged in the Lamarkian family of Naiades. In the waters of the State of Ohio are found sixty-four or five species ; perhaps a larger number. Most naturalists and anatomists have considered them as hermaphrodites, though some discrepancy of opinion has been entertained. A familiarity with their habits, and a series of dissections, long since convinced me that the commonly received opinion was incorrect.

This conclusion was founded upon the facts, that very many species present, in their shells, two varieties of forms, in about equal numbers, and that, with one form, is associated animals with oviducts, which, at certain seasons, teem with young, while the inhabitants of the other form remain permanently barren. Subsequent investigations have shown, that it is applicable to about two thirds of the American species. In a few others, no difference in form is discernible between the shells of the prolific and barren varieties. If minute dissections, aided by the microscope, have discovered and demonstrated the existence of both male and female organs in the same individuals, of course I must abandon the position I have taken ; but if their hermaphrodite structure be a mere matter of inference, as I suspect it is, drawn from the failure to discover any anatomical difference between the prolific and barren individuals, then the probabilities are in favor of their being diœcious.

The several families of mollusca present examples of all modes of generation ; some are hermaphrodite, others are diœcious. Several possess the faculty of self-impregnation ; others, though hermaphrodite, require a reciprocal coitus ; and the mode of fecundating, in those in which the sexes are distinct, is not, in all instances, understood. The animals of the *Cephalopoda* are distinct, the male and female organs being found in different individuals. The *Pteropoda* are all hermaphrodite, and their sexual organs are discoverable. In some of the *Gasteropoda* the sexes are separate. in others united. Though the fourth class of Cuvier's mollusci — the *Acephala* — have generally been considered as hermaphrodite, analogies are equally in favor of their being diœcious ; or, like the third class, perhaps some species may be hermaphrodite, while in others the sexes may be separate. If the affirmative of this question be established, some other cause for the occurrence of the two forms of shells must be sought. It would, however, be an anomaly in nature, if one half of the individuals should prove barren, and of no use whatever, in a family where she has provided so carefully for the increase and perpetuity of the species. So prolific, indeed, are fertile individuals, that they produce annually their young in numbers almost too great to admit of enumeration. Mr. Lea calculated the oviducts of an *Anodonta undulata* to contain 600,000 young shells. This, it will be recollected, is a small species, and does not produce a tithe of the young contained in a prolific *Anodonta plana*. The barren members of a colony of honey-bees, (the *Apis mellifica*,) might, at first view, seem to afford an analogy; but they subserve a useful purpose. On the products of their labor are sustained all the members of their community. If the barren mollusci do not fulfil the purposes of the male, it is difficult to discover of what use they are in creation. It may be proper to state a fact in regard to the habits of the *U. gibbosa*, and its allied species, the *Unio rangianus*, which may have some connection with the subject before us. During the months of April or May, according to the state of water in the streams, and warmth of the weather, the females may be seen lying upon their beaks on gravelly ripples, with their heads directed up stream, and the valves of their shells extended to their utmost capacity. At this time they are heavy with their young. The pure whiteness of their bodies and appendages renders them conspicuous objects, seen through the limpid water; and their position and appearance would lead to the conclusion that they were dead, and the valves were expanding as their transverse muscles were relaxed. An attempt at taking a specimen into the hand will at once show that it still abounds in vitality. The object of assuming this position at this particular period of the year, I could never discover, but suspect it to have some connection with the process of fecundation. In the immediate vicinity are always found more or less males; but as their shells remain closed, they are not so readily recognized. The female, *U. ventricosus* and *fasciolus*, may sometimes be seen throwing out of their shells the prolongations of their mantles, and playing them about the water, during clear and warm days in autumn. At the same time male individuals may always be found very contiguous, and it has often been observed by collectors, that, at this season, these species seem to be associated in pairs.

On several occasions I have seen the females of various species of these mollusci discharging their young progeny. At that period of existence they are perfectly formed shells, as may be discovered by the naked eye, if they are placed in the sun for an hour; or by the aid of a microscope when first obtained. They are agglutinated together with a secretion, probably of mucus and albumen; and the mass conforms to the shape and size of the branchial cell. The contents of one cell are thrown off at a time, by a jet of water, issuing rapidly through a syphon or contracted aperture, formed by the posterior margins of the mantle. The mass, on being evacuated, falls upon the bottom of the stream, and soon begins to crumble in pieces by the action of the water and collision of the sand, till at length each minute individual becomes free and is left to take charge of itself. It then begins to exert volitions for its own safety and provision. Many, if not all, of the species, in this condition, spin from their bodies, near the foot, a filament resembling silk, by which they attach themselves to adjacent objects which are fixed and solid, such as shells, sticks and stones. I have frequently seen them anchored to their mothers. This filament is deciduous, and disappears as they advance in age and size.

ON THE BORING POWER OF THE PHOLAS DACTYLUS.

Mr. John Robertson, Brighton, England, communicates to the Edinburgh Journal the following observations on the boring power of the *Pholas dactylus*: — "I have endeavored during the last six months to discover how this mollusc makes its hole or crypt in the chalk: by a chemical solvent? by absorption? by ciliary currents? or by rotatory motions? My observations, dissections, and experiments set at rest all controversy in my own mind. Between twenty and thirty of these creatures have been at work in lumps of chalk, in sea-water in a glass and a pan, at my window, for the last three months.

The *Pholas dactylus* makes its hole by grating the chalk with its rasp-like valves, licking it up, when pulverized, with its foot, forcing it up through its principal or branchial siphon, and squirting it out in oblong nodules. The crypt protects the *Pholas* from *confervæ*, which, when they get at it, grow not merely outside, but even within the lips of the valves, preventing the action of the siphons. In the foot, there is a gelatinous spring or style, which, even when taken out, has great elasticity, and which seems the main-spring of the motions of the *Pholas dactylus*.

ON THE ECONOMICAL USES OF THE SKIN OF THE WHITE PORPOISE.

Mr. T. S. Hunt, of the Canadian Survey, presented a communication to the American Association, Albany, on the "Economical Value of the Skin and Oil of the White Porpoise," the uses of which have recently been brought before the public by M. Tetu, of Canada.

This cetacean, the *Delphinus leucas*, is a native of the Arctic Seas, particularly of the Gulf of St. Lawrence and Hudson's Bay, where it attains a length of from twelve to twenty feet. Its color is of a nearly uniform creamy white. The fisheries of these animals, already somewhat extensive, are principally in the lower St. Lawrence. The oil extracted from them is extremely valuable, furnishing purer oleine than that obtained from any other natural source. In good seasons, a porpoise of twenty feet yields 150 gallons. This oil is now employed exclusively for the light-houses of the lower St. Lawrence, the Board of Commissioners having, after a careful trial, given it a preference over all other oils for illuminating purposes. The skin of this porpoise, freed from its epidermis, and a thick mucous layer which underlies it, has been found to be capable of being made into leather of a very superior quality. This process is, in many respects, very different from that which is required for the manufacture of other skins, and is the result of a long series of careful experiments, by Mr. Tetu, of Riviere Ouelle, who has recently obtained a patent for the invention. The leather, in its ordinary form, has the thickness of sole-leather ; but its peculiar and valuable property is the uniformity and closeness of its texture, which enables it to be split into three or four parts, each of which, when dressed, has the smoothness and uniformity of surface which usually belongs to grain leather. Thin sections of it resemble the finest kid, and are employed for the fabrication of gloves. Other important characters of this leather are its great strength when compared with calf-skin; a peculiar elasticity, which obviates the ordinary tendency to wrinkle and fold ; and, to a great degree, imperviousness to water. Such are the general features of this discovery, which, from the abundance in which the animals are found, promises to be of very high importance in an industrial and commercial point of view. The new process of M. Tetu has also been successfully applied to the skin of the common whale of the gulf, which yields an excellent coarse leather.

ON THE HABITS AND LOCALITIES OF THE WHALE.

An official statement has been issued by Lieut. Maury, of the National Observatory, giving information to the whaling interest, of great value, in relation to the habits and localities of the whale at different periods of the year. This information is published preparatory to the issuing of a chart, now in the course of preparation. The facts have been gleaned from the log-books of many of our whale-ships, and show when and where our whale-men have searched for whales, when and where they have found them ; with what abundance, and whether in schools or alone. The chart divides the ocean into districts of 5 deg. latitude by 5 deg. longitude ; perpendicularly through each of which districts are twelve columns for the twelve months ; and horizontally through each of which districts are three lines : one to show the number of days that have been spent in each month in every district, and the two others to show the number of days in which whales, sperm or right, have been seen.

In regard to the information afforded by the chart, Lieut. Maury remarks : " As to whether the right whales are to be found in the high northern latitudes in our winter, or in high southern latitudes in our summer, when the whalemen do not visit such latitudes, of course the chart does not show. Thus, between 50° and 60° N., 130° and 155° W., we only know that whales are abundant from May to September, inclusive. We know not as to the other months, because the night and cold then drive the whale-men from this part of the ocean, and we cannot say anything as to the numbers in which the fish resort there then. The charts are therefore silent on the subject. It is the same at the south, in its seasons ; that is, when it is winter there the whalemen abandon the high latitudes, and seek their game in more genial climates.

" But, seeing the abundance of whales in the Greenland and Arctic seas in our summer season, and seeing that they have not been sought for in similar latitudes south, I invite the attention of whalemen to the subject of southern whaling in south summer time. Below the parallel of 50° S. — indeed, with here and there an exception, I might say below the parallel of 48° S. — the whale chart is a blank; consequently, few vessels go beyond that parallel. The indications to the chart are, that somewhere to the south of these parallels, and between these meridians, as given below, whales are probably to be found in considerable numbers, if not in greater quantities. I have reason to believe that the right whale of the southern hemisphere is quite a different animal from the northern; that the two are separated by (to them) an impassable barrier. I have also reason to suspect, from results that have been elicited in the course of these investigations, that the same whale which is taken in Behring's Straits is taken in Baffin's Bay also; and, if this be so, these investigations prove, beyond question, that this animal cannot pass from one region to the other except through the Arctic ocean; and hence we are entitled to infer that there is, at times at least, an open water communication between these Straits and Baffin's Bay; in other words, that there is a north-west passage.

ON THE STORY OF THE PAINTING BY ZEUXIS.

The following anecdotes prove, I think, that the ancient story of some fruit having been painted by Zeuxis, which birds were deceived by and pecked at, may be quite true, and yet, that the inference may be wrong that has been drawn from the fact, viz., that they were well painted; for it appears to be more probable that the birds were attracted only by the bright spots of color in the painting. Swainson, in his zoological illustrations, gives a description of the *Trichoglossus Swainsoni*, a beautiful bird of Australia, which feeds on the honey it obtains from the blossoms of the Eucalyptus tree. In describing it he says, that " a tame bird, on being shown the colored drawing of a native plant, tried to suck the flowers, and it even made the same attempt with a piece of cotton furniture." I have seen an *insect* in the same way deceived by bright spots of color. In a room rudely stencilled with imitations of bright colored flowers, the genus or species of which it would not be easy for the most skilful botanist to decide, I saw the moth of the *Sphinx convoluti* repeatedly fly along the wall, and dart at every bright spot of color, as if taking it for a real flower. These anecdotes would also tend to show, that some animals are guided to their food more by sight than by scent.—*Sir W. Trevilyan.*

ON THE STRUCTURE OF THE SPINAL CORD IN BATS.

Cuvier has stated, as a general law, that the size of the bulging portions of the spinal cord is in proportion to the force of the limbs opposite to them. But, in birds, the posterior enlargement is the largest, while the wings are more muscular and stronger than the legs, except in a few instances. In bats the anterior enlargement extends through the lower cervical vertebræ and some distance down the dorsal. It has been a question whether these bulgings of the spinal cord are to be considered centres of sensation or motion. In birds, it is found that the greater area of *sensitive surface* in the legs corresponds to the greater enlargement of the cord. Cuvier and Spalunzani observed that bats are able to fly through intricate passages in the dark without touching the walls, a faculty thought to be due to a minute net-work of nerves distributed throughout the wing, arising from the superior enlargement of the spinal cord. Thus it would seem that these portions of the cord are intended to reinforce the function of sensation rather than that of motion; a view which agrees with the theories of recent physiologists, that the spinal cord is a centre as well as a conductor of nervous influence. — *Prof. Wyman.— Proc. Bos. Soc. Nat. His.*

SEVENTEEN YEAR LOCUSTS.

The seventeen year locusts appeared in great numbers in various parts of Maryland and Pennsylvania, during the months of May and June, 1851. The following description of the first appearance of the insect above ground, and its transition to the winged state, is given by Dr. Smith, of Baltimore: —

"When they come up from the earth — always about day-light or a little before — they immediately climb the first object they meet with, a tree, a bush, or stake, anything two or three feet. They then lay hold of the bark, fixing themselves firmly by their claws, and commence working themselves out of their old shell, which is done by rupturing it on the back, between the shoulders, and drawing themselves out. As soon as they get fairly out, they seize hold of the old shell with their claws, raise themselves, and begin to expand their wings. Their bodies and wings at this time are exceedingly delicate, white and moist; but a few minutes' exposure to the air dries and hardens them, so that, by the time the sun is fairly risen, they are perfect, and can fly. The wings, before sloughing, are beautifully folded up, and it is a beautiful sight to see them unfolded, and, in a few minutes, changed from the most soft and delicate tissue to the firm and rigid wing of the perfect insect. If it be a wet or very cloudy day they are apt to perish in the operation of sloughing and drying."

At the Boston Natural History Society, in June, Dr. Burnett furnished an account of some observations recently made by him on the structure of these locusts. He had found that, in the male, in many instances, there is scarcely a trace of a digestive canal, or biliary apparatus, whereas, in the female, both are fully developed. This arrangement is adapted to the peculiar wants of each; the male living but a few days, and the female much longer. The female, on emerging from the earth, has about 500 eggs in her abdomen, of about one thirtieth of an inch in diameter, which is only about half their size at the time they are deposited. The development of the eggs accounts for the necessity of food and her complete digestive system. As the locusts appear in about the same numbers at every period of their return, it follows that only two of the eggs, on the average, are developed. It would thus appear, supposing the production of these insects to have always followed the same law, that there must have been originally a multiplicity of individuals. The male is about one third larger than the female. The drumming apparatus of the male, Dr. Burnett had made the subject of careful microscopic study. He had found it to be integumental in its nature, not presenting any relation, either by structure or analogy, to the respiratory system. It is situated on each side, between the thorax and abdomen, the head of the drum being just under the attachment of the wings to the body, and of the size of a marrowfat pea. It consists of a tense, dry, crisp membrane, crossed by cords or bars, produced by a thickening of the membrane, which meet on one side at the point of attachment of the muscles, which, by their contraction, keep it stretched. The sound is produced by a series of rapid undulations, running from the contracting muscles across the drum. The upper part of the abdomen seems to act as a sort of sounding-board; when a portion is removed the sound is sensibly diminished. A dry condition seems to be necessary to the perfect action of the drum, as, on wet days, or when it is moistened, the sound is very much diminished. The drumming sound is heard four or five hours during the day, principally between the hours of twelve and two. In the female there is no drum, nor any trace of the muscular apparatus belonging to it. As an illustration of the immense numbers in which these insects appear, Dr. Burnett stated that he saw an oak tree, on every leaf of which were six or eight individuals.

ON THE ECONOMY OF SEVENTEEN YEAR LOCUSTS.

The following is an abstract of a paper read before the American Association, Albany, by Dr. W. I. Burnett, of Boston: —

A careful analysis of the conditions of animal existence has led some to believe in the special creation of the separate faunas in the localities in which they are found. Prof. Agassiz has traced the various phases under which this question may be considered, and in it may be found reasons for the particular creation of such fauna and its immutability through any period of time. A question allied to this, but based upon a different, and, perhaps, more enlarged view of life, is the one of the primitive numbers of each species. In this we call to our aid embryology and its allied branches, but the influences which civilization has wrought, both directly and indirectly, upon the ratio of mortality of animal life, affect much the validity of our conclusions. Nevertheless, the general tenor of all such inquiries is to show that the number of each species must have been pretty near that which we find in its natural and undisturbed state, instead of a single pair, as otherwise viewed. In a locality the natural relations of which to animal life have not been disturbed by the agencies of man, we have a right to infer that the existing state of destructive elements of life is a fair expression of the past, and also that the present rate of the mortality of a species is that to which it has been subjected during past times. If, in a term of human experience of one hundred or a thousand years, the natural prolicity of any well known species only keeps pace with its relative mortality, so that the number of that species, at the end of that time, is about the same, it is very difficult to comprehend how, even with species of limited numbers, the same power of prolicity could enable a single pair to reach the present numbers under any existing climate of the earth.

Were it so, we should expect to find a very correct ratio subsisting between the present numbers of any undisturbed species and its powers of reproduction. But, since attention has been called to the subject, and, with many of the lower animals, the ova counted, not only is there no reason for supposing that such relation is present, but, in many instances, the very opposite is true — a fact of the truth of which I have lately been the more and more convinced, from counting the ova of many insects, and comparing the result with their well-known habits and conditions of life. There are examples in which there appears no escape from conclusions of this character. And, although I might detail many taken from the ranks of lower animals, yet, from its well marked character and recent occurrence, I select that furnished in the seventeen year locust as the subject of this paper.

The present year, (1851,) may be noted as containing an episode of insect life of more than ordinary interest and value, for in it has occurred the grand appearance of the locust. The regularity and promptness with which this insect appears at the end of an interval of seventeen years is well known in science. Justly does it excite our astonishment that the conditions of its economy should be so unique. During the last of May, I had the good fortune to witness their grand appearance in the interior of Pennsylvania. They came forth in their usual and almost incredible numbers, and a fine opportunity was given me to learn something about their conditions of life. The insect appears in its perfect or *imago* condition simply for the preservation of its species; its period of life in this state is, therefore, quite brief. Both male and female go about their functions immediately on escaping the earth, after which they die. Their existence is, therefore, almost entirely subterranean, and, considering the depth to which they descend, almost as isolated from the agencies of civilization as those of the tenants of the ocean. It appeared evident, from what I saw of their movements, that, unless swept away by violent currents, they remain generally in the locality of their birth, so that the comers of this year may properly be said to be the lineal descendants of those which there appeared fifty or more years since. This is important as to our determining whether or not they really increase in number. I made strict inquiries of several men who had witnessed this their fourth appearance through the same tract of country, and their replies always were that they did not think their numbers to vary materially either way. Being men of sense and farmers, I thought them able to judge of this matter, since they regarded the ravages of this insect with no common eye. We will now look a little to its powers of reproduction. The female has about 500 eggs, which, from certain relations of the other sex, which I have made out microscopically, are, probably, all or nearly all fecundated. We have, then, for every two individuals which have appeared this year, a deposit of 500 embryos, for the generation to appear 17 years hence. Now, from what has just been stated about the uniformity of their numbers each time, it appears that, from the liabilities of destruction during the long term of seventeen years, out of these 500 embryos only two appear certain of life and appearance in their perfect state; that is, just replacing the two parents. The chances of life, therefore, with this insect, are, in round numbers, two in five hundred. This calculation may seem strange to some, but, if we reflect, it can scarcely be otherwise; for, suppose the chances were double, that is, four in five hundred, then we should have at each time just double the numbers of their last time, which observation has shown to be untrue, and which would augur much evil for the future condition of the vegetable world in the localities of their appearance. Even if their chances were three to five hundred, or half again the original stock, agriculturists would quickly perceive the difference. To sum up the matter, then, we have here an insect whose economy and conditions of life are so unique that it is almost entirely isolated from human destructive agencies, and which is obliged to deposit five hundred chances for the certainty of securing two. The ovaries have been formed with this capacity, and the whole internal economy is of a corresponding character.

From these data we can draw two valuable conclusions: — 1st. The evidence of design in Nature in thus balancing numbers against chances of mortality for the preservation of the species. 2d. The plurality origin of this species, instead of a single pair. In the first, such evidence I regard as of the highest zoological character, and quite free from many of those objections belonging to the analogous evidence generally. As to the second, it is quite difficult to conceive how the present myriads could have arisen from a pair, even if their chances of life were increased twenty or thirty per cent., which we cannot believe possible with the present climate of the earth. Regarding, then, these insects, from these data, as of a special local creation, and whose original numbers were nearly as great as at present, we find the same view supported by different grounds. I refer to the fact of the different years in which they make their appearance in different portions of the country. Although, during the present year and the past ones, indivisible by the number 17, have been those of its greatest appearance, yet the appearance of smaller numbers at different years has been noticed in various or even in the same portions of country. In the southern portion of New England, different parcels have appeared at irregular periods; and, in some of the Middle States, there are localities that have four distinct appearances of this insect. Now, as there is no evidence for our thinking that they are ever unfaithful in their time, appearing at the end of a longer or shorter interval than 17 years, we are forced to the belief of not only their special local creations, but special creations at different periods in the same locality. The ground of such inferences is, I think, equally as tenable, as much as in geology and paleontology, and certainly is in accordance with many of the recognized principles of zoological science.

EXTRACTION OF THE TUSKS OF AN ELEPHANT.

This novel operation was performed with success, during the past summer, upon a large elephant belonging to a menagerie in Paris. The animal having given strong symptoms of insanity, and being very valuable, a consultation of surgeons was held upon his case. These gentlemen gave as their opinion, that the animal was attacked by hypochondria in consequence of caries at the root of his tusks, and advised the removal of them, which were a yard and a half each in length. To aid in this attempt, the proprietor endeavored to put the animal to sleep by means of opium and chloroform, but though administered in immense quantity, they had no apparent effect, and they were compelled to employ a windlass to hold him down. The operation took place July 7th, before thirty of the pupils of the veterinary school, and a crowd of veterinary surgeons. The animal was alternately placed on each side for the different teeth, and with the aid of a saw and forceps, and cords attached, the teeth were cut off, and the roots extracted, which alone weighed 18 pounds.

ON THE POISON OF THE COMMON TOAD.

It is an ancient and common opinion that toads and salamanders possess a subtile venom; this, however, has generally been deemed fabulous by those engaged in scientific pursuits. MM. Gratiolet and Cloez, in a recent report to the French Academy, show that there is in reality some foundation for the current belief, and that toads and salamanders do secrete a deadly poison. They inoculated small animals with the milky fluid contained in the dorsal and parotid pustules of these animals, and found it productive of fatal effects in a short space of time. A turtle-dove, slightly wounded in the wing with the liquid secreted by the salamander, died in terrible convulsions in eight minutes. Five small birds inoculated with the lactescent humor of the common toad, (*Rana bufo*,) died in five or six seconds, but without convulsions. The liquid of the pustule of the toad kills birds, even after being dried, though not with the same rapidity as when fresh. The mammiferous animals experimented on had convulsions, but these convulsions were not mortal. — *Répertoire de Pharmacie.*

ON THE GEOGRAPHICAL DISTRIBUTION OF ANIMALS IN CALIFORNIA.

The following is an abstract of a paper presented to the American Association, Albany, by Dr. J. L. Le Conte. The author first draws attention to the fact that in early spring the beauty and variety of the flowers is so great as to give the country the appearance of a well-cultivated garden. But the peculiarity of the vegetation is in the distribution of the species. Particular plants are confined to limited districts, so that a constant variety is presented to the traveller almost from day to day. Such being the fact among vegetables, the author wished to ascertain whether this novel feature was extended to the animal kingdom, and upon directing his attention to this point, he ascertained the remarkable fact that a limited number of insects are found at any one point. Thus, about 200 species of coleoptera, and a somewhat smaller number of the other orders combined, were found at a single locality in three months, a period which would have yielded three or four times this number in the Atlantic portion of the United States. On removing to a second locality, two or three hundred miles distant, the same fact will be repeated, with a different set of species, among which the commonest kinds of the former locality may not be found — the species common to two adjoining localities not exceeding eight per cent. This is the more remarkable, since, on the Atlantic side of the continent, common species are found from New England to the Gulf of Mexico. These facts are the more curious, as they cannot be referred to climate, or other physical causes. The author cites various examples to sustain his views, several of the results of which are as follows: — A comparison of the animals of California with those of the other portions of the continent disproves the idea that similar physical conditions will be accompanied by similar animals. California, although a peculiar zoological district, belongs to the general region of the continent, and is subdivided into a number of well defined sub-districts. The local distribution of a few species extends to the islands of the eastern Pacific, so that this must be regarded as the characteristic of that region — as the wide range of many species is the peculiarity of the Atlantic side of the continent.

ON THE ORIGIN AND EXISTENCE OF MAN AND THE CONTEMPORANEOUS ANIMALS.

By the creation of a species, I simply mean the beginning of a new series of organic phenomena, such as we usually understand by the term "species." Whether such commencements be brought about by the direct intervention of the First Cause, or by some unknown second cause, or law appointed by the Author of nature, is a point upon which I will not venture to offer a conjecture. That some of these species or series of vital phenomena occasionally come to an abrupt termination in our own times, as they have done in every preceding geological epoch, is no longer disputed: and the arguments of those who imagine that new creations entirely ceased from the moment that man was introduced into the globe, (the destroying agencies continuing in full activity while the renovating power was suspended,) appear to me uncertain and premature. It would be presumptuous to assume that the presence of the human race upon the land could affect, still less utterly change, those laws which have governed the organic world in the ocean for millions of years; and if we enlarge our ideas respecting the antiquity of man, and concede those ten thousand or even twenty thousand years, which some ethnologists demand in order to account for the early civilization of nations and the origin of their languages, we must hesitate before we affirm that such a period has been one of stagnation, or diminished fluctuation in the animate world.

The identity of the fauna and flora of England and the continent of Europe, requires us to assign a very distant date to the period when the existing species of animals and plants began to spread themselves over the lands which we inhabit. At the period of such migrations, this island (England) was still united with the continent; but a large number of the existing species of mollusca, and some other tribes of marine animals, can claim a much higher antiquity; so much so, that they were already created during the drift or glacial epoch, when the physical geography of Europe bore no resemblance to that now established. If, therefore, ten or twenty thousand years were added to the chronology of the human period, it would still constitute a mere fraction of that vast geological division of time during which the species, now our contemporaries, have been coming into existence. But how small is the progress yet made by us in ascertaining the order in which the mammalia now living were created! Some species are so ancient as to have coëxisted with a fauna of which nearly all the species have died out; while others may be coeval in their origin with man, and a few, perhaps, of a more recent creation. Man himself has been multiplying on the earth since he entered upon it, and enlarging the range of many animals, both intentionally and against his will. These species occupy, together with the human population, the places left vacant by such as are exterminated from time to time. Whether the amount of change in those ten or twenty thousand years which immediately preceded our own times, has been greater or less than the average mutation during equal periods of the past, from the Silurian to the Pliocene era, is a point on which, in the present infancy of the science, it would be idle to speculate. Of this, however, we may feel assured, that the greater the identity of the system of terrestrial changes, present and future, organic and inorganic, with that which has prevailed throughout past time, the more faithfully shall we be able to interpret the records of creation which are written on the framework of the globe.

In the first publication of the Huttonian theory, it was declared that we can neither see the beginning nor the end of that vast series of phenomena which it is our business, as geologists, to investigate. After sixty years of renewed inquiry, and after we have greatly enlarged the sphere of our knowledge, the same conclusion seems to me to hold true. But, if any one should appeal to such results in support of the doctrine of an eternal succession, I may reply that the evidence has become more and more decisive in favor of the recent origin of our own species. The intellect of man, and his spiritual and moral nature, are the highest works of creative power known to us in the universe; and to have traced out the date of their commencement in past time, to have succeeded in referring so memorable an event to one out of a long succession of periods, each of enormous duration, is perhaps a more wonderful achievement of science, than it would be to have simply discovered the dawn of vegetable or animal life, or the precise time when, out of chaos, or out of nothing, a globe of inanimate matter was formed. — *Sir Charles Lyell's Address before the Royal Geological Society.*

DOCTRINE OF SPECIFIC ORGANIC CENTRES.

The actual zoology and botany of the earth's surface exhibit several distinct regions, in each of which the indigenous animals and plants are, at least as to species, and to a considerable amount as to genera, different from those of other zoological and botanical regions. They are respectively adapted to certain conditions of existence, — such as climate, temperature, mutual relations, and, no doubt, other circumstances of favorable influence which men have not yet discovered, and which may never be discovered in the present state. These conditions cannot be transferred to other situations. The habitation proper to one description of vegetable or animal families would be intolerable, and speedily fatal, to others. Even when, as in many parts of the two hemispheres and on the contrary side of the equator, there is apparently a similarity of climate, we find not an identity, but only an analogy of animal and vegetable species. These opinions have met with violent opposition from some prejudiced minds; but the more these views are examined, the more self-evident they become: whence Sir Charles Lyell's observation, that naturalists have been led "to adopt very generally the doctrine of specific centres; or, in other words, to believe that each species, whether of plant or animal, originated in a single birth-place." M. De Candolle has suggested twenty-seven of these independent regions for plants, and the Rev. J. S. Henslow forty-five. For the inferior animals D. Prichard proposes seven regions, Mr. Swainson five, Prof. Hitchcock eleven, Mr. Waterhouse also eleven, but with some geographical differences; and Sir Charles Lyell, Prof. Agassiz, and many, if not all, the continental zoologists of the present day, are united in sentiment on this principle. How unjust, therefore, it is to attempt to brand as infidels those who adopt an opinion irresistibly derived from an examination of the truths of nature, and which has the sanction and support of such names as we have enumerated! It is necessary, however, to add, that most of these authorities make the human species an exception, and the sole exception, to this doctrine of independent creations.

EXPLANATION OF THE RAPID DECREASE OF THE NATIVE POPULATION OF POLYNESIA.

The fertility of hybrid races, originating in the intermixture of two races whose affinity is most remote, is a fact of which there can be no doubt whatever; and there is strong reason to believe that these hybrid races, the parents of which are Europeans on one side, and the aborigines of any country on the other, are generally destined to become the dominant population of those countries. For, on the one hand, these "half castes" very commonly combine the best attributes of the two races from whose admixture they spring, namely, the intelligence and mental activity of the European, and the climatic adaptation of the native; and they are also in general distinguished for their fertility, when paired with each other, so that they are rapidly rising into numerical importance. On the other hand, this very intermixture, taking place, as it usually does, between a European father and a native mother, tends to diminish the number of the native population in a very remarkable manner; for there is now a large amount of evidence, that when a native female of the Americans or Polynesians has once been impregnated by a European male, she thenceforth loses all power of conception from intercourse with the male of her own race. This was first pointedly stated by that very intelligent traveller, the Count de Strezlecki, who has lived much among different races of aborigines, the natives of Canada, of the United States, of California, Mexico, the South American republics, the Marquesas, Sandwich and Society Islands, New Zealand and Australia, and who affirms that *in hundreds of cases* of this kind into which he has inquired, and of which he preserves memoranda, there has not been a single exception. As regards Australia and New Zealand, this statement, strange as it seems at first sight, has been fully borne out by independent evidence; and it offers the most complete explanation yet given of the very rapid decrease in the native population of the various islands of Oceanica, in which European races have been long established. — *Dr. Carpenter.*

THE FOUR DEGREES OF HYBRIDITY.

The following remarks are from a recent work of the late Samuel George Morton, of Philadelphia: — Hybridity, whether in plants or animals, has been singularly neglected by naturalists. It has generally been regarded as an unit, whereas its facts are as susceptible of classification as any other series of physiological phenomena. Hence, I have proposed *four degrees* of hybridity.

The first degree is that in which the hybrids never reproduce, — in other words, where the mixed progeny begins and ends with the first cross. *The second degree* is that in which the hybrids are incapable of reproducing, *inter se*, but multiply by union with the parent stock. *The third degree* is that in which animals of unquestionably distinct species produce a progeny which is prolific *inter se*. *The fourth degree* is that which takes place between closely proximate species — among mankind, for example, and among those domestic animals most essential to their wants and happiness.

ORIGIN OF THE DOMESTIC CAT.

Dr. Ruppell decided that all our varieties of the domestic cat were derived from one species, (*Felis maniculata.*) Fischer and Schink, who are among the latest authors on synoptical mammalogy, refer the above species, (which is yet wild in Nubia, and appears to have been the parent of the common Egyptian house cat,) and the domestic cat of Europe, to different species; and Fischer further calls the *F. maniculata* "the parent of *some varieties* of the domestic cat." Temminck, after admitting the Egyptian species as the common ancestor of our house cats, adds, that "it is altogether probable that the crossing of the Egyptian race with the wild one of our forests may have given rise to an intermediate breed," but which, he adds, it would be impossible to prove by demonstrable evidence. Again, "It appears to me probable that our house cats are derived from Egypt; but that the original race of Russia, known by the name of the Angora Cat, has been produced from another wild type, yet unknown, and inhabiting the northern regions of Asia. Milne Edwards and the learned editors of the New *Faune Francaise*, still insist on the identity of the wild cat of Europe and the domestic animal; and, should this view of the case ever be substantiated, we shall have to admit at least three wild species for the source of our familiar variety. But the difficulty does not end here. M. Blainville states that, among the numerous series of cat mummies brought from Egypt by the French commission, he has identified not only the *F. maniculata*, but also the *F. chaus*, and the *F. bubastis*, — all indigenous African species, and all reduced, in ancient times, to the domesticated state. And I was the more gratified at this discovery because I had already observed, in the Chevalier Bunsen's Hieroglyphic Alphabet, three *different cats*, each possessing a different symbolic value. I do not pretend to have any evidence of hybrid crosses between these animals; but these and other facts show us that we may yet have to modify some of our zoological impressions from a study of the catacombs and monuments of Egypt. — *Dr. S. G. Morton.*

ANCIENT REMAINS OF MAN FOUND IN OHIO.

At the American Association, Cincinnati, Mr. Charles Whittlesey exhibited two ancient human skulls, and other bones, found in a cave near Elyria, Loraine Co., Ohio; their position being such as to give them a probable age of 2,000 years. The cavity of the brain in both skulls was entire, showing all the developments. Mr. Whittlesey remarked, that it was evident that both of them belonged to persons of very low intellectual force, having low, narrow, and shallow foreheads; and that the animal propensities were largely developed. Prof. Agassiz thinks they belong to the present race of Indians. What renders them worthy of notice is the fact that they are unquestionably ancient; and if skulls of Indians, it will be proved that that race has long been the occupant of this region. If they are not Indian crania, and belong to another race, it becomes interesting to decide to what race, and thus, whether they belong to the "Mound-builders."

The position in which these remains were found was in a cave on the banks of the Black River, in the "grindstone grit," about thirty feet above the water. On account of the hard and imperishable nature of the grit, it resists the wearing action of the elements; and the shale beneath it being soft, there are in consequence numerous caves and sheltered places, where the sand rock projects far over the base. It was in one of these places that the skulls lay, covered by *four feet* of the accumulated bones and earthy remains of wolves, bears, deer, rabbits, squirrels, fishes, reptiles, snakes, birds, and other creatures not yet determined. Every shovelful thrown out contained more or less of the bones, teeth, jaws, scales, etc., of animals, until finally, at the bottom, resting on clean yellow sand, the parts of *three* human skeletons were found lying in confusion, as though they had perished or been placed there violently, and not by a process of burial. Although the place was perfectly sheltered from the weather, and dry, the bones were so much decayed, and were so porous, that they would scarcely bear their own weight. One of the skulls is evidently that of a female, of under size and very old. The other is that of a male below the age of majority, and possessing better mental developments than the female. Of the third skeleton, only a few fragments were found.

It appeared as though they had been killed by the falling of some loose rocks from the roof, while they lay asleep in the cave. A stone of fifty or sixty pounds' weight lay on the head of one of them, and a still larger piece on the breast of the other. The substance which had accumulated above them was principally the dirt and earthy powder of animal remains, and their bones, with which were occasional remnants of fires and burnt stones. Indian arrows of flint were found from top to bottom. The skulls lay at the remotest part of the cave, and were left there before it was occupied by men. It is probable that the human remains were at first covered by the remnants brought by animals into the place, and that it was used also for shelter and a place for cooking by whoever inhabited the country previous to the whites. The extent of sheltered space filled with bones is about fifteen feet by fifty; and as very little vegetable matter was found in it, the accumulation must have been due principally to the residue of animals.

CRANIAL CAPACITY OF THE FLATHEAD INDIANS.

Dr. Wyman recently presented to the Boston Natural History Society the result of some investigations, undertaken with a view of determining the comparative cranial capacity of the distorted skulls of the Flathead Indians. Actual measurement of this capacity of eleven flattened crania from different Oregon tribes gave an average of 81¾ cubic inches. The capacity of the skulls of the American Indians generally, as stated by Dr. Morton, from the measurement of 161 crania, gives an average of 84 cubic inches. It does not appear that the Flatheads are less intelligent than other North American savages. Dr. Pickering describes them as even more intelligent, and as having made greater advancement in the arts, than the hunting tribes of North America.

MEN WITH TAILS.*

Count Castelnau, a French savant, has lately communicated to the Geographical Society of Paris the result of some personal inquiries at Bahia, in South America, respecting a race of human beings with tails. "I found myself in Bahia," he says, "in the midst of a host of negro slaves, and thought it possible to obtain from them information of the unknown parts of the African continent. I soon discovered that the Mohammedan natives of Soudan were much further advanced in mind than the idolatrous inhabitants of the coast. Several blacks of Haoussa and Adamawah related to me that they had taken part in expeditions against a nation called *Niam-Niams*, who have tails. They traced their route, on which they encountered tigers, giraffes, elephants, and *wild camels.* Nine days were consumed in traversing an immense forest. They reached at length a numerous people of the same complexion and

* See *Annual of Scientific Discovery*, 1850, pp. 318, 319.

frame as themselves, but having tails more or less long (3 to 4 inches in length). This member is described as smooth and without the power of motion. The Haoussas massacred these unfortunate people, and among the slain were found the bodies of several females bearing the same appendage. All were entirely naked. The Haoussas remained six months in that country, which they describe as covered with rocks of great height; the greater part of the Niam-Niams lived in caves, although some had built themselves huts of straw. They cultivate rice, Indian corn, and other grain, unknown in the country of the Haoussas. They have small oxen without horns, sheep, and goats. The only thing in the shape of furniture which they possessed were benches furnished with holes to accommodate their tails. This region is situated south-west of Lake Tchad.

"I saw seven or eight blacks who assured me that they had been on these expeditions, that they had seen the tails, and had cut them off in some instances, &c. I give the facts as they were stated to me, without in the least being responsible for their truth."

We afterwards find, in the minutes of the society, that on M. de Trémeax observing, (in answer to these remarks of M. de Castelnau,) that during his residence in Soudan he had heard of certain tribes who clothed themselves in the skins of animals, the tails of which passing through their legs seemed to make part of the body, and that probably such appearances had given rise to the report of the blacks, — M. de Castelnau added that in the accounts he had received it had been stated that the Niam-Niams go naked, and that the blacks whose deposition he had taken asserted that they had attentively examined those killed in battle, and found that they had real tails. M. de Castelnau was then requested to put in writing this interesting communication. — *Bulletin Geo. Soc. 4th series.*

ON THE ARSENIC-EATERS OF AUSTRIA.

At a late poisoning trial in Vienna, some curious facts were disclosed relative to the existence of a class of persons who habitually, for various reasons, eat arsenic. The following evidence in relation to the subject is given by a Dr. Von Tschudi: — "In some districts of Lower Austria, and in Styria, especially in those mountainous parts bordering on Hungary, there prevails the strange habit of eating arsenic. The peasantry in particular are given to it. They obtain it, under the name of *hedri*, from the travelling hucksters and gatherers of herbs, who, on their side, get it from the glass-blowers, or purchase it from the cow-doctors, quacks, or mountebanks. The poison-eaters have a twofold aim in their dangerous enjoyment: one of which is to obtain a fresh, healthy appearance, and acquire a certain degree of *embonpoint*. On this account, therefore, gay village lads and lasses employ the dangerous agent, that they may become more attractive to each other; and it is really astonishing with what favorable results their endeavors are attended, for it is just the youthful poison-eaters that are, generally speaking, distinguished by a blooming complexion, and an appearance of exuberant health. Out of many examples I select the following: —

"A farm-servant who worked in the cow-house belonging to ———, was thin and pale, but nevertheless well and healthy. This girl had a lover whom she wished to enchain still more firmly; and, in order to obtain a more pleasing exterior, she had recourse to the well-known means, and swallowed every week several doses of arsenic. The desired result was obtained; and in a few months she was much fuller in the figure, rosy-cheeked, and, in short, quite according to her lover's taste. In order to increase the effect, she was so rash as to increase the dose of arsenic, and fell a victim to her vanity: she was poisoned, and died an agonizing death. The number of deaths, in consequence of the immoderate enjoyment of arsenic, is not inconsiderable, especially among the young. Every priest who has the cure of souls in those districts where the abuse prevails could tell such tragedies; and the inquiries I have myself made on the subject have opened out very singular details. Whether it arise from fear of the law, which forbids the unauthorized possession of arsenic, or whether it be that an inner voice proclaims to him his sin, the arsenic-eater always conceals as much as possible the employment of these dangerous means. Generally speaking, it is only the confessional or the death-bed that raises the veil from the terrible secret. The second object the poison-eaters have in view is to make them, as they express it, 'better winded!' — that is, to make their respiration easier when ascending the mountains. Whenever they have far to go, and to mount a considerable height, they take a minute morsel of arsenic and allow it gradually to dissolve. The effect is surprising; and they ascend with ease heights which otherwise they could climb only with distress to the chest. The dose of arsenic with which the poison-eaters begin, consists, according to the confession of some of them, of a piece the size of a lentil, which in weight would be rather less than half a grain. To this quantity, which they take fasting several mornings in the week, they confine themselves for considerable time; and then gradually, and very carefully, they increase the dose according to the effect produced. The peasant R———, living in the parish of A———g, a strong, hale man of upwards of sixty, takes at present at every dose a piece of about the weight of four grains. For more than forty years he has practised this habit, which he inherited from his father, and which he in his turn will bequeath to his children.

"It is well to observe, that neither in these nor in other poison-eaters is there the least trace of an arsenic cachexy discernible; that the symptoms of a chronic arsenical poisoning never show themselves in individuals who adapt the dose to their constitution, even although that dose should be considerable. It is not less worthy of remark, however, that when, either from inability to obtain the acid, or from any other cause, the perilous indulgence is stopped, symptoms of illness are sure to appear, which have the closest resemblance to those produced by poisoning from arsenic. These symptoms consist principally in a feeling of general discomfort, attended by a perfect indifference to all surrounding persons and things, great personal anxiety, and various distressing sensations arising from the digestive organs, want of appetite, a constant feeling of the stomach being overloaded at early morning, an unusual degree of salivation, a burning from the pylorus to the throat, a cramp-like movement in the pharynx, pains in the stomach, and especially difficulty of breathing. For all these symptoms there is but one remedy — a return to the enjoyment of arsenic.

"According to inquiries made on the subject, it would seem that the habit of eating poison among the inhabitants of lower Austria has not grown into a passion, as is the case with the opium-eaters in the East, the chewers of the betel-nut in India and Polynesia, and of the cocoa-leaves among the natives of Peru. When once commenced, however, it becomes a necessity.

"In Vienna, the use of arsenic is of every-day occurrence among horse-dealers, and especially with the coachmen of the nobility. They either shake it in a pulverized state among the corn, or they tie a bit the size of a pea in a piece of linen, which they fasten to the curb when the horse is harnessed, and the saliva of the animal soon dissolves it. The sleek, round, shining appearance of the carriage horses, and especially the much-admired foaming at the mouth, is the result of this arsenic feeding. It is a common practice with the farm servants in the mountainous parts to strew a pinch of arsenic on the last feed of hay before going up a steep road. This is done for years without the least unfavorable result; but should the horse fall into the hands of another owner, who withholds the arsenic, he loses flesh immediately, is no longer lively, and, even with the best feeding, there is no possibility of restoring him to his former sleek appearance."

In relation to this subject, the editor of Chambers' Journal remarks: "Arsenic is said to be harmless in the quantity of one sixteenth part of a grain; and in the cure of agues it is so certain in its effects, that the French Directory once issued an edict, ordering the surgeons of the Italian army, under pain of military punishment, to banish that complaint, at two or three days' notice, from among the vast number of soldiers who were languishing under it in the marshes of Lombardy. It would seem that no poison, taken in small and diluted quantities, is immediately hurtful, and the same thing may be said of other agents. The tap of a fan, for instance, is a *blow*, and so is the stroke of a club; but the one gives an agreeable sensation, and the other fells the recipient to the ground. In like manner the analogy holds good between the distribution of a blow over a comparatively large portion of the surface of the body and the dilution or distribution of the particles of a poison. But the misfortune is, that poisons, swallowed for the sake of the agreeable sensations they occasion, owe their effect to their action on the nervous system; and the action must be kept up by a constantly increasing dose till the constitution is irremediably injured. In the case of arsenic, as we have seen, so long as the excitement is undiminished, all is apparently well; but the point is at length reached when to proceed or to turn back is alike death. The moment the dose is diminished or entirely withdrawn, symptoms of poison appear, and the victim perishes because he has shrunk from killing himself. We trust this vice will never be added to the madnesses of our own country.

Think of a man deliberately condemning himself to devour this horrible poison, on an increasing scale, during his whole life, with the certainty that if at any time, through accident, necessity, or other cause, he holds his hand, he must die the most agonizing of all deaths !"

ON THE TEMPERATURE OF MAN WITHIN THE TROPICS.

In continuation of some researches on the temperature of man, Dr. Davy has communicated to the Royal Society the results of his observations on this subject, during a period of three years and a half, chiefly at Barbadoes, where the mean annual temperature of the atmosphere, he states, is 80° F., and the range of temperature throughout the year from about 10° to 18° in the open air. The observations were made three times a day; the temperature of the body being noted, with that of the external air, the pulse, and the number of respirations per minute; all of which are duly set forth in elaborate tables. The chief general results are the following: — 1. That the average temperature of man within the tropics is a little higher — nearly 1° — than in a temperate climate, such as England. 2. That within the tropics, as in cooler regions, the temperature of the body is almost constantly fluctuating. 3. That the order of fluctuating is different from that in a cooler climate; the minimum degree being early in the morning, after a night's rest, and not at night. 4. That all exertion, whether of body or mind, except it be very gentle, has a heightening effect on the temperature; while passive exercise, especially carriage exercise, has a lowering tendency. 5. That heavy clothing, especially if tight and close, tends to raise the temperature unduly, especially under active exercise; and that close, ill-ventilated rooms, particularly when crowded, have in a marked manner the same tendency. 6. That when the body is in a healthy state, it rapidly recovers its normal condition as to temperature. 7. That when laboring under disease, however slight, the temperature is abnormally elevated, its undue degree being some criterion of the intensity of the diseased action. 8. That within the tropics there is comparatively little difference of temperature between the surface of the body and the internal parts; the skin is more active in its functions, and the kidneys are less active. 9. That the effect of wine, unless used in great moderation, is commonly lowering as to temperature, while it accelerates the heart's action, followed, after a while, by an increase of temperature. 10. The tendency of sea-sickness, like that of disease, is to elevate the temperature. 11. The tendency of a sea-voyage, apart from sea-sickness, is to equalize the temperature without permanently elevating it. 12. That even at sea, with a change of atmospheric temperature, there is a tendency to change of temperature of the body, increasing towards the tropics. The most interesting facts, however, are the changes of temperature depending on changes of health or disease, and the lowering influence of wines and ordinary stimulants. — *Philosophical Transactions*, 1850.

EXTERNAL SYMPTOMS OF STARVATION, AS OBSERVED IN THE FAMINE DISTRICTS OF IRELAND.

In grown-up persons, besides an amount of attenuation, which seems to have absorbed all appearance of flesh or muscle, and to have left the bones of the frame barely covered with some covering which has but little semblance to anything we would esteem to be flesh, the skin of all the limbs assumes a peculiar character ; it is rough to the touch, very dry ; and, did it not hang in places in loose folds, would be more of the nature of parchment than anything else with which I can compare it ; the eyes are much sunk into the head, and have a dull, painful look ; the shoulder-bones are thrown up so high that the column of the neck seems to have sunk, as it were, into the chest ; the face and head, from the wasting of the flesh and the prominence of the bones, have a skull-like appearance ; the hair is very thin upon the head ; there is over the countenance a sort of pallor, quite distinct from that which utter decline of physical power generally gives in those many diseases in which life still continues after the almost entire consumption of the muscular parts of the body. In the case of the starved young — and we saw many hundreds — there are two or three most peculiar characteristic marks, which distinguish them from the victims of other mortal ills ; the hair on a starved child's head becomes very thin, often leaves the head in patches, and what there is of it stands up from the head ; over the whole brow, in many instances, over the temple in almost all, a thick downy sort of hair grows, sometimes so thick as to be quite palpable to the touch ; between the fingers there are sores ; very often there is anasarcous swelling of the ankles. In the majority of famine cases, there is either dysentery or chronic diarrhœa. Such is to-day, drawn in no exaggerated colors, the condition of Connaught. The devastation had been long preparing, and it is complete. — *Times, Sept. 24th*, 1850.

TRANSFUSION OF BLOOD.

The practice of the transfusion of blood from the veins of a healthy individual into those of one diseased, with a view of restoring health, was, it is well known, followed to some extent in times past. During the past year the practice has been revived again at Paris, in a particular instance, at the Hospital of St. Louis. A young woman, during her accouchement, had suffered from severe hemorrhage, and from the loss of blood was sinking rapidly. Under these circumstances, the director of the hospital, M. Nelaton, made up his mind to try the operation of the transfusion of blood. One of the hospital assistants offered to supply the necessary blood. A vein in his arm was, therefore, widely opened, for the purpose of obtaining rapidly the requisite quantum. This blood was received into a basin kept at a temperature of about 95° Fah., and transferred without loss of time to a hydrocele syringe similarly warmed. In the mean time, M. Nelaton discovered, by the aid of an incision of two centimeters, the median cephalic vein, which was dissected and raised with a loop of thread. Taking hold, then, with pincers, of the superficial coat of the vein above the loop, which held it up, the operator, provided with scissors, divided obliquely the vessel, in the half only of its circumference, so as to form a small opening in the form of a V, the upper part of which was directed to the outer extremity of the vessel. Matters being thus arranged, the assistant, who had received the blood, cleared away, with the nicest care, the globules of air and froth which the syringe contained, and inserted its tube underneath the small valve of the venous coat, which, being raised up by the pincers, formed a sort of funnel for its reception. As the tube was conical in shape, it was sufficient to insert it so deeply into the vein that the coat lapped exactly over its surface, and prevented the reflux of the injected liquid. The piston being then gently pressed, the whole contents of the syringe, that is to say, about two hundred grammes of blood, were made to penetrate into the venous system. At the expiration of five minutes, a new injection, similar to the former, was made, transferring to the vein nearly one hundred and fifty grammes. The little wound on the arm was immediately closed, by means of a bandage. During the course of this operation no particular phenomenon was manifested. The patient, who was, moreover, in a state of absolute insensibility, exhibited no sensation. Her pulse, however, felt from time to time, appeared, after a quarter of an hour, to be a little more firm, a little less quick; at the same time, the patient made it understood by signs that her respiration was rather less difficult. A week after, the patient was in a favorable condition; but subsequently sank away gradually, and died.

In regard to this operation, the editor of a foreign medical journal makes the following remarks: — "It was in France that the bold attempt of the transfusion first took place. In 1667, Jean Denis infused the blood of an animal into a man's body; and shortly afterwards, Tardy, who was at the head of the faculty of medicine in Paris, did the same from one man to another. These early efforts were crowned with such entire success, that they brought about the frequent practice of this operation, always a difficult one, and always dangerous, unless due precautions are taken, and the requisite arrangements made for ensuring its success. It was thus that it was adopted at Paris, with the son of the Swedish minister, who was given up by his medical attendants, and in whose intestines mortification had already commenced; also at Rome, with a man whose constitution was entirely broken down. In both these cases death very rapidly ensued. The Châtelet of Paris then thought it a duty to interfere, and by decree of the 17th of April, 1668, forbid the practice of this operation, unless with the sanction of the faculty, which was not very easily obtained. Thus, after enjoying a repute but little merited, this transfusion fell into neglect equally blamable; the prejudices of the many, and the timidity of the few, soon told against it; and at last the wit of Perrault gave it the finishing stroke. 'It would be rather too droll,' said he, 'that a fellow could change his blood as he changes his shirt.' The operation then was scarcely known, save by the learned, when some experiments, made thirty years ago, by Messrs. Prévost and Dumas, upon animals, again drew the attention of the scientific world to this valuable resource. These gentlemen demonstrated that the injection of blood into the veins of an animal exhausted by hemorrhage, reänimated and restored the quasi-corpse, provided that the blood thus introduced was derived from an individual of the same species, and that it consequently was endued with the same physical and chemical properties. Under the influence of these beautiful and conclusive experiments, several trials of the transfusion took place in England and in Germany, between 1825 and 1834. We can reckon up ten; others have perhaps escaped our recollection. In all, of which we have been able to consult the records published by the profession, death appeared imminent and unavoidable; and in all, under the influence, apparently at least, of the transfusion of youthful and healthy blood, the patients were restored to life, more or less promptly, but in general very rapidly. In all cases, with one exception, the operation was applied to young women, sinking in consequence of excessive loss of blood."

EXPERIMENTS ON CADAVERIC RIGIDITY, BY BROWN SEQUARD.

Following up the researches on which he has been for some time engaged, the author has ascertained that if a current of arterial blood be reëstablished through muscles in which cadaveric rigidity has already begun to show itself, they cease to be rigid and recover their irritability. He found that when he connected the aorta and vena cava of the body of a rabbit in which the cadaveric rigidity had already manifested itself for between ten and twenty minutes, with the corresponding vessels of a living rabbit, so as to reëstablish the circulation in the lower extremities, the rigidity disappeared in from six to ten minutes, and that, in two or three minutes afterwards, muscular contractions took place when the nerve-trunks were irritated. These experiments have been repeated in various ways with the same results; and they fully justify the opinion of those who maintain that cadaveric rigidity is a vital phenomenon, and not an indication of the death of the muscles, which does not take place until the rigidity passes off. He has even succeeded in removing the cadaveric rigidity from the muscles of the decapitated body of a criminal, thirteen hours after execution, and two hours after the supervention of the rigidity. By the infusion of blood fresh from his own veins into the radial artery, at a slight distance above the wrist, the muscles of the hand, which had before been rigid, became pliant and irritable. Of the nineteen muscles of the hand, twelve regained a very lively irritability, and three of them became so irritable that, under the influence of mechanical excitation, they contracted throughout their whole length. The irritability thus reäwakened at nine o'clock, lasted until midnight in the greater part of the muscles. On the morrow morning at six o'clock death was definitively confirmed, and new injections could produce no effect. — *Gazette Medicale.*

REMEDY FOR NEAR-SIGHTEDNESS.

Among the countless inventions of the day is a curious contrivance by Mr. J. Ball, of New York, for the cure of imperfect vision. The instrument consists of a circular cup, attached to an India rubber ball. The cup is placed over the central portion of the globe of the eye, the eyelids being closed, and the air of the ball is pressed out so as to form a vacuum ; the ball is then allowed to expand, thus producing a strong compression on the globe, by which the capillary vessels are speedily filled with blood. It operates precisely on the principle of the ordinary cupping glass. It is well adapted to that condition of the eye — too great flatness of the globe — which is a frequent cause of imperfect vision ; and to chronic weakness of the eye from deficient circulation.

EXISTENCE OF LIVE ANIMALS IN THE HUMAN STOMACH.

At the Boston Society of Natural History, June, Dr. Durkee read a letter from Dr. J. B. Johnston, Sherbrooke, Canada, detailing the case of a girl, a patient of his, who had been suffering for several months with gastric difficulties and a cough, which were suddenly relieved by the vomiting, as she alleged, of a specimen of *Salamandra symmetrica*. The account was accompanied by the specimen preserved in alcohol. The letter stated that the patient, being suddenly seized with nausea, hurried to the door, and, discharging the contents of her stomach on the door-step, the salamander was observed in the mass. On being taken up it was very sluggish in its movements, and of a light color. It was kept living in water for a week, in which time it assumed a darker hue. It was about two inches and a half in length.

Prof. Wyman doubted the facts in the case. He thought it impossible for this animal to exist in the human stomach alive for any length of time. He knew of an instance in which a toad had been swallowed alive by an insane man, and was ejected dead within half an hour. A few years since, a man in Reading was reported to have vomited a snake, and by this act to have been immediately relieved of a chronic disease of the stomach. The fact being doubted, the point was settled by opening the stomach of the snake, when its only contents were found to be another snake, proving incontestably that it could not have been an inmate of a human stomach. The supposed vomiting of the reptiles, in both instances, was the result of an accidental coincidence, such as might very readily account for the story without impugning the veracity of the witnesses.

SEA-SICKNESS.

At the late meeting of the British Association, a paper was read by Mr. J. Atkinson, "On Sea-sickness, and a remedy for its prevention," from which we make the following extracts : —

"Let a person on shipboard, when the vessel is bounding over the waves, seat himself, and take hold of a tumbler nearly filled with water or other liquid, and, at the same time, make an effort to prevent the liquid from running over, by keeping the mouth of the glass horizontal, or nearly so. When doing this, from the motion of the vessel, his hand and arm will seem to be drawn into different positions, as if the glass were attracted by a powerful magnet. Continuing his efforts to keep the mouth of the glass horizontal, let him allow his hand, arm, and body to go through the various movements — as those observed in sawing, planing, pumping, throwing a quoit, &c., — which they will be impelled, without fatigue, almost irresistibly to perform; and he will find that this has the effect of preventing the giddiness and nausea that the rolling and tossing of the vessel have a tendency to produce in inexperienced voyagers.

"If the person is suffering from sickness at the commencement of his experiment, as soon as he grasps the glass of liquid in his hand, and suffers his arm to take its course and go through the movements alluded to, he feels as if he were performing them of his own free will; and the nausea abates immediately, and very soon ceases entirely, and does not return so long as he suffers his arm and body to assume the postures into which they seem to be drawn. Should he, however, resist the free course of the hand, he instantly feels a thrill of pain, of a peculiarly stunning kind, shoot through his head, and experiences a sense of dizziness and returning nausea. From this last circumstance the author of the paper infers it as probable that the stomach is primarily affected through the cerebral mass, rather than through the disturbance of the thoracic and abdominal viscera; and he is of opinion that the method of preventing sea-sickness just described, (which he has found by experience to be effectual,) depends on the curious fact that the involuntary motion communicated to the body by the rolling and tossing of the vessel are, by the means he adopts, apparently converted into voluntary motion."

PINE BARRENS OF SOUTH CAROLINA.

At the Boston Natural History Society, November, the following paper was read by Dr. Burnett, on "The Pine Barrens of upper South Carolina:"—

The sand hill region of the upland portion of this State is situated about 121 miles westward of the sea coast, and intermediate between the low country of South Carolina on one side, and that of Georgia on the other. Its maximum elevation is about 700 feet above the sea. It is covered with pines, which extend like one vast sea of evergreen on every side. This district is quite thinly populated, and, at distances of 16 or 20 miles, will be seen little villages, nested as it were in the bosom of this extensive wilderness. The general features of the country have little variety. The soil is of a light, porous, sandy nature, poorly adapted for strength or luxuriance of vegetation, but at the same time rendering the climate dry, mild and equable. With the exception of the small creeks, which on the sloping sides enter the rivers, there is no water, and wells are dug from 60 to 80 feet. I should mention, however, that there are here a number of circular depressions scattered over the surface, and these form a peculiar feature of this region. Mr. Tuomey, in his Geology of the State, has given them notice. They consist of concavities of a quarter to one mile in diameter, filled during the greater part of the year with water from two to three feet deep; and, as they are probably fed by intermittent springs, they are dry at one time and full at another, without any apparent external cause. They subserve excellently well as breeding places for aquatic insects and reptiles, and were it not for them, their numbers must be materially diminished.

The fauna of the pine barrens presents some peculiarities of interest, which have heretofore been scarcely noticed. Among peculiarities of domestic animals, I may allude to those of the hog. These run at large in the woods, and their thin form and length of leg not only give them an almost incredible fleetness, but show their half-famished condition. From force of hunger they often become purely carnivorous, and I have seen them run down domestic fowls and young goats, which they kill and devour like dogs. Squirrels are quite rare in this region, the pines affording little means of subsistence. The wharf-rat is found only along the line of the railway, and the Florida rat exists in the back country in great numbers, being granivorous and destructive. As for the rabbit, it is quite common, the light soil affording it great facilities for life, and it is quite hurtful to gardens. The opossum, also, is common, and the male and female live in separate burrows, two or three rods apart.

The insects of this pine barren region may be said to be quite peculiar. One cannot but be struck with the great numbers of wood-eating, boring beetles. These certainly are the most numerous of all, the carnivorous and anthophagous insects being comparatively few. The *Buprestidæ*, of which I recognized no less than ten species, are the pine-boring insects, and small as they are, they form a most formidable enemy to the luxuriance of the pine. The insidious yet certain work of destruction the myriads of these insects carry on, can only be appreciated when we consider that tracts of pines miles in length yield before them, and the most stalwart trees, that never have even noticed winds or currents, gradually bend before them. On some of the fallen trees, I counted the holes of the insects' exit to the number of 100 or more over the space of a square foot. By several of them boring for a year or two, the tree is so weakened that the next strong wind breaks it off, sometimes five, and sometimes fifty feet from the ground, or the tree may die in a standing position.

There is another insect which, from its great numbers, deserves mention: I allude to the ant-lion, (*Mynmilion*,) which, from the fineness of the sand in many places, lives with ease. The habits of this remarkable insect are well known. With its abdomen it excavates in the fine dry sand an infundibuliform cavity of an inch or so in depth. To the bottom or apex of this cavity the insect retires, burying all but its powerful jaws, which are there exposed wide open. An ant, or some other small insect, walking along, treads on the edge, the sand rolls, and in a moment it is at the bottom, in the jaws of the enemy.

The turkey buzzard is constantly seen flying about, seeking dead animal matter. I suppose the question as to whether it discovers its food by sight or smell, has for some time been settled in favor of sight. I had many opportunities to try their skill, of which I took advantage. If a dead dog was dragged into the woods and carefully covered up with pine boughs, it might remain there any length of time untouched; but if fully exposed, it would remain but a few hours. And to show how acute their sight is, I need only say, that a snake hung upon a twig will be removed in less than twenty-four hours.

The blue-bird has three broods in a season, beginning to nest as early as February. It need spend no time in seeking out a place for nesting, for the holes in dead pine trees, left by the past year's woodpeckers, are taken up. The dead pine trees, therefore, contribute to this bird's increase. The mocking-bird here gives a charm to these places, solitary as they may be. Entirely unmolested, they gather around the dwelling of the inhabitant, seeking apparently to make his life pleasant by their ever varied and varying notes. They celebrate their connubial state with more than usual joy, and, during the warm days and nights at the opening of summer, the male sings through the whole twenty-four hours; and many a night after midnight have I been awakened by what exactly resembled a man whistling for his dog, directly under my window.

The great number of woodpeckers here seen must be noticed by every one. Not only does every species known in the United States here reside, but great numbers of each, and especially the *red-headed* and golden-winged, which meet your view on every side.

Their great numbers are in exact accordance with many conditions to which we have alluded; for they seem always to follow on the track of the wood-boring insects. For not only do these insects destroy the pines so that they can easily nest in them, but they are themselves excellent food for these birds. And thus it would appear, that they are the enemies of those very beings which indirectly afford them the means of easy propagation and life. Did these destructive insects not exist, there would not be sufficient inducement for the woodpeckers to live here; and while they may be considered as very subservient in thus destroying the energies of the pine, they are at the same time eating up the very conditions, as it were, of their own existence.

An enumeration of the fauna of the pine barrens gives the following numbers: — Mammalia, 17; birds, 43; reptiles, 40. Of both birds and reptiles, many more may be found to reside here for a little while; but, in giving this list, I believe I include nearly all which make this their permanent habitat.

ASTRONOMY AND METEOROLOGY.

NEW PLANETS DISCOVERED IN 1851.

A NEW planet, a member of the group of asteroids, was discovered by Mr. J. R. Hind, at Bishop's Observatory, London, on the 20th of May, 1851. In number, it is the fourteenth of the ultra-zodiacal planets, and is the fourth discovered by Mr. Hind; the other three being Iris, Flora and Clio. This new body has received the name of Irene, from the goddess of Peace; its symbol being a dove with an olive-branch and star on head. The brightness of this planet is that of a star of the eighth or ninth magnitude; the light being of a bluish color and steady. It appears to be surrounded by a faint, nebulous envelope, which was not perceptible at the time of its discovery about any of the stars in its vicinity. The distance of Irene from the sun proves to be 2,554, and its period 1491 days; coming very close to the last previously discovered asteroid, Egeria, the numbers for which were respectively 2,579 and 1513. An interesting feature in this history of the discovery of this planet, is the fact of its having been independently seen only four days later by the active Neapolitan astronomer, M. Gasparis.

On the 29th of July, another planet was discovered by Gasparis, having the appearance of a star of the ninth magnitude. It has received the name of Eunomia.

COMETS IN 1851.

Two new comets have been discovered in 1851. The first was by Dr. D'Arrest, at Leipsic, on the 29th of June. This comet Villaceau finds, from his observations, is a periodical one, and its time of revolution is about eight years. There is some probability of its identity with the comet observed 1678, and computed by Douwes.

The second comet was discovered by Mr. Brorsen, August 1st, at the Seuftenburg Observatory, Germany. It was also seen at Cambridge, Mass., August 23d, 26th, and 27th, and its elements computed.

NEW SATELLITES OF URANUS.

MR. LASSEL, of Liverpool, on the 24th of October, discovered evidence of the existence of two new satellites accompanying the planet Uranus.

On the 3d of November his supposition was confirmed, and he now states confidently that Uranus has two satellites interior to the closest, suspected by Sir William Herschel. This had a period of five days; but the two new ones have for their time of revolution four days and two and one half days respectively. "These new satellites," says Mr. Lassel, "are very faint objects, probably much less than half the brightness of the conspicuous ones, and, generally, the nearest has appeared the brightest. All four were steadily seen at one view, in a twenty foot equatorial, with a magnifying power of 778, in the more tranquil movements of the atmosphere. The finest definition of the planet, and freedom from all loose light in the field of view, are necessary for the scrutiny of these most minute and delicate objects."

These discoveries of Mr. Lassel make the whole number of satellites accompanying Uranus to be six, the number predicted by Sir John Herschel many years since. A late writer, speculating on the satellites of Uranus, a few weeks before the discoveries of Mr. Lassel, says, "If we suppose the satellites of Uranus to be of the same order of magnitude as our moon or Jupiter's moons, it seems almost incredible that they should be seen by light which has gone eighteen hundred millions of miles before it has been reflected, and afterwards retraced its steps through another eighteen hundred millions of miles before it entered the telescope of the observer. The observations, however, upon the two brightest satellites agree extremely well."

THE NEW RING OF SATURN.

The following abstract account of the new ring of Saturn, and the opinions entertained respecting the constitution of all the rings, is taken from an article furnished by Messrs. Bond, of Cambridge, and published in the Boston Traveller of June 16th, 1851.

The first diagram which the Messrs. Bond were enabled to make of the new interior ring was on the night of the 11th of November, 1850. On the 15th, measurements were made, the new ring being sharply defined. Subsequently, continuous observations were made at the Cambridge Observatory, until the 7th of January. The appearances noticed by the Messrs. Bond were seen by the Rev. W. R. Dawes, at his Observatory, near Maidstone, in England, on the 25th and 29th of November, and subsequently by Mr. Lassel, of Starfield, near Liverpool. In relation to this new discovery, the authors of this communication remark: — The question of the multiple divisions of the ring of Saturn has engaged the attention of astronomers from an early period. Cassini appears to have been the first to notice the primary division, though he has placed it midway between the inner and the outer edges. This interval is always visible with a good telescope, but much nearer to the outer edge than Cassini describes it to be. Short, next, with a telescope of twelve feet focus, probably a reflector, saw two or three divisions outside of the centre of the ring. In June, 1780, Sir W. Herschel noticed on four different nights a division near the inner edge. From its never, either previously or subsequently, having been seen by him, it is probable that the subdivisions are not permanent; otherwise they could scarcely have escaped detection under the scrutiny to which he subjected everything appertaining to the system of Saturn for thirty or forty years. Quetelet, at Paris, with an achromatic of ten inches' aperture, saw the outer ring divided, in December, 1823. On the 17th of December, 1825, and, on the 16th and 17th of January, 1826, at least three divisions were seen on the outer ring by Captain Kater. At Berlin, on the 25th of April, 1837, the outer ring was seen by Prof. Encke, with perfect distinctness, divided into two nearly equal parts, and several divisions were recognized on the inner edge of the inner ring. The great equatorial of the Berlin Observatory was used with an achromatic eye-piece. On the 28th of May, the place of the outer secondary interval was determined. The great optical capacity of the telescope, and the eminence of Professor Encke as an observer, give the highest value to these observations. On the 7th of September, 1843, a division of the outer ring was detected by Messrs. Lassel and Dawes, at Starfield. They employed a Newtonian reflector of nine inches' aperture.

The newly discovered inner ring of Saturn cannot properly be classed with the subdivisions of the old ring, as it lies within its inner edge.

We have, then, the best assurance, in the number and reputation of those who have described the phenomena in question, that to set aside these appearances by referring them to some optical deception on the part of the observer, or to some defect in his instrument, is an explanation altogether insufficient and unsatisfactory. On the other hand, we know that some of the best telescopes in the world, in the hands of Struve, Bessel, Sir John Herschel, and others, have given no indication of more than one division, when the planet has appeared under the most perfect definition. The fact, also, that the divisions on both rings have not usually been visible together, and that the telescopes which have shown distinctly several intervals in the old ring have failed to reveal the new inner ring, while the latter is now seen, but not the former, may be taken as some evidence that the difference is not probably owing to any extraordinary tranquillity or purity of the atmosphere, nor to any peculiarly favorable condition of the eye or instrument, but rather to some real alterations in the disposition of the material of the rings. Admitting this, the idea that they are in a fluid state, and, within certain limits, change their form and position in obedience to the laws of equilibrium of rotating bodies, naturally suggests itself. There are considerations to be drawn from the state of the forces acting on the rings which favor this hypothesis. For instance, on the assumption that the matter of which the ring is composed is in a solid state, we may compute, for any point on its surface, the sum of the attractions of the whole ring and of Saturn. The centrifugal force, generated by its rotation, may then be determined from the condition that the particle must remain on the surface. Now, in the case of a solid ring, particles on the inner and outer edges must have the same period of rotation. This condition limits the breadth of the ring, for, if it be found necessary for the inner and outer edges to have different times of rotation, this can be accomplished only by a division of the ring into two or more parts. In this way Laplace has inferred the necessity of there being several rings.

To the supposition of a large number of small rings encircling the planet, there are various objections.

Any intervals permanently existing so large as one half, or even one third, of that usually seen, could not escape observation. Moreover, if the subdivisions are numerous, the width of the intervals must be proportionably diminished, because the whole area occupied by them goes to diminish the amount of light reflected, and to increase the density of each ring, both of which are already large. The light of the ring being sensibly brighter than that from an equal area on the ball, it is not probable that any considerable part of the light of the sun is transmitted through intervals. And to preserve the same mass, if the intervals are large, the matter must be compressed, as it is not allowable to give a thickness greater than is indicated by observation. To avoid the hypothesis of a reflective power, and a density greater than we are warranted in assuming, we must, therefore, consider the intervals to be very narrow. We may take, then, the width of all but the known interval as certainly less than 0.01, which is one half of the width of the known interval. From the blackness of the shadow of the ring upon the ball, which would be diminished in intensity were a considerable part of the sun's rays transmitted, we may infer that the intervals which reflect no light at all cannot occupy an area so large as one fourth of the average breadth of the rings.

It is known, in the case of a single ring, that, if it were perfectly uniform in every part of its circumference, the slightest exterior disturbance would precipitate it upon the body of the planet. To avoid this catastrophe, we must suppose each ring to be an irregular solid, its centre of gravity not coinciding with its centre of figure, but having a motion of rotation about the body of *Saturn*. In addition to this, a number of regular concentric rings are in a position of unstable equilibrium, by virtue of their own mutual attractions. The slightest inequality in the intervals would have the effect of throwing the whole system into confusion. Let us suppose, for instance, that the inner ring deviate, by ever so small an amount, from an exact central position with reference to the ring outside it. The nearest sides commence moving together, until they come in contact. All the others must follow. The consequence of such a conflict of these masses, each urged by different velocities, corresponding to the different times of rotation of the several rings, must be fatal to the whole structure.

It is, therefore, again necessary that the rings be not of regular figure or density. But if these irregularities are small, there will be only a feeble resistance opposed to their tendency to fall upon the body of the planet. On the other hand, if they be large, they will become the source of mutual disturbances, which must end in their destruction, by causing them to fall upon each other. The smallness of the intervals between them, and the near equality in the period of rotation of two adjacent rings, will make the danger of the latter event imminent, if not wholly unavoidable. The nearness of the rings will, in any case, render it impossible that they can assume a figure of equilibrium permanent or nearly so. The hypothesis that the whole ring is in a fluid state, or at least does not cohere strongly, presents fewer difficulties.

There being no longer any unyielding coherence between the particles of the inner and outer edges, they have not necessarily the same period of rotation about *Saturn.* A continual flow of the inner particles past the outer may be supposed, by which centrifugal force will be brought into equilibrium with the other forces. And even should an accumulation of disturbances, of which the absence of inequalities lessens the probability, bring the rings together, the velocities at the point of contact will be very nearly equal, and the two will coalesce without disastrous consequences. If in its normal condition the ring has but one division, as is commonly seen, under peculiar circumstances, it might be anticipated that the preservation of their equilibrium would require a separation in some regions of either the inner or outer ring; this would explain the fact of occasional subdivisions being seen. Their being visible for but a short time, and then disappearing, to the most powerful telescope, is accounted for by the removal of the sources of disturbance, when the parts thrown off would reunite. Finally, a fluid ring, symmetrical in its dimensions, is not of necessity in a state of unstable equilibrium with reference either to *Saturn* or to the other rings.

At the meeting of the American Association, Cincinnati, the following remarks were made by Prof. Peirce, of Harvard, in relation to the discoveries made by the Messrs. Bond, and the supposed fluidity of Saturn's rings: —

1. The author of the Mecanique Celeste proved that Saturn's ring, regarded as solid, could not be sustained about the primary, unless it had decided irregularities in its structure. But the observations of Herschel and others have failed to detect any indications of such irregularity; and Mr. Bond's observations have finally convinced him of the utter improbability of any serious irregularities, and he has, therefore, adopted the conclusion that Saturn's ring is not solid, but fluid. Mr. Bond's argument is chiefly derived from observation; but a new investigation of the mechanical conditions of the problem has led me on a step farther. I am now satisfied that there is no conceivable form of irregularity, and no combination of irregularities consistent with an astreal ring, which would permit the ring to be permanently maintained by the primary if it were solid. Hence it follows, independent of observation, that Saturn's ring is not solid, but fluid. Adopting as the basis of the calculations the mass of the ring which was determined by Bessel, the thickness from Bond, and the other dimensions from Struve, the density of the ring will be found to be about one fourth greater than that of water. The ring of Saturn is, then, a stream or streams of fluid, rather denser than water, flowing about the primary.

2. Mr. Bond next undertook a series of very curious and novel computations, in order to determine, from theoretical considerations alone, whether the ring was one or many; and arrived at the remarkable result that neither hypothesis could be maintained. He is, therefore, disposed to reconcile the discrepancies of observation in this respect, by supposing the constitution of the ring to be variable; and that, although the principal division, which has been always observed, is

permanent, the other divisions are constantly annihilated by the mutual concussion of the rings, and again re-produced by some process which he does not undertake to define. This bold and ingenious theory is fully sustained by my own analytical investigations, and not only do my researches exhibit the possibility of this strange phenomenon, but they even go farther, and, exhibiting the precise mode of action, show that it must be the case of nature. If the ring had been originally one, it would soon have divided itself at definite points, which can be exactly computed, into portions of a determinate width. The disturbing causes must, after a time, have driven these separate rings against each other. There would then have followed an interchange and moving of currents, a mutual retardation, a momentary state of equilibrium, as one ring and then another broke off, when the same process would be again repeated.

3. But even a fluid ring could not be permanently retained by the direct action of the primary, for, whatever may be its general figure, the velocity of its current must be slower at the points which are more remote from the planet; so that there must be an accumulation of fluid at these points, and no exact analysis shows that the accumulation precisely balances the greater distance, so that the ring must be attracted equally in every direction by the planet. The resulting action upon the motion of the centre of gravity is, therefore, cancelled, so that it must continue to move uniformly in any direction in which it may have begun to move — under any foreign influence to which it may have been subject — until the mass of the planet will at length come into collision with the edge of the ring and destroy it. Why, then, has not Saturn's ring been long ago destroyed? It is simply because the disturbing forces have always counteracted their own effects. These disturbing forces are the actions of the satellites, and it is by means of these satellites that the ring is held in its place. They are at once the disturbing and the sustaining agents of the ring, and if there were no satellites there could be no ring. If the satellites were removed, the ring would soon strike against the primary, and be broken to pieces, or resolve itself into satellites. The theory of the action of the satellites in sustaining the ring admits of various forms of illustration. In the first place, each particle of the ring may be regarded as a satellite, which the other satellites disturb in such a way as not to vary, in the least, the mean distances from Saturn, and the disturbance of the eccentricity can only reach certain definite limits, after which it must diminish. Secondly, in consequence of the attraction of the satellites, Saturn describes an orbit about the common centre of gravity of the system; each particle of the planet tends to move in this same orbit, and also the centre of gravity of the ring tends to describe nearly the same orbit. The orbit would be precisely the same if the attractions of the ring for the satellites were the same as if the mass of the ring were accumulated at its centre of gravity; but the deviation from this orbit may be safely referred to the laws of periodical perturbations.

4. It follows from what precedes, that no planet can have a ring, unless it is accompanied with a sufficient number of properly arranged

satellites. Saturn seems to be the only planet which is in this category; and the only one, therefore, which could sustain a ring. Our sun, also, does not seem to have satellites properly disposed for supporting a ring, and the only part of the solar system where such a phenomenon might have been expected, is just within the powerful mass of Jupiter. But if there had ever been a ring at this part of the system, it must have been subject to such extraordinary perturbations that it would, in the course of time, have been made to strike against its next interior planet, Mars, and in this way have been broken up into the asteroids with their eccentric orbits.

5. But suppose that, from any cause whatever, the sun had, at one period, been surrounded by a ring of a large radius; and, in order to escape the planetary influence, we may suppose the plane of the ring to have had a large inclination to the ecliptic. The result would have been, that the centre of gravity of the ring would have soon begun to move in some direction or other, and would continue to move until its inner edge was brought in collision with the sun. But during this motion, and in consequence of the solar action, the matter of the ring would have accumulated at the most remote part, so that if the sun were a mere point, it would happen that, on the very instant of its meeting the ring, the whole ring would have escaped from the point of contact, and it would be a comet in its aphelion!

If, however, the ring were supposed to be a large, gaseous mass, of a circular figure, the condensation which would occur at the point of aphelion might lead to chemical action. Precipitation might ensue, and the necessary consequence would seem to be a constantly accelerated accumulation at this point, which would terminate in the production of a planet. Under this modification, the nebular hypothesis may possibly be free from some of the objections with which it has justly been assailed. But in approaching the forbidden limits of human knowledge, it is becoming to tread with caution and circumspection. Man's speculations should be subdued from all rashness in the immediate presence of the Creator, and a wise philosophy should beware lest it strengthen the arms of atheism by venturing too boldly into so remote and obscure a field as that of the mode of creation which was adopted by the Divine Geometer.

Prof. Mitchel suggested whether there were not a possibility that this alleged fluid ring, in its changes of configuration, might run into a fluid sufficiently thin to give the possibility of the transmission of light through it. If it really changes its form and becomes several rings, it seemed that in the act of passing from one single ring to two, before it divided, it must become so thin as to allow the light to penetrate and come to us refracted. If this should prove to be the case, the Professor considered it of the utmost importance, and every observer should carefully observe the occultations. He considered it a very strange and curious doctrine.

Prof. Peirce replied that it was of course almost impossible to answer the question of Prof. Mitchel. He supposed, however, that at the moment of separation, a sinking takes place, producing a depression at the point where the separation takes place, and that rapidly after it begins, it goes on to the reduction of two rings. It was doubtful whether the refraction would be sufficient to reach the earth.

ON THE ZODIACAL LIGHT.

Prof. D. Olmstead, at the meeting of the American Association, Albany, submitted the results of a series of observations on the zodiacal light, made at Yale College during six years, from 1833 to 1839. He adverted to the general ignorance prevalent respecting this body, and enumerated several causes which render continual observations difficult, such as the presence of clouds, of the moon, of Venus and Jupiter, as also the low angle which the direction of the zodiacal light makes with the horizon at certain seasons of the year. The Professor next proceeded to inquire into the nature and constitution of the zodiacal light, as its length, its direction, its motions, and the material of which it is constituted. It appears that the length, or elongation from the sun, varies much at different seasons of the year, and not only apparently, but really, being sometimes below 60° at one time, and again reaching, in a few and rare instances, to 120°. An elongation of 90° from the sun implies that it reaches to the earth's orbit, and it must of course sometimes reach far beyond it. The direction of the axis of this body was supposed, by Cassini and others, to be that of the solar equator; but the professor showed that that direction varies at different times of the year, the vertex sometimes terminating in the ecliptic itself. The motions of the zodiacal light are such as to indicate a revolution around the sun, and this point was shown to be accordant with the views of Laplace. The material of which this body is constituted appears to have great analogies to that which forms the tails of comets, included under the general appellation of nebulous matter, being like that in its tenuity, transparency, shape, and even shade of color. Finally, Professor O. proceeded to the question whether or not the zodiacal light is the origin of the periodical meteors of November and August, particularly those of November. He says that he does not assert, positively, that this is the body which affords the meteoric showers. He had inferred, from all the facts of the great meteoric shower of November 13th, 1833, independently of all hypothesis, the existence of a nebulous body; and now the question is, is the body in question such as to identify it with that? In answer to this question, he, with great deference, offered the following presumptions in favor of the idea that this is the body which affords the periodical meteors. 1. It is a nebulous body. 2. It lies over the earth's orbit in such a position that the earth might pass through or near it at the time of the meteors of November. 3. Like the supposed "nebulous body," it revolves about the sun. 4. Like that, its periodic time must be commensurable with the earth's period. 5. Finally, the meteors actually are seen to come from the visible extremities of the zodiacal light.

LONGSTRETH'S LUNAR FORMULA.

Prof. Peirce, at the American Association, Albany, read a paper entitled "An account of Longstreth's Lunar Formula." The Professor stated that the title of the paper was probably sufficient to tell what he meant to say. But he wished it distinctly understood that he only intended to give an account of a discovery by a man who was as remarkable for his extreme modesty as for the eminence of the position which he occupied among the scientific benefactors of the age. This was intended for an account of Mr. Longstreth's discovery, and was not his own. The very modest manner in which Mr. Longstreth had announced his discovery was worthy of remark. He would read from the preface to the published tables all that Mr. Longstreth had himself said in relation to this great discovery. It was as follows: — "The coefficients deduced from theory by Damoiseau, Plana, Pontecoulant, and those deduced from observation by Burckhardt, (though differing considerably,) give the moon's place with nearly the same accuracy." Previous to this tabular formula prepared by Mr. Longstreth, there was no method of testing a theory. All will remember the celebrated dispute between Newton and Flamstead, as to the investigation of the formulas for the longitude of the moon. Longstreth had obtained results which involved the true theory of variations of the moon's longitude. The results of observations, now that we had a tabular formula to compare them with, when spread over sufficient ground, would be sure to be confirmed by theory subsequently. The Professor exhibited the tables themselves, showing where Damoiseau and Plana agreed, and where they began to differ, and stating that Prof. Airy, of England, had compared the results obtained by Longstreth. By means of Longstreth's formula we are sent back to the theories of Damoiseau and Laplace. The difference had been ascertained to be greater between Plana and Laplace than Laplace and Damoiseau. We are therefore travelling backward to the theory propounded by Laplace, while the supposed advances made by latter physical astronomers are assuming their true position.

Mr. Longstreth's observations are now to be used in the American Nautical Almanac. This alone renders that work of the utmost importance to navigators of every nation, as well as of this country.

TOTAL SOLAR ECLIPSE, JULY 28TH, 1851.

The following description of the total eclipse of the sun, which occurred July 28, 1851, is by Mr. G. P. Bond, of the Cambridge Observatory, and was first published in the Boston Traveller. Mr. Bond, in order to obtain a favorable position, visited Lilla Edet, Sweden, a point crossed by the central line of the eclipse: —

"The evening which preceded the day I have looked forward to with so much anxious expectation, closed in without the slightest prospect that the clouds and incessant rain of the last week would not continue, and effectually prevent our seeing the grand phenomenon which had been the sole object of our journey. The morning was dark, with heavy clouds drifting from the wonted quarter, and the rain, which had ceased the night before, commenced falling again, as if the idea was a new one, and it liked the novelty of it. We had nothing to do but look as gloomy as the weather, and fancy how dark it would be when the eclipse came on. I entirely gave up all hope, and determined to stay in the village, and watch the effect of the darkness on the inhabitants. Mr. C. went to a station we had selected on the opposite side of the river, to set up his telescope at all events, as he required some hours of previous preparation before he would be ready, in case of an unexpected change in the weather. This was about eleven o'clock, and though the rain had stopped, the clouds were still as heavy as ever. On the first day of our stay at Lilla Edet, we had chosen a spot near the village, very well fitted for our purposes. This I was to occupy if there was the least chance of seeing the sun. It was now two o'clock, an hour only before the eclipse; patches of blue sky here and there were increasing in area and number; our hopes revived, and everything was made ready for whatever chances should offer. The elevation which I occupied is a bold, precipitous, rocky hill to the eastward of the town. It stands about one hundred and fifty feet above the river. My telescope I placed on the very summit, but afterwards removed it under the shelter of a large rock, to avoid the annoyance of a brisk breeze from the south-west, which was at one time troublesome; but the coming on of the darkness seemed to produce the singular effect of hushing the winds into silence; for the moment of totality was preceded by a calm, like that which often marks the approach of a thunder-storm. For the first contact, which presented little interest, I watched a long time in an uneasy position: after losing the sun once or twice in the clouds, I observed it tolerably well. Meanwhile the sky was clearing delightfully; a heavy bank of cirro-stratus in the west was rising so slowly that it was now nearly certain that we should have a fulfilment of all that we could wish. The telescope was placed close to the ground, and made perfectly firm with stones piled on its tripod. As the time drew near when the moon was to completely cover the sun, the clouds dispersed entirely from its neighborhood, leaving a thin veil of cirrus, which, without question, often accompanies the most perfect vision. A few cumuli were gathered round the horizon. The awful, unearthly aspect which these assumed before the darkness, was a fitting precursor of what was to follow. Until about five minutes before the time of total obscuration, I had leisure to watch the general effect, on the landscape, of the increasing darkness. It is a common error, though a great mistake, to suppose that the darkness of a total eclipse is of the same kind with that of night of equal intensity. An ordinary starlight night, when the moon and twilight are absent, is much darker. But the thickest darkness that ever shrouded the earth is joy and gladness compared with the peculiar light emanating from the corona which encircles the moon when the eclipse is total. The outline of the lunar mountains was finely projected in profile upon the sun; and these, as the crescent of light narrowed, produced a singular appearance on the southern cusp. Presently, as I watched intently, the edge of light was broken up into beads, moving towards the point. The complete covering of the sun's disc by the moon succeeded instantaneously. Up to this point I may say that I was in a great measure prepared for all that I saw. I had seen other eclipses, and this was like one of them on a great scale. The change which takes place in less than a tenth of a second so entirely alters the scene, that the second which precedes the instant of total obscuration gives one no idea of what is to follow. Some seconds elapsed before I had my thoughts sufficiently about me to remove the screen from the eye-piece. What I then saw, it is utterly beyond my power of language adequately to express. The corona of white light which encircled the dark body of the moon resembled the aureola, or glory, by which painters designate the person of the Saviour, its radiations extending from the circumference to a distance equal to about one half of the sun's diameter. I suppose it must be some peculiarity in its light which gives such a strange aspect to all natural objects seen by it. How shall I attempt to describe those other wonders? The rose-colored flames, which, at the same instant with the corona, appeared on the sun's edge. The sight filled me with unmingled, inexpressible admiration. An arch of light like a rainbow connected two of them, not so bright as they were. The scene was as surpassingly beautiful as it was awful and grand. In a moment, in the twinkling of an eye, it bursts upon the sight — the most sublime of all that we are permitted to see of the glory of the material creation. An hour before I should have been as sceptical about all this as many others may now be. Without seeing what I did I should never thoroughly have believed. I had a vague conception, founded on what I had read of the eclipse in 1842, that something unusual would take place at the moment when the sun disappeared. But had a new sun appeared in the heavens, I could scarcely have been more taken by surprise than I was when I saw these flame-like prominences projecting from the inner edge of the corona. My eye was at the telescope, with the exception of a glance or two about me at the landscape shrouded in darkness, the whole time during which the total phase continued. They were seen, however, by many with the naked eye. Before the end of totality, the left hand flame disappeared entirely; perhaps was covered by the advancing limb of the moon. Those on the side which the moon was first to leave increased, until the moment before the edge of the sun appeared; when the rosy light was suffused over the limb of the moon, near where the sun-light first broke forth, and then all vanished as quickly as it had first appeared. The light of day had no sooner returned than I went to my room to record all I had seen. I only stopped to notice the shadow of the moon to the south-east, where the sky was black as night, while we were already in the sunbeams. I had scarcely reached my lodgings, long before the last contact, when the sun entered the bank of clouds in the west, and was soon concealed from our sight; but all that we could desire was secured already. It was noticed that during the eclipse the flowers of the '*Hesperis matinalis*,' which give forth their perfume only at evening, smelled sweetly during the period of darkness. Some of the cows and horses were stupid enough to feed quietly through the whole. Of the birds, the swallows were most affected, seeking to hide themselves in great numbers in the bushes, and under the eaves of the houses."

Prof. Smyth, in the Edinburgh Phil. Magazine, states that the eclipse seems to have been, on the whole, very fully observed, the weather being clear and the definition good at a great number of the stations. The various English observers, in order to guard against the false impressions of what had been seen which often result from conversation with others, agreed each to communicate their results separately to the Astronomer Royal, and not to tell each other what they had seen. The beads of light which occur at the beginning and end of the totality of the eclipse, and which are generally known as "Bailey's Beads," were very markedly seen by most observers. The reason of their occurrence, viz., the serrated edge of the moon, combined with the irradiation of the sun's light seen in the hollows, seems to be so clearly settled, that the phenomena are no longer subjects of wonder, and hardly worthy of particular notice.

The red prominences appear also to have been well seen, and to have been decidedly proved to belong to the sun and not to the moon. On the occasion of the eclipse of 1842, they took observers so much by surprise, that they were not prepared with any instrumental means to ascertain the nature of these strange appearances, and the several accounts varied alarmingly as to the number, size, and position of these appendages. On the present occasion, however, from more attention having been paid to the subject, the statements are much more uniform, and observers seem positive to having seen the red prominences occultated by the moon, which they regard as proof of their being solar phenomena, being, in fact, masses of rose-colored light on the sun's surface, upwards of 20,000 miles high. Prof. Smyth suggests the probability of these red appendages being a kind of mirage produced by the action of the sun's light on the surface of the moon; at the same time he admits that the weight of all the evidence on this subject is in favor of the eclipse-flames being real appendages to the sun, and in that case must be masses of such immense size as to play no unimportant part in the economy of the sun, and even of the system itself. No true theory now, therefore, of the sun can be attempted, without including these monstrous flames; and if we can only see them in the few and far between intervals of total eclipses, thousands of years must elapse before we become much wiser. Mr. Nasmyth has called attention to the subject of rendering these flames visible by some artificial total eclipse; and has proposed a method by which the sky in the vicinity of the limb of the sun may be examined in comfort and comparative darkness. A telescope being arranged in a dark room, in camera-obscura fashion, is to throw the sun's image, not on to a white screen, but into a black box, the sides of which will absorb all the light, while a sheet of cardboard, (white, blue, or green, to bring out the pink light,) with a hole in the middle just large enough to allow the sun to pass through, being placed on the top, will receive the image of the surrounding part of the sky, into which the red flames from the sun are supposed to protrude. This method has been tried at the Edinburgh Observatory, and found to succeed completely so far as the destruction of the sun's light in the dark box was concerned, but nothing in the shape of red flames was seen on any occasion. This, however, could hardly have been expected, on account of the excessive brightness of the adjacent portion of the sky, caused by the multitudinous reflections of the sun's light in the atmosphere outside of the observatory, and therefore altogether irremediable by any contrivances within. It is an evil only to be met by establishing the telescope on the top of a very lofty mountain, as on some of the inhabited parts of the Himalaya range, 16,000 and 18,000 feet above the level of the sea, where there would be but half the quantity of atmosphere to battle against, and that of a much purer and more transparent quality, and free from a cause which was very disturbing, on some occasions, even within the observatory, — atmospheric dust.

PROFESSOR MITCHEL'S SYSTEM OF ASTRONOMICAL OBSERVATIONS.

At the meeting of the American Association, in 1850, at New Haven, Prof. Mitchel, of Cincinnati, announced some important improvements effected by him in the observing of right ascensions and declinations. In regard to these improvements a long and spirited discussion took place, the practicability of the plan being doubted by some members. To settle the question, a committee of investigation was appointed, with instructions to examine the apparatus of Prof. Mitchel, and report at a future meeting of the Association. The committee consisted of Profs. Peirce, Coffin and St. John, Sears C. Walker, and Capt. Wilkes. At the meeting of the Association, in Cincinnati, May, 1851, the following report was submitted and accepted: —

1. Professor Mitchel's apparatus for observing right ascensions is thought by the committee to sustain all his claims in regard to its simplicity, accuracy, facility and despatch. It is a fine specimen of ingenious contrivance, and the best proof of its superiority in this respect is the fact that, notwithstanding the roughness of construction to which the inventor has been forced to submit by his limited resources, it rivals in the accuracy of its results the most finished specimens of skilful workmanship. By the use of two pens he has avoided all possibility of the peculiar error which must constantly arise whenever the same pen is used for recording the observations and the clock-beats. By recording upon a disc with a pencil, which makes a slight dot at a single swift stroke, he has reduced to a minute quantity the perturbations in the motion of the disc which arise from the act of recording. The methods for adjusting the disc and reading its record exclude all danger of error from imperfect centring, while the ingenious apparatus for reading admits of great nicety and rapidity in the execution of this task. The attention which has been paid to the determination and elimination of minute sources of error, such as armature, time, and the like, deserves high commendation.

2. In regard to the apparatus for observing declinations, the committee report, in some respects, with less confidence, because the series of observations, although quite various, is not yet sufficiently extensive. They think, however, that they may venture to report upon the probable capabilities of the apparatus, and the limit of accuracy which it may be expected to attain, and which it may already have attained. The principles of its construction are regarded by the committee as perfectly correct, and as exhibiting a happy combination of ingenuity and

originality. They are surprised and delighted at the simplicity with which all danger of error from eccentricity or flexure is avoided, as a partial equivalent for which, it may be important not to overlook any short lateral motion of the pivot of the telescope in its socket. In its present form, the apparatus must be considered to be purely differential, and to depend upon other fundamental observations for the absolute determination of the length of its arc. With this condition, the measurement of differences of declination may extend to the degrees, and perhaps much further, without any loss of accuracy. The principal feature which characterizes this apparatus, and distinguishes it from all others, consists in its admitting of the observation of ten different horizontal wires during a single transit; and these observations are made with great facility, without mental tension, and so close to the meridian as to involve no difficulty in their reduction to the meridian.

By an additional piece of mechanism for some observations, these may be conducted with unsurpassed rapidity, and sufficient exactness, without risk of confusion or any perplexity of thought on the part of the observer.

Finally, the committee are not aware that the history of astronomical science exhibits a more astonishing instance of great results produced with what would seem to be wholly inadequate means. With the ordinary tools of a common mechanic, and with insignificant pecuniary outlay, an isolated individual has aspired to rival the highest efforts of the most richly endowed institutions, upon which sovereigns and governments have showered their inexhaustible patronage, and his aspirations have been crowned with success. The committee are persuaded that under more propitious circumstances, and with more generous opportunities, Prof. Mitchel's plans of apparatus will lead to still more admirable results, and contribute yet further to the advancement of astronomical science.

At the conclusion of the report, Prof. Bache remarked, that the value of this report was enhanced by the cool, investigating character of the members of the committee, and the practical and theoretical knowledge which they had brought to their task. The circumstances attending the reception of the description of Prof. Mitchel's invention at the New Haven meeting further increased its value. It was not surprising that those versed in the methods of astronomical observation in established use should be sceptical in regard to the performance of an apparatus avowedly constructed with imperfect means, and startled when its results were stated as vying with those of perfect instruments imported or made at a great cost. The committee has carefully and with great minuteness investigated the whole apparatus, its action and its results; and they unanimously report that they are satisfied that the claims set up to this method as a marked improvement are real. It goes out, then, with the stamp of this Association; it has passed a critical ordeal, and stands by its merits as one of the most remarkable steps ever made in our country in the progress of astronomical observation.

The instrument and apparatus of Prof. Mitchel are of too complex a character to admit of a description in this place. It suffices to say, however, that by their aid the astronomer can now accomplish more work in one night, and execute the same with greater accuracy, than he could previously in many weeks of continued observation. — *Editor.*

THE AURORA BOREALIS OF SEPTEMBER, 1851.

SINCE the grand aurora of November 17, 1848, (which was distinguished for its great extent, being seen in nearly equal splendor from Odessa on the east to California on the west,) we have had no exhibition of the highest class like those which occurred from 1835 to 1839, inclusive, but the month of September, 1851, was signalized by three grand auroras, occurring respectively on the nights of the 3d, the 6th, and the 29th. An aurora borealis of the highest class is distinguished by the presence of all the more striking characters of the phenomena combined, or at least exhibited in rapid succession, such as arches, streamers, a corona and waves. Each of the late auroras was characterized by marks of the greatest intensity, especially in the completeness and grandeur of the *corona*, and of the auroral waves; and that of the 29th was remarkable for passing to a great distance beyond our zenith, presenting a well-defined and very luminous arch, whose point of culmination was within 30° of the southern horizon. What is quite unusual, this meteor was visible throughout the southern states, and presented a striking and splendid appearance as far south as Charleston and Savannah.

INFLUENCE OF THE AURORA UPON THE WEATHER.

MR. J. L. HENDRICK, of Litchfield, Conn., in furnishing the Regents of the University of New York with a series of observations on the occurrence and intensity of the aurora borealis during the year 1850, makes the following remarks on the fancied connection between this phenomenon and changes in the weather. "These observations confirm me in the belief that the aurora is not an indication of any future change in the weather, but an effect of a previous change, or of a certain state of the atmosphere. Of those that occurred during the first six months, every one (8) was preceded by rain or snow within two days preceding that in which the aurora borealis occurred, while only six were followed by either within three days after. During the next six months 11 were preceded and 8 followed by snow or rain. A change, however, that occurs three days after the phenomenon hardly deserves to be counted, as so many things may interfere to effect the result. If we take the same number of days selected at random throughout the year, we should doubtless find as many of the selected days followed, if not preceded, by changes of weather, as we find among those distinguished for the appearance of the aurora. The greatest number of the more remarkable occurred in April, May, September and October."

ON THE CLOUDS AND EQUATORIAL CLOUD RINGS OF THE EARTH.

THE following is an abstract of a paper read at the meeting of the American Association, Albany, by Lieutenant Maury, of the National Observatory: —

Sailors have opportunities of making observations on clouds, and the various phenomena accompanying them, which no other class enjoy. The sailor, bound in his ship to the southern hemisphere, enters the region of the north-east trade winds, and frequently finds the sky mottled with clouds, but generally clear; continuing his course south, he observes his thermometer to rise as he approaches the equator, until, entering the equatorial region, he finds the weather to become murky, close and oppressive. He then enters the south-east trades; and, on looking at his log-book, he is surprised to find that, notwithstanding the oppressive weather of the rainy latitudes, both his barometer and thermometer stood lower in them than in the clear weather on either side of them. In passing that rainy latitude, he has passed a cloud ring which encircles the earth.

Lieut. Maury then proceeds to give a description of the various changes which this great equatorial cloud ring undergoes, and of its effects on the climate over which it hangs, the laws which control its shifting, sometimes to the north and sometimes to the south of the equator, and the accessions it receives from the more temperate latitudes, while the ring itself is the great source of supply of moisture to regions of the earth very distant from the equator. Thus this cloud ring modifies the climate of all places beneath it; overshadowing at different seasons all parallels from five degrees south to fifteen degrees north. It may be asked, where do the vapors come from which are condensed and poured into the sea as rain? They come from the trade wind regions under the cloud ring, then rise up, and as they rise they expand, and as they expand they grow cool and are condensed. There is, therefore, a ceaseless precipitation going on under the cloud ring. Evaporation under it is suspended nearly the whole year round. This ring is formed by the meeting of the N. E. and S. E. trade winds; the vapors which each bring from northern and southern regions meet and ascend. Our knowledge of the laws of nature will tell us, therefore, that the atmosphere will be cooler under this ring than on either side of it, without consulting the thermometer. Were the clouds which overhang this belt luminous, and could they be seen by an observer from one of the planets, these clouds would present an appearance not unlike the rings of Saturn. He would also observe that this ring had an apparent movement contrary to that of the earth; for though it moves with the earth, the motion of the ring is relatively slower, and the earth slips from under it, giving the ring an apparent slow motion from east to west. This ring would be unlike those of Saturn in another respect. Its edges would appear very jagged and rough and uneven.

Navigators are now learning to tell by the barometer when they have passed the cloud ring. In the log-book of an American captain, in a voyage round the world, in 1850–51, recently forwarded to the National Observatory, I find the following remarks: — "I here predict," he says, before reaching the equator, "the barometer will remain below 30 in. until we get without the influence of the rainy latitudes." After having crossed a belt of five or six degrees of latitude, within which such remarks are frequent as, "warm and sultry;" "heavy rains;" "very murky and close at times;" "quite oppressive ;" "rain," &c. ; on the seventh day he remarks, "Assuming the settled weather of the 'trades,' only requiring a rise of barometer to assure me of that fact." The day after, I find in his column of remarks, "Fine weather, every appearance of trades — barometer up." This remark is made the 5th of March, 1850, in 6° south lat. Had he passed this cloud ring in August, he would probably have made the same observations in 6° north lat., indicating that he had passed from under the influence of this equatorial cloud belt.

It is thus we arrive at a new application of the barometer, which thus informs the navigator, when other means fail, when he leaves and when he enters the trade winds.

ON THE EQUINOCTIAL STORM.

The following views respecting the occurrence of a periodic storm, known as the Equinoctial, were communicated, by Prof. Loomis, to the American Association, Albany : —

"About twelve years ago I made a somewhat extensive comparison of meteorological observations, for the purpose of testing various popular notions with regard to the weather. My object particularly was to determine whether any connection could be traced between the fall of rain and the phases of the moon, or the seasons of the year. The result of this investigation was, that many popular proverbs, with regard to the fall of rain, have little foundation in truth. One of the popular beliefs is worthy of note here, for many of the most scientific men have faith in the fall of heavy rains at or about the period of the equinoxes.

"I propose to inquire whether rain is unusually prevalent about the time of the autumnal equinox? The register to which I first refer, for an answer to this question, is that of the Royal Society of London, which has been accurately kept for a period of 64 years. Comparing the observations for the month of September, including 1920 days, shows that there is annually in London a fall of rain greater by one fifth for the last half of the month than the first half. This may be adopted, therefore, as the law for London. But there is no indication that there is a greater fall of rain than might be occasioned by the change of season, and that no particular day can be pointed out in the month of September where there ever was, or ever will be, a so called equinoctial rain. If the number of rainy days, instead of the quantity of rain, is taken into consideration, we arrive at the same result. I will not attempt to conceal that the amount of rain for the five days embracing the equinox is greater than for any other period of five days throughout the month ; but if any one should be disposed to attach any special importance to this circumstance, I would remark that the amount of rain for the last five days of the month falls short of the preceding five days by less than three per cent., and that this quantity is too small to afford any satisfactory basis for a conclusion in a research of this kind. Certain it is, that the difference is too small to be detected, without a most careful observation of the rain-gauge, and inasmuch as the popular belief on this subject was certainly never derived from meteorological journals, I do not hesitate to conclude that the common opinion of an unusual fall of rain at London, about the time of the autumnal equinox, has been taken up without reason. I now proceed to inquire what foundation there may be for a similar opinion in the United States. And here we encounter a difficulty arising from the want of a continuous register of the fall of rain at a single locality for any long period. In this country, accurate observations extend only over a period of 25 years. And these are only known at one point, which is at Albany. These were taken under the direction of the regents of the University. But the great inequalities of these observations show that the period of observation is too short to elucidate any correct results as yet; and that, before arriving at any correct conclusion, we must extend these observations over a long series of years. If the first five days of the month of September be taken, we find 20.62 inches to have fallen; the next five days only 8.81 inches; the third group of five days 13.34; the fourth group of five days 13.82; the fifth 17.16; the sixth 13.48 inches. It will thus be seen that more rain fell on the first days of September than on any other part of the month. From these figures it would be preposterous to come to the conclusion that the first week in September would be wet, and that the second would be peculiarly dry. Another fact worthy of notice is the recorded fact that, for 23 successive years, no rain has fallen on the 6th of September in Albany, yet no popular proverb is prevalent in that vicinity noticing the fact. In order to supply, as far as possible, the want of a series of observations sufficiently long, I have had recourse to the journal of Dr. Holyoke, kept at Salem, Mass., from 1786 to 1828, in which it was recorded, each day, whether it was fair, cloudy or rainy, although the amount of rain was not registered. I have taken the sum of the rainy days for each day of the month, and have appended to this the Albany register, making thus a continuous record for 65 years. The greatest number of rainy days on any one day of the month, for the entire period, was 25, on the 5th, and the least number was 12, on the 6th. So far, then, as these observations indicate any influence of the day of the month upon the amount of rain, they lead to the conclusion that the first five days of September are unusually rainy, and the second five days unusually dry. Still, it would be premature to draw definite conclusions from these facts. On the whole, we may conclude that there is as much reliance to be placed on a storm happening in the New England States at the equinox as at the annual meeting of the Quakers; or, in the language of the poet,

> "If the first of July be rainy weather,
> 'T will rain more or less for forty days together."

Prof. Guyot said that he was not surprised that there should be doubts as to the prevalence of any storms at the season of the equinoxes in the United States; that opinions relative to it came, as he supposed, from Europe, in the central portions of which certain atmospheric changes had a regularity which did not prevail in Great Britain, which stood at the extreme verge of the area over which these periodic changes prevailed. In referring to periodic changes of the atmosphere, we should not be guided, in this country, by observations made in Europe, where very different conditions of the atmosphere prevailed.

Mr. W. C. Redfield remarked that nothing could be more unfounded than the traditional notion of an immediate or special connection between the equinox and the storms of that period. The meteorological records which he had examined afford no ground for this very prevalent opinion, as will equally appear whether we view the fall of rain above as constituting the storm, or consider the rain as but a common though not essential feature of a storm or gale.

ALTERNATION OF COLD AND WARM SEASONS.

The idea of a cycle of good and bad seasons has often been mooted by meteorologists, and has frequently recurred to my thoughts when endeavoring to find a reason for the ease with which, at some periods of arctic discovery, navigators were able to penetrate early in the summer into sounds which subsequent adventurers could not approach, and to connect such facts with the fate of the discovery ships. But neither the periods assigned, nor the facts adduced to prove them by different writers, have been presented in such a shape as to carry conviction with them until very recently. Mr. Glaisher, in a paper published in the Philosophical Transactions for 1850, has shown, from eighty years' observations in London and at Greenwich, that groups of warm years alternate with groups of cold ones, in such a way as to render it most probable that the mean annual temperatures rise and fall in a series of elliptical curves, which correspond to periods of about fourteen years; though local or casual disturbing forces cause the mean of particular years to rise above the curve or fall below it. The same laws doubtless operate in North America, producing a similar gradual increase and subsequent decrease of mean heat, in a series of years, though the summits of the curves are not likely to be coincident with, and are very probably opposed to, those of Europe; since the atmospherical currents from the south, which, for a period, raise the annual temperature of England, must be counterbalanced by currents from the north or other meridians. The annual heat has been diminishing in London ever since 1844, according to Mr. Glaisher's diagram, and will reach its minimum in 1851. It can be stated only as a conjecture, though by no means an improbable one, that Sir John Franklin entered Lancaster Sound at the close of a group of warm years, when the ice was in the most favorable condition of diminution, and that since then the annual heat has attained its minimum, probably in 1847 or 1848, and may now be increasing again. At all events, it is conceivable that, having pushed on boldly in one of the last of the favorable years of the cycle, the ice, produced in the unfavorable ones which followed, has shut him in, and been found insurmountable.— *Sir J. Richardson's Arctic Expedition.*

ARCTIC CLIMATE.

Sir John Richardson, in the history of his late expedition, gives the following facts with regard to the climate of the arctic regions. He says: — "The power of the sun this day, in a cloudless sky, was so great, that Mr. Rae and I were glad to take shelter in the water while the crews were engaged on the portages. The irritability of the human frame is either greater in these northern latitudes, or the sun, notwithstanding its obliquity, acts more powerfully upon it than near the equator; for I have never felt its direct rays so oppressive within the tropics as I have experienced them to be on some occasions in the high latitudes. The rapid evaporation of both snow and ice in the winter and spring, long before the action of the sun has produced the slightest thaw or appearance of moisture, is made evident to residents in the high latitudes by many facts of daily occurrence; and I may mention that the drying of linen furnishes a familiar one. When a shirt, after being washed, is exposed in the open air to a temperature of 40° to 50° below zero, it is instantly rigidly frozen, and may be broken if violently bent. If agitated when in this condition by a strong wind, it makes a rustling noise like theatrical thunder. In an hour or two, however, or nearly as quickly as it would do if exposed to the sun in the moist climate of England, it dries and becomes limber. In consequence of the extreme dryness of the atmosphere in winter, most articles of English manufacture, made of wood, horn, or ivory, brought to Rupert's Land, are shrivelled, bent and broken. The handles of razors and knives, combs, ivory scales, and various other things kept in the warm rooms, are changed in this way. The human body, also, becomes visibly electric from the dryness of the skin. One cold night I rose from my bed, and, having lighted a lantern, was going out to observe the thermometer, with no other clothing than my flannel night dress, when, on approaching my hand to the iron latch of the door, a distinct spark was elicited. Friction of the skin, at almost all times in winter, produced the electric odor. Even at mid-winter we had three hours and a half of daylight. On the 20th of December, I required a candle to write at the window at ten in the morning. On the 29th, the sun, after ten days' absence, rose at the Fishery, where the horizon was open; and, on the 8th of January, both limbs of that luminary were seen from a gentle eminence behind the fort, rising above the centre of Fishery Island. For several days previously, however, its place in the heavens at noon had been denoted by rays of light shooting into the sky above the woods. The lowest temperature in January was 50° Fah. On the 1st of February, the sun rose to us at nine o'clock and set at three, and the days lengthened rapidly. On the 23d I could write in my room without artificial light from ten A. M., to half-past two P. M., making four hours and a half of bright daylight. The moon, in the long nights, was a most beautiful object; that satellite being constantly above the horizon for nearly a fortnight together in the middle of the lunar month. Venus also shone with a brilliancy which is never witnessed in a sky loaded with vapors; and, unless in snowy weather, our nights were always enlivened by the beams of the aurora."

SNOW PHENOMENA.

Prof. Dove, of Berlin, in a recent publication on meteorology, gives a curious illustration in relation to the formation of clouds of snow over plains, which are situated at a distance from the cooling summits of mountains. On one occasion a large assembly had gathered in the concert hall of a northern residence. It was one of those icy, starlight nights, which are so aptly called "iron nights" in Sweden. In the room, however, there was a fearful crowd; and the heat was so great that several ladies fainted in consequence. An officer who was present sought to end this distressing state of things by attempting to open a window; but this was impossible, so hard was it frozen to the sill. As a last resort, he broke a pane of glass; and now what happened? It *snowed* in the room! It is needless to add any comment on this, as the phenomena explains itself.

CURIOUS METEOROLOGICAL FACT.

It will be recollected that in January and February of the year 1851, the changes of the barometer were very frequent, and the elevation in New England greater than had been noticed for twelve years. On the 19th of January, the barometer at Portsmouth, N. H., rose to 30.83; on the morning of the 13th of February to 31 inches; and to the same height on the 19th of February. The Boston Traveller, of February 14th, gives the following notice of the remarkable state of the barometer that week:—

"The barometer, Thursday morning, February 13, at nine o'clock, attained the extraordinary altitude of 31.02, reduced to the temperature of 50, and to the mean level of the sea. This is the *third* extraordinary condensation of the atmosphere in this vicinity, within the last three and a half weeks, and as such, we believe, unprecedented even here, where the barometer is believed to rise as high as in any other part of the earth. The last time it rose to 31 inches was on January 1, 1839, viz., to 31.11, which is supposed to have been the highest recorded at any place at the above level."

Advices received subsequently from India show that, at the same time, within a day of the greatest elevation of the barometer here, there was the lowest depression in India. Here it was three days rising to the maximum, there it was three days sinking to the minimum. The Bombay Times, of March 3d, says: — "A remarkable instance of atmospheric disturbance, of simultaneous occurrence over a vast region of space, and which will, in all likelihood, have been observed in Europe, occurred on the 12th of February. On this day the barometer reached its minimum at Bombay and Calcutta, 1,200 miles apart, after a synchronous descent of three days; it continued to fall at Madras till the 16th." Violent storms and floods prevailed all over India about this time, doing immense damage in various quarters, especially in the Punjaub.

From the foregoing statement it will appear that sympathetic undulations of the barometer sometimes extend around the world; in this case a converse change taking place at the same epoch in the opposite hemisphere.

GEOGRAPHY AND ANTIQUITIES.

EXPLORATIONS IN EASTERN AFRICA.

Dr. Knoblecher, the Pope's Vicar-General in Central Africa, has recently returned to Europe, and published an account of his discoveries and travels. He has been further into Soudan than any previous traveller, having penetrated on the White Nile, or Bahr-el-Abiad, as that river is called in Arabic, to within four degrees of the Equator. At this point the traveller ascended a mountain called Logwek, and saw the Nile trending away in a south-westerly direction, until it vanished between two mountains. The last natives he met with, the Bary negroes, informed him that beyond those mountains the river came straight from the south. The Nile was in 4° 45′ north latitude, 200 French metres broad, (about 625 English feet,) and from three to five metres deep.

Such an abundance of water in the dry season indicates with tolerable certainty that the river rises at a great distance, in some unknown range of mountains, probably beyond the Equator. Even if we assume the origin of the Nile to be a great lake or internal sea, as the obscure but unconfirmed tradition declares, the existence of such a lake cannot be supposed without the vicinity of a lofty range of mountains, whose springs and brooks feed it in the dry season. Dr. Knoblecher saw from the summit of Logwek, on the furthest edge of the horizon, a range of heights whose exact form was lost in the distance.

Doctor K. and his associates have founded a missionary establishment at Khartoum, the junction of the White and Blue Nile, from which point other expeditions are to be sent to the interior.

EXPEDITION INTO THE INTERIOR OF AFRICA.

It will be remembered that early in 1850, Mr. Richardson, an agent of the British Government, together with two German savants, and a select escort, started from Tripoli on an expedition to explore the interior of Africa. Intelligence of the party has been received up to August, 1851. Mr. Richardson died in the kingdom of Bornou, in March; the other members of the party were well. The expedition had passed through many dangers and difficulties, with no greater misfortune than the loss of a little property, of which it was robbed by the Tuariks. This is a powerful tribe who inhabit oases in the Sahara, or Great Desert, and are noted for their inhospitality to travellers. Dr. Barth, one of the German gentlemen accompanying, mentions a vast tract of fertile land through which he passed in the region of the Great Sahara, and which has remained entirely unknown to travellers and geographers. He describes it as being of considerable extent, beautifully wooded, with a number of small rivers passing through it, and susceptible of the highest degree of cultivation. It is inhabited only by animals, among which he mentions the elephant, buffalo, lion, giraffe, &c.

At the latest date, Messrs. Barth and Overweg, the German gentlemen, had reached Kuka, Central Africa, and Dr. Barth had proceeded onward to the kingdom of Adamowa, a country never before visited by a white man. Dr. Overweg was engaged in the exploration of Lake Tsad. The boat brought from England, and which for twelve months, with immense trouble, had been carried in pieces on camels across the desert of Sahara, had been put together and launched upon the lake. The travellers in this vicinity had everywhere been treated with great kindness by the natives. The dimensions of the lake were found by Dr. Overweg to be much smaller than those given by Denham, being about 60 miles from east to west, whereas in Denham's map it is more than double. These apparent discrepancies, however, may find their explanation in the remarkable nature of the lake; it being an immense body of water, which is greatly augmented in the rainy season, but in the season of drought evaporates so much that it seems at times to dry up entirely.

CURIOUS RELICS FROM BABYLON.

Within the last few years, Col. Rawlison and Mr. Layard have added to the antiquarian treasures of the British Museum certain curious bowls made of terra cotta, and found buried some twenty feet deep amidst the ruins of Babylon. These bowls are upwards of fifteen in number, and generally six inches broad and three or four in depth. Most of them have inscriptions inside, commencing at the bottom and extending in a spiral line towards the left, till, after some revolutions, ranging from five to ten in number, they close at the brim. The characters and language of the inscriptions have hitherto baffled all our antiquarians. We are informed, however, that very recently both have been satisfactorily explained by Mr. Thomas Ellis, who is engaged in the Oriental Manuscript of the British Museum. The language is Chaldee, and the characters somewhat resemble the Phœnician or square Chaldean. At the same time, there are found certain words and terms peculiar to the Jews only; and thence Mr. Ellis infers that the inscriptions must either have been written by the Jews during their captivity in Babylon, or by a remnant of that people who never returned from Assyria. — *London Athenæum.*

ANCIENT CLOTH FROM THE MOUNDS OF OHIO.

The following discription of some samples of ancient cloth from the mounds of Ohio was given by J. G. Foster, Esq. U. S. Geologist, at the American Association, Albany: —

As far back as the year 1838, (said Mr. Foster,) I procured from a person residing in Jackson Co., Ohio, several fragments of cloth, mostly decayed, which he had taken from a low mound in that vicinity. This fact was so novel in itself, and so at variance with the prevailing ideas as to the degree of civilization and the knowledge of the arts among the mound-builders, that I hesitated about making it public, fearing that it might have been a modern substitution, and that, by publishing, I might be the means of propagating error. But within a recent period I have received from Mr. John Woods, of Ohio, additional samples, accompanied with evidence, and a description of the circumstances under which they were found. A quantity of charred cloth, (says Mr. Woods,) was dug out of a mound on the west side of the Great Miami River, in Madison township, Butler Co., Ohio. Its height was originally twenty feet, but when first seen by Mr. Woods, thirty years ago, it was probably sixteen feet high. It was covered fifty years ago with large forest trees, as we are informed by the old settlers. The Cincinnati and Dayton Railroad runs through one side of the mound, half of which has been cut down for the track. The workmen have found an arrow and a considerable quantity of charcoal, cloth and bones. A quantity of this cloth was preserved by Mr. Woods, in nearly the same condition in which it was found in the mound. The bones were few and small. Very little earth appeared to be mixed with the coal and cloth, which were evidently in the position in which they had been placed when burned and covered up. The charcoal appeared to be on the outside of the cloth.

The only question which arises in my mind, (says Mr. Woods,) as to the time when the charcoal and cloth were deposited in the mound, is whether the mound erected by an anterior race may not have been made a burying-place by the Indians, and that they had wrapped their dead in the cloth, and after partially burning the bodies, or the bones and cloth, had covered up the fire. I thought of this question at the time, and was careful to examine, as fully as was then practicable, the condition of the earth around and over the relics which I dug out, and it appeared to me that the original formation could not have been disturbed, after it was placed in the mound. There is no evidence, according to Mr. Foster, (whose language is now resumed,) that the North American Indians possessed the art of spinning and weaving, when first known to the white man. An art so conducive to the comfort and convenience of man, when once acquired, would not become lost; nor would it be rational to infer that this cloth was a European fabric, obtained by the Indians, and substituted in the mound, within comparatively recent times, for the following reasons: In the Butler Co. mound, the semi-stratification described by Mr. Woods indicates no disturbance; and the material of this cloth is not such as a civilized race would manufacture to traffic with a barbarous one, it being more costly than wool, and less adapted to the purposes of clothing.

PATENTS.

TABLE SHOWING THE NUMBER OF PATENTS, REISSUES, DESIGNS AND ADDITIONAL IMPROVEMENTS, GRANTED AT THE PATENT OFFICE IN WASHINGTON, DURING EACH MONTH OF THE YEAR 1851.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Total Patents,	55	39	44	66	57	58	68	57	73	76	72	69	734
Re-issues,		2	4	1	5	1	2	0	0	1	1	1	18
Designs,	4	4	8	6	9	7	4	1	10	5	5	4	67
Additional Improvements,									1		1		2
	59	45	56	73	71	66	74	58	84	82	79	74	821

TABLE SHOWING THE NUMBER OF PATENTS ISSUED TO CITIZENS OF DIFFERENT STATES DURING THE YEAR 1851.

Maine,	10	Virginia,	9	Michigan,	5
Vermont,	9	North Carolina,	2	Indiana,	13
New Hampshire,	15	South Carolina,	4	Illinois,	9
Massachusetts,	132	Georgia,	9	Missouri,	7
Rhode Island,	14	Alabama,	2	Florida,	0
Connecticut,	53	Mississippi,	0	Texas,	1
New York,	282	Louisiana,	4	Iowa,	2
New Jersey,	15	Arkansas,	0	Wisconsin,	3
Pennsylvania,	89	Tennessee,	5	District of Columbia,	11
Delaware,	3	Kentucky,	9	Foreign,	17
Maryland,	9	Ohio,	79	Total,	821

Patents, reissues, designs and additional improvements, are all included in this Table.

OBITUARY

OF PERSONS EMINENT IN SCIENCE. 1851.

John James Audubon, the eminent ornithologist; aged 76.
John Broadhead Beck, M. D., Professor of Materia Medica, N. Y. College of Physicians.
M. Beudant, Member of the French Institute, Professor of Geology, College of France.
Edward Binns, M. D., of Jamaica, W. I., author of the Anatomy of Sleep.
Marshall Dode de la Brunerie, constructor and engineer of the fortifications of Paris.

Peter Clare, Secretary of the Manchester (England) Phil. Society.

Charles Coquerell, for many years reporter of the French Academy of Sciences.

Sir James Graham Dalyell, an eminent naturalist, and President of the Society for promoting the Useful Arts in Scotland.

M. Daguerre, the discoverer of the Daguerreotype; aged 62.

T. S. Davies, an eminent English mathematician, Professor in the College at Woolwich.

James De Kay, an eminent American naturalist, editor of the ornithological portion of Natural History of New York.

Federick Fernbach, at Munich, inventor of the style of painting which bears his name.

Dr. Frachn, the oldest member of the Imperial Academy at St. Petersburgh, and a distinguished oriental and numismatic scholar. He left a collection of 20,000 rare Eastern coins.

Dr. Gauladet, celebrated as an instructor of the Deaf and Dumb.

Dr. B. Goldschmidt, Director of the Observatory at Gottingen, Germany.

Dr. Haviland, Regius Professor of Medicine, University of Cambridge, England.

Giovanni Inghirami, a celebrated mathematician and astronomer of Tuscany, Italy.

William Jacob, F. R. S., an English writer on scientific agriculture.

Dr. Jacobi, an eminent German mathematician.

Dr. Kidd, Regius Professor at the University of Oxford, England, and author of one of the Bridgewater Treatises.

Charles Kœnig, keeper of the Mineral Department of the British Museum.

Dr. Lachmann, Professor of Philosophy, University of Berlin, Prussia.

Conrad Langenbeck, Professor of Anatomy and Surgery at the University of Gottingen.

Pierre Lapie, one of the geographical celebrities of France.

Baron De Leiderer, a celebrated Russian botanist; aged 65.

M. Lavy, Member of the Academy of Turin, and of the Council of Mines, Sardinia.

Dr. Leuret, Physician of the Bicetre, France, well known for his works on mental derangement, and on the anatomy of the brain.

D. Link, Professor of Botany, University of Berlin, Prussia.

Dr. Mackness, of Hastings, England, author of several elaborate scientific works.

William Martin, of England, inventor of the High-level Bridge.

Joshua Milne, London.

Dubois de Montpereux, the first geological explorer of the Crimea, Caucasus and Armenia, Professor in the University of Neufchatel, Switzerland.

Samuel George Morton, M. D., President of the Academy of Natural Sciences, Philadelphia, and distinguished for his researches and publications on ethnology.

Dr. Patrick Neill, Secretary of the Wernerian Society, England.

William Nicol, of Scotland, the inventor of the single image prism of calcareous spar, known as "Nicol's Prism."

The Marquis of Northampton, late President of the Royal Society of England.

Professor Oersted, a Danish philosopher, celebrated for his discoveries in electro-magnetism, &c.; aged 74.

Lorenz Oken, of Zurich, Switzerland, the originator of the theory of cranial homologies, and one of the most celebrated naturalists of the 19th century; aged 75.

Richard Phillips, a celebrated English geologist.

Count Stanislaus Plater, of Poland, a geographical writer of distinction.

James Richardson, the explorer of Central Africa; died at Bornou, March.

Dr. S. Smyth Rogers, for some years Prof. of Chemistry in Trinity College, Conn.

Edward C. Ross, Prof. of Mathematics and Natural Philosophy, N. Y. Free Academy.

Count Alexander Saluzzo, President of the Academy of Sciences in Turin.

C. M. Sander, a celebrated German surgeon, and writer on philosophy, archæology, &c.

M. Savigney, Member of the French Academy, well known for his scientific labors during the French expedition to Egypt.

M. Schumacher, the celebrated astronomer of Altona, died December 31st, 1850.

Baron de Silvestre, Member of the French Academy.

John S. Skinner, Editor of the Plough, Loom and Anvil; accidentally killed at Baltimore, Md.

Rev. John Pye Smith, an English Congregational minister, distinguished for his geological publications and pursuits.

William Sturgeon, a celebrated English electrician.

R. Thorpe, M. D., a well-known English anatomist.

Richard C. Taylor, an eminent geologist and mining engineer; author of "Statistics of Coal," &c.

Samuel Veall, a distinguished meteorologist and promoter of science, England.

James Wallace, Professor of Mathematics, Columbia College, N. Y.

M. Wahlenburg, a distinguished Swedish geologist and botanist.

W. West, F. R. S., a chemist of some distinction in England.

Martin Wilcox, Professor of Mathematics, Cleveland University, Ohio.

John Wilmot, of England, a distinguished horticulturist.

LIST OF BOOKS, PAMPHLETS, &c.,

ON MATTERS PERTAINING TO SCIENCE, PUBLISHED IN THE UNITED STATES DURING THE YEAR 1851.

Accompanying Documents of the President's Message, for 1850–51.
Address before the American Institute of New York. By C. T. Jackson, M. D.
Agricultural Report to the Legislature of Massachusetts, for 1850–51.
Agriculture for Schools, by Rev. J. L. Blake. Newman, New York.
American Almanac. Little & Brown. Boston.
American Gardener's Calendar. Lippincott & Co. Philadelphia.
American Muck Book, by Browne. Saxton. New York.
Analytical Geometry and Calculus, by Loomis. Harpers. New York.
Annals of the Lyceum of Natural History. New York.
Annual of Scientific Discovery, for 1851. Wells and Bliss. Gould & Lincoln. Boston.
Annual Report on the Canals of New York.
Appendix to Duggan's Stone, Iron and Wood Bridges.
Army Meteorological Register, from 1842 to 1851. Washington. Pub. Doc.
Book of the Telegraph, by Davis. Boston.
Brain, Ray on the. Ticknor & Co. Boston.
Calculation of Excavations and Embankments. Trautwine. Philadelphia.
Chemistry, Stockhard's, 5th Edition, by Pierce. Bartlett. Cambridge.
Chemistry, Elementary, by A. F. Olmstead. Babcock. New Haven.
Chemistry, Elementary, by Youmans. New York.
Chemistry, Outlines of, Gregory. Amer. Ed. by Sanders. Derby. Cincinnati.
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